

2D Hydraulic Modeling Webinar Series

Modeling Multiple Barrel 2D Culverts in SRH-2D/SMS

November 13, 2025



TRANSPORTATION
HYDRAULICS
SOLUTIONS

AQUAVEO®

Transportation Hydraulics Solutions

Expert Support for 2D Hydraulic Modeling & Bridge Scour Challenges

Advanced SRH-2D & HEC-RAS 1D/2D Modeling

Bridge Scour Evaluations & Risk Reduction

Scour Countermeasure Design & Review

Training, Technical Support, and Project QA/QC

Scott Hogan, PE – Principal Hydraulic Engineer

Scott.hogan@transportationhydraulics.com



**TRANSPORTATION
HYDRAULICS
SOLUTIONS**

2D Hydraulic Modeling Webinar Series Objectives

- Highlight best practices in 2D modeling for transportation hydraulics
- Showcase new features and capabilities in SMS/SRH-2D
- Share examples of 2D modeling applications
- Compare SRH-2D and HEC-RAS 2D modeling approaches
- Provide an open forum for questions and other insights

Agenda

- Housekeeping
- 2D Hydraulic Modeling Webinar Series Mailing List
- 2D Hydraulic Modeling Resources page 
- SMS 13.4 updates
- When to use 2D vs. 1D culverts
- **Modeling Multi-Barrel 2D Culverts in SRH-2D/SMS**
- Tips and Tricks

Housekeeping

- Please stay muted and off camera unless asking a question
- Please post any questions in the Chat Pod
- PDF file of presentation slides available on the [Aquaveo 2D Hydraulic Modeling Webinar Series Page](#)
- Recording link and PDH certificate will be sent out to all on the mailing list

2D Hydraulic Modeling Webinar Series Mailing List

Sign up to receive future webinar invites

- Register to participate
- Recording links and PDH certificate will be send to mailing list

AQUAVEO®
[Software](#)
[Services](#)
[Support](#)
[Downloads](#)
[About](#)

[Transportation Hydraulics](#)
[Webinars](#)
[Modeling Resources](#)
[Mailing List](#)

2D Hydraulic Modeling Webinar Series

Aquaveo LLC and Transportation Hydraulics Solutions LLC have partnered to deliver a new **2D Hydraulic Modeling Webinar Series** designed to help engineers enhance their modeling capabilities and understanding of transportation hydraulics.

This ongoing series will:

- **Highlight best practices** in 2D modeling for transportation hydraulics, with emphasis on detailed bridge and culvert hydraulics and bridge scour analyses.
- **Showcase new features and capabilities** in SMS/SRH-2D for transportation-related hydraulic applications.
- **Compare SRH-2D and HEC-RAS 2D modeling approaches** for bridge hydraulics and scour analysis, explaining best practices and potential differences in results.
- **Provide an open forum** for both new and experienced 2D modelers to ask questions, share insights, and suggest ideas for future improvements and developments.



Webinars are offered quarterly.
To receive invitations to upcoming sessions, please **sign up for the 2D Modeling Webinar Series mailing list** (see form to the right).

Questions or suggestions for future webinar topics?
Email Scott Hogan: scott.hogan@transportationhydraulics.com.

Webinar Resources

- [SMS Hot Keys and Helpful Tips](#)
- [Sample Theme File](#)

2D Modeling Webinar Series Mailing List

Please sign up to receive invites to future webinars

First Name *

Last Name *

Email Address *

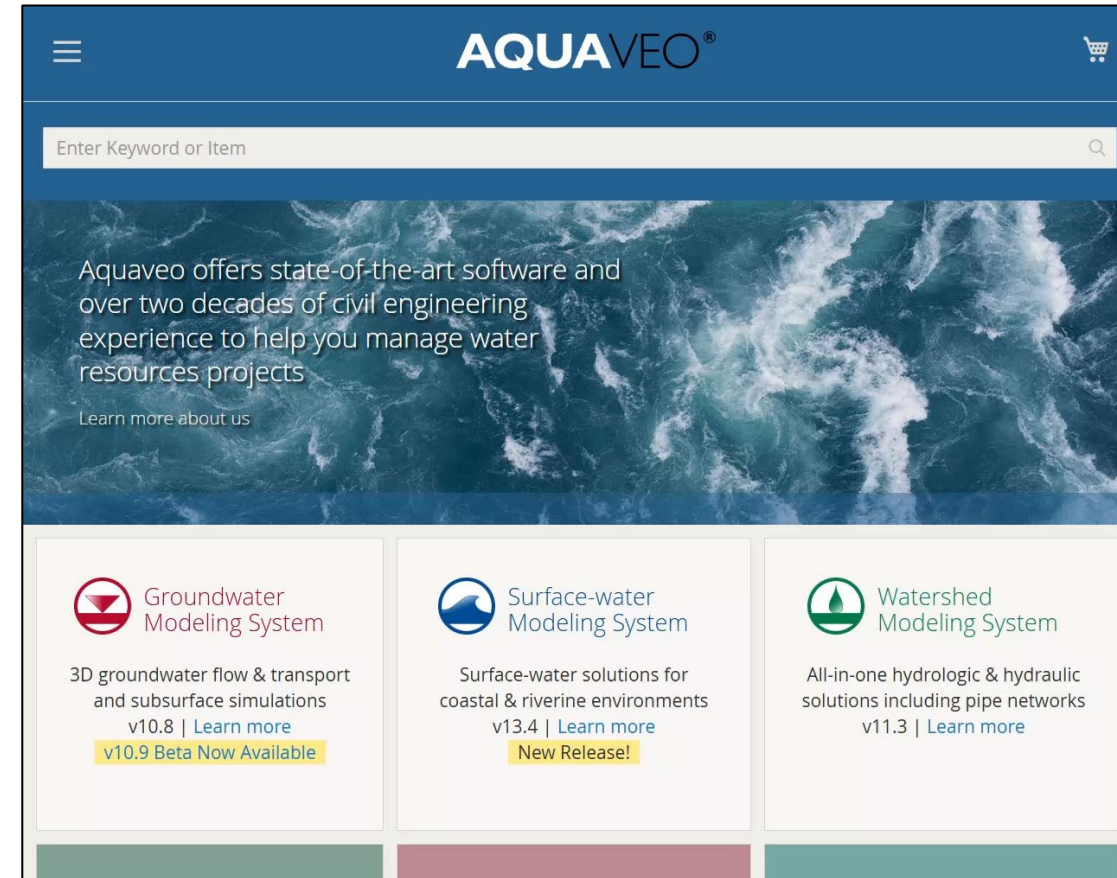
☐ I'm not a robot
 

Submit

2D Hydraulic Modeling Resources

- New [2D Hydraulic Modeling Resources](#) page
 - SMS Quick References and Sample Files
 - Software download and [licensing](#)
 - FHWA 2D Hydraulic Modeling Reference Document
 - Training links
 - SMS wiki page
 - Tutorials
 - You Tube Videos
 - Past FHWA 2D Hydraulic Modeling User's Forum Videos
 - Additional resources

aquaveo.com



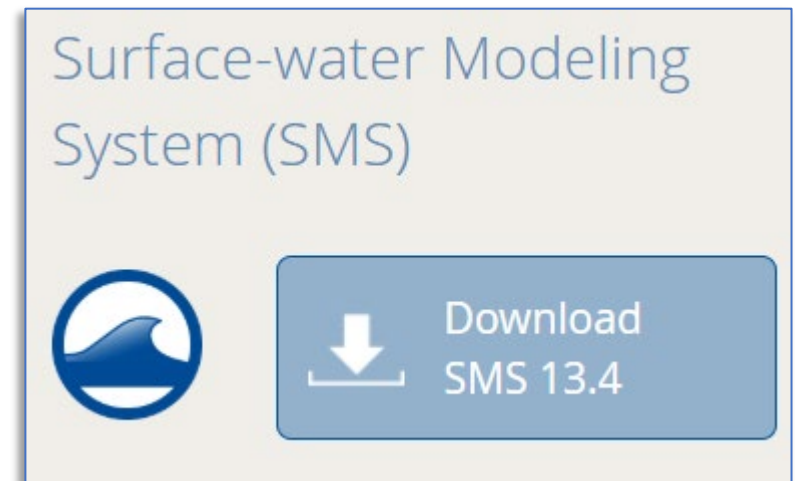
2D Hydraulic Modeling Resources

- SMS wiki: [SMS 3D Structure \(Workflows\)](#)
- Recommended [Tutorials](#): 3D Structures (1, 2, & 3)
- 2D Modeling Forum: September 28, 2023 – *Modeling 1D and 2D Culverts in SRH-2D SMS* ([Recording](#) / [Handout](#) / [Demo](#))

SRH-2D Model Tutorials		
Category	Title	SMS 13.4
SRH-2D	SRH-2D	PDF  Data 
	SRH-2D Boundary Conditions	PDF  Data 
	SRH-2D Bridge Pressure Flow	PDF  Data 
	SRH-2D Culvert Structures	
	SRH-2D Culvert Structures with HY-8	PDF  Data 
	SRH-2D DIP File	PDF  Data 
	SRH-2D Gates	PDF  Data 
	SRH-2D Obstructions	PDF  Data 
	SRH-2D Post-Processing	PDF  Data 
	3D Structures 1	PDF  Data 
	3D Structures 2	PDF  Data 
	3D Structures 3	PDF  Data 
	SRH-2D Pressure Flow with 3D Bridges	
	SRH-2D Reports	PDF  Data 
	SRH-2D Simulations	PDF  Data 
	SRH-2D Adv. Simulations – Calibration	PDF  Data 
	SRH-2D Adv. Simulations – Calibration Mannings	PDF  Data 
	SRH-2D Adv. Simulations – Scenarios	PDF  Data 

SMS 13.4 Current Release

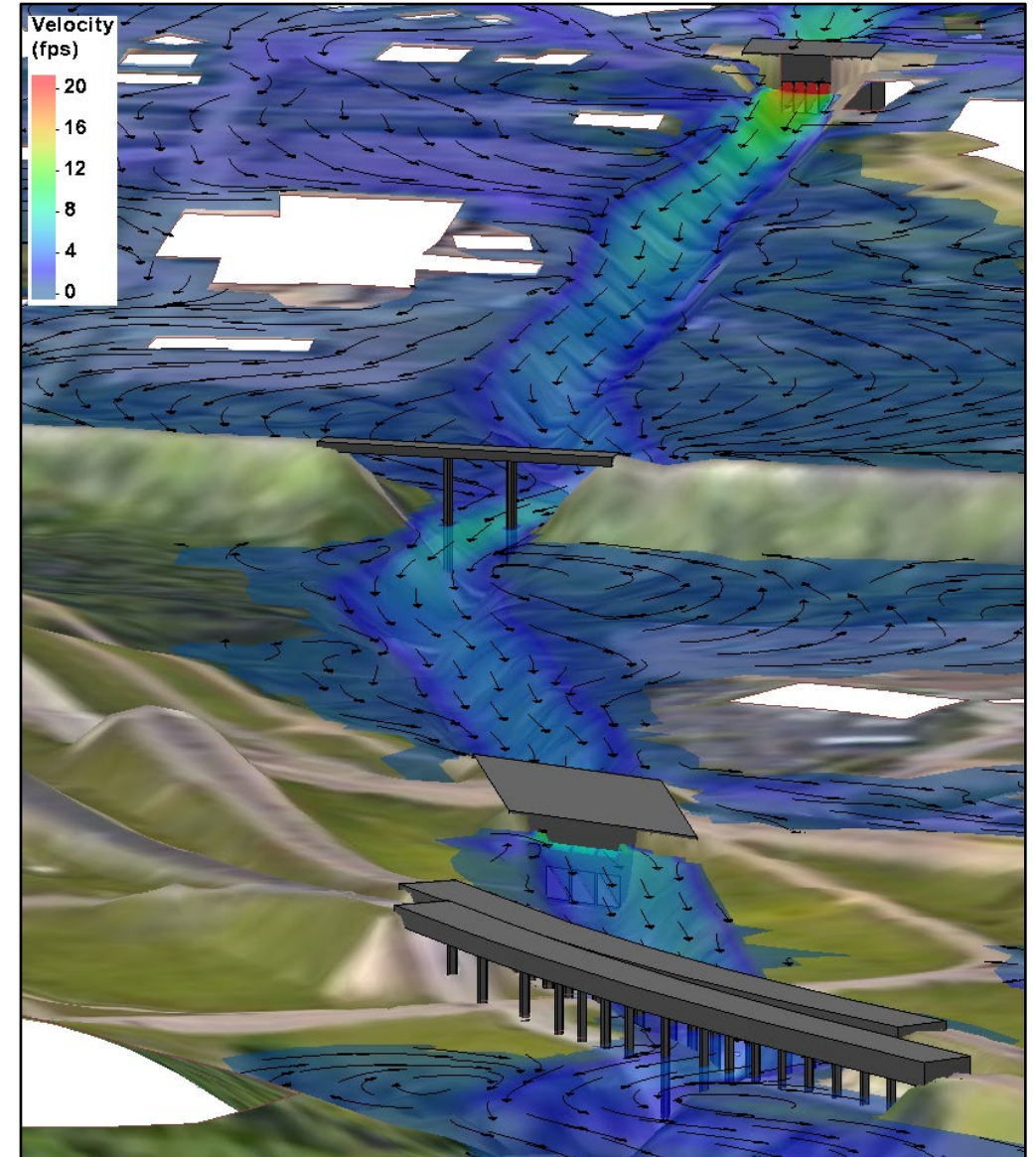
- Current version: SMS 13.4.8
- Build date: November 5, 2025
- Several revisions/bug fixes relating to:
 - 3D Structures summary
 - 3D Structure culverts
 - UGrid contour options/crashes
 - Compare datasets tool error
 - Bridge scour dataset updates
 - Other misc. bug reports



Modeling Multi-Barrel 2D Culverts in SRH-2D/SMS

Feature Highlights

- Box and circular culverts
- Other shapes may be modeled as bridges
- Multiple identical barrels
- Culvert embedment
- Culvert mesh is auto-generated
- Overtopping is computed as 1D weir flow (just above the barrels)

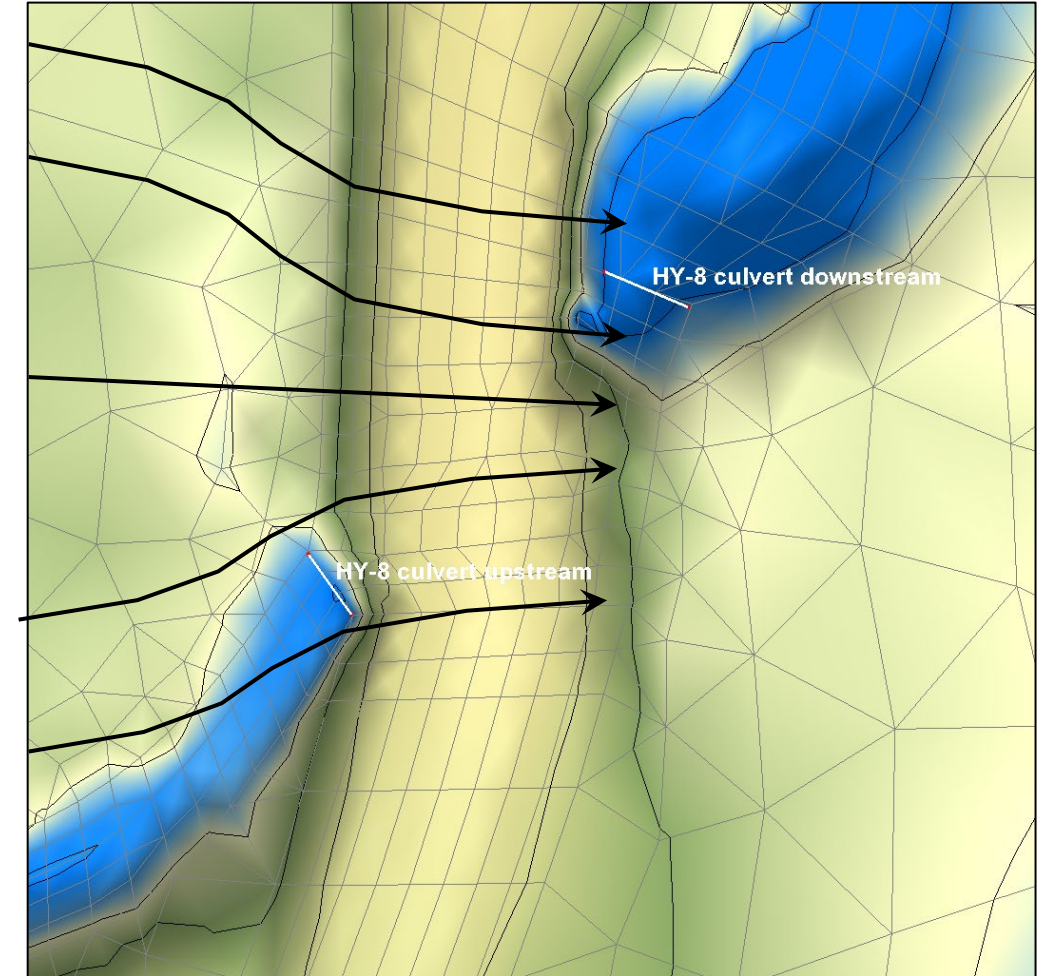


Why use 2D Culverts?

- Better representation of hydraulic losses for mainline structures
- Affects of approach angle of flow are considered
- Approach velocity and momentum are considered (skewed and lateral structures)
- Variable flow distribution (i.e. around bends) is represented
- Detailed hydraulic parameters available within barrel and at outlet
- Outlet velocities are more representative
- Sediment transport through structures

When are 1D Culverts Still Recommended?

- Secondary / relief culverts
- Smaller culverts
- Scenarios where the culvert inlet is inundated (low approach velocity)
- Skewed culvert scenarios where the overtopping is the predominant flow.



When are 1D Culverts Still Recommended?

- Secondary / relief culverts
- Smaller culverts
- Scenarios where the culvert inlet is inundated (low approach velocity)
- Skewed culvert scenarios where the overtopping is the predominant flow.

** For overtopping flow that is parallel with the culvert, use the 1D HY-8 overtopping

** For non-parallel or other conditions, check the option to compute 2D overtopping.

SRH2D Assign BC

BC Type:
Culvert HY-8

Label:

Structure boundaries

Arc id - 3:
Upstream

Arc id - 4:
Downstream

HY-8 culvert options

Units for HY-8 display:
English

☐ Use total head (velocity and water surface)

☒ Checked uses 2d terrain for overtopping.
Unchecked disables 2d domain in culvert region and uses hy8 for overtopping.

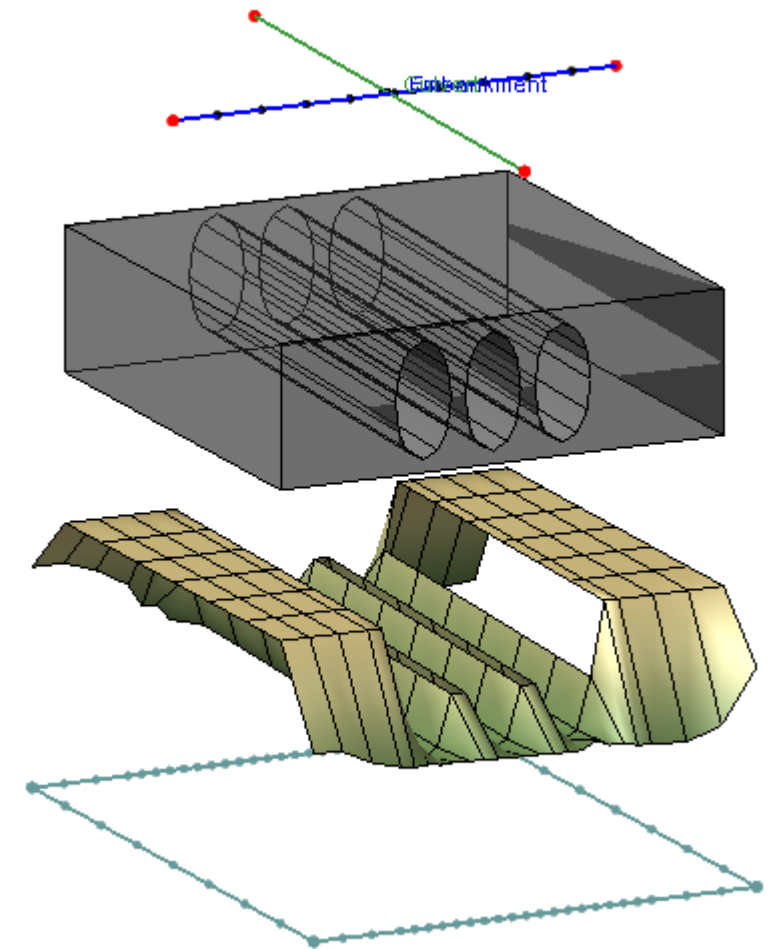
HY-8 crossing:
4 ft CMP

Launch HY-8...

Tolerance for checking consistency between SRH mesh elevation and HY8 culvert invert elevation:
1.0

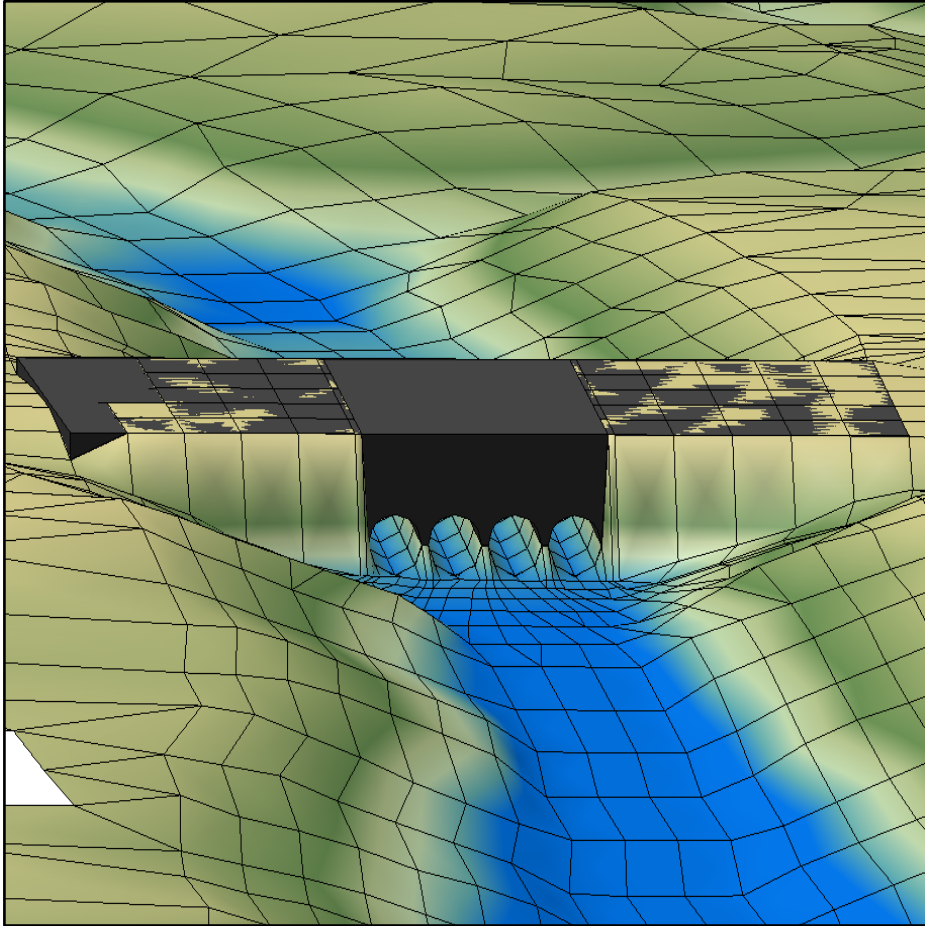
3D Structures Tool Application For Culverts

- User defines embankment and culvert group centerlines.
- User enters culvert geometric data
- A 3D framework for the culvert group is auto-generated
- The mesh for the culvert inverts is auto-generated (overwrites terrain)
- A footprint of the structure mesh is auto-generated for insertion into the mesh generator coverage



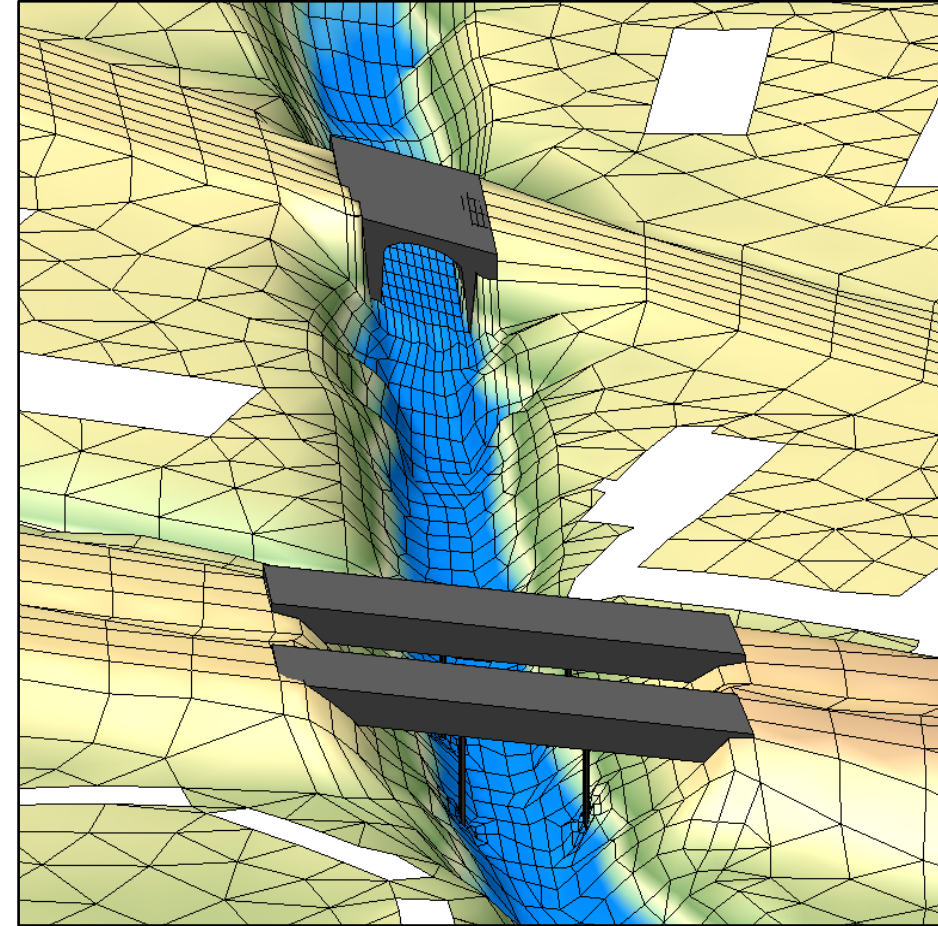
3D Structures – Culverts vs. Bridges

Culverts



Culvert invert elevations are stamped into an automatically generated mesh

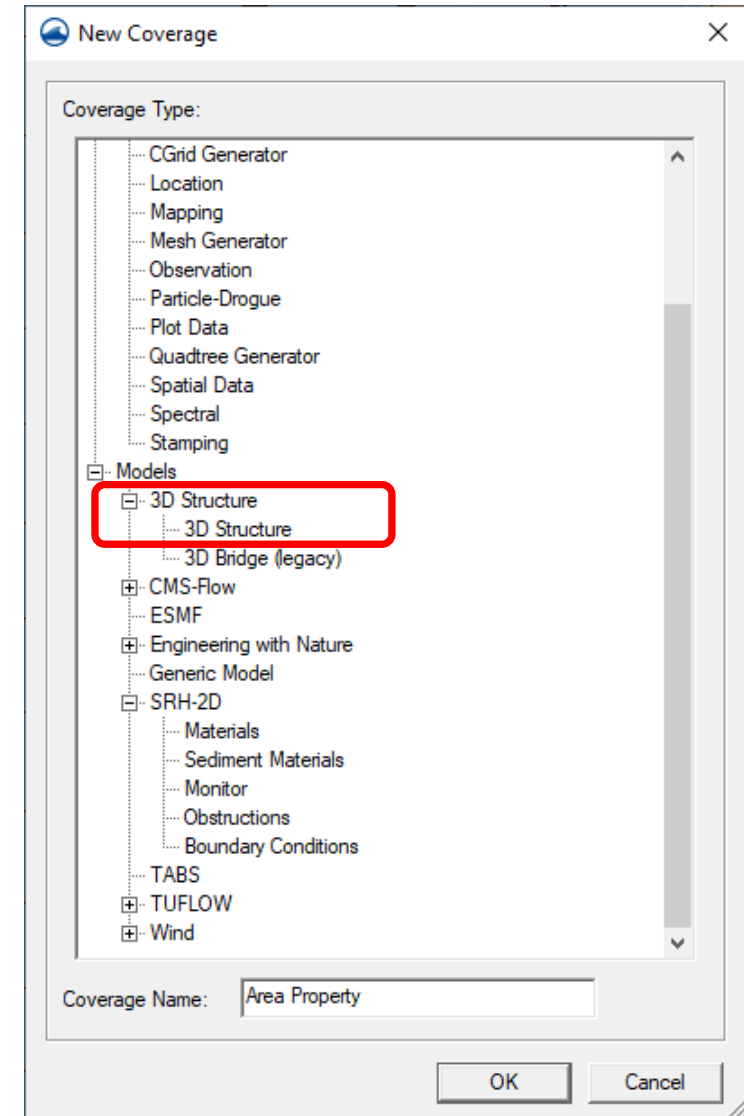
Bridges



Channel bed, bridge sloping abutments, and pier pile caps are represented in the terrain data (scatter set or raster)

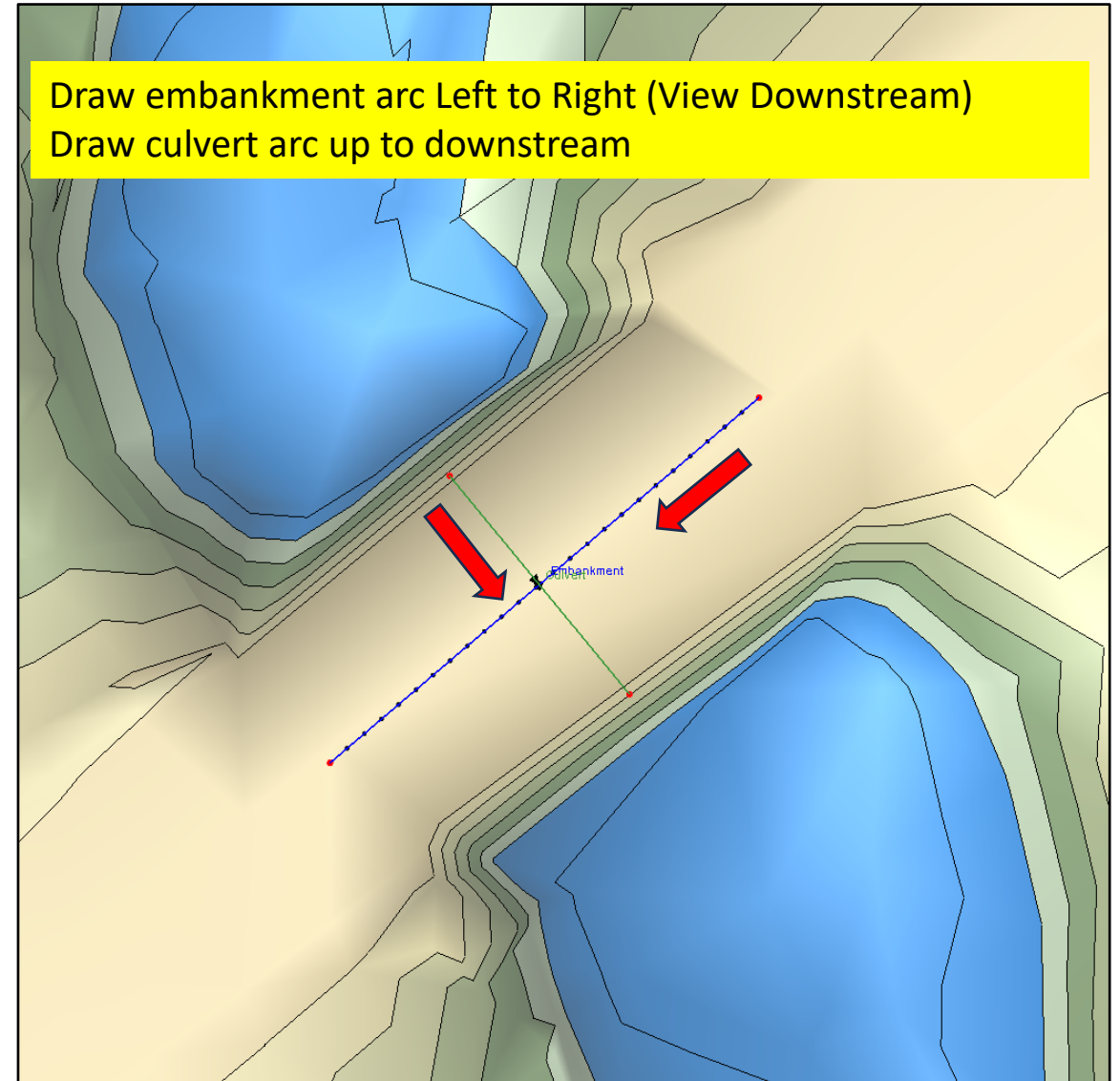
Workflow for Using 3D Structure Culverts

- Generate a new 3D Structure coverage
- Add road centerline arc, culvert group centerline arc, and abutment arcs (optional for skewed alignments)
- Add vertices along road centerline arc to define the number of elements
- Edit 3D Structure – Select Culvert type
- Enter crest profile
- Enter culvert properties
- Define overtopping parameters
- Preview mesh and edit parameters as needed
 - Add 3D Culvert UGRID
- Select options to:
 - Add coverage to SMS
 - Add 2D mesh



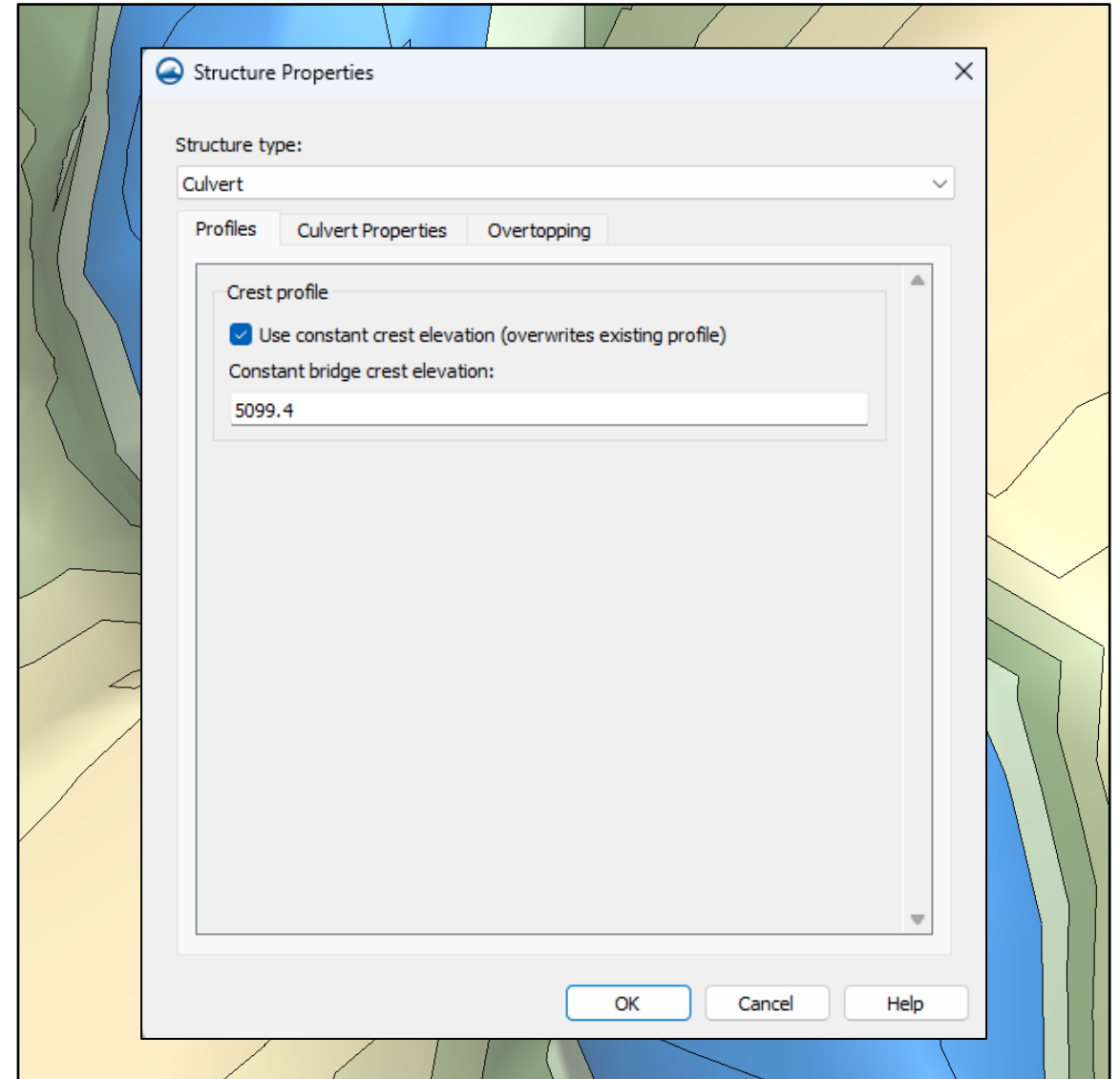
Workflow for Using 3D Structure Culverts

- Generate a new 3D Structure coverage
- Add road centerline arc, culvert group centerline arc, and abutment arcs (optional for skewed alignments)
- Add vertices along road centerline arc to define the number of elements
- Edit 3D Structure – Select Culvert type
- Enter crest profile
- Enter culvert properties
- Define overtopping parameters
- Preview mesh and edit parameters as needed
 - Add 3D Culvert UGRID
- Select options to:
 - Add coverage to SMS
 - Add 2D mesh



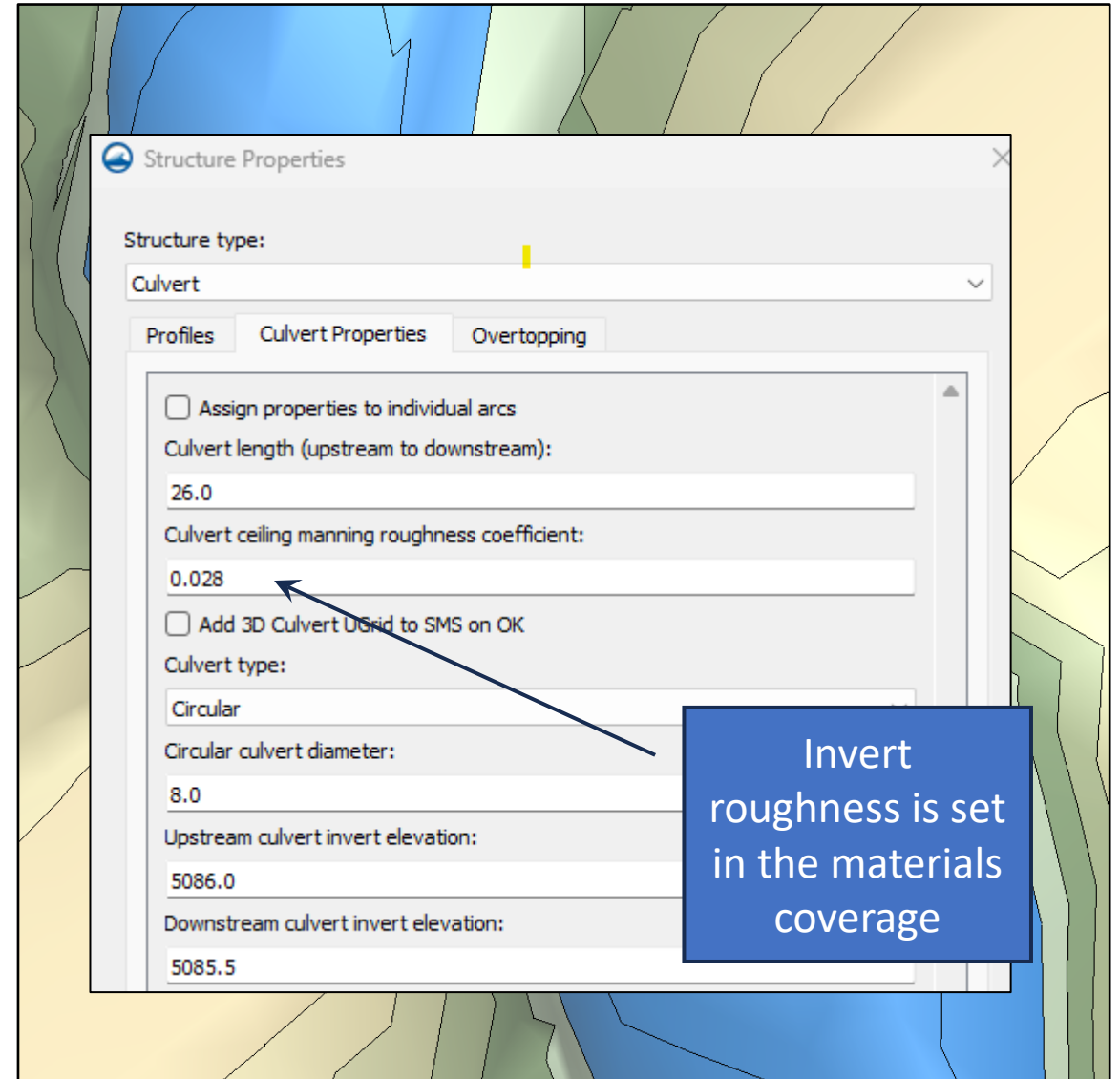
Workflow for Using 3D Structure Culverts

- Generate a new 3D Structure coverage
- Add road centerline arc, culvert group centerline arc, and abutment arcs (optional for skewed alignments)
- Add vertices along road centerline arc to define the number of elements
- **Edit 3D Structure – Select Culvert type**
- **Enter crest profile**
- Enter culvert properties
- Define overtopping parameters
- Preview mesh and edit parameters as needed
- Select options to:
 - *Add 3D Culvert UGRID*
 - *Add coverage to SMS*
 - *Add 2D mesh*



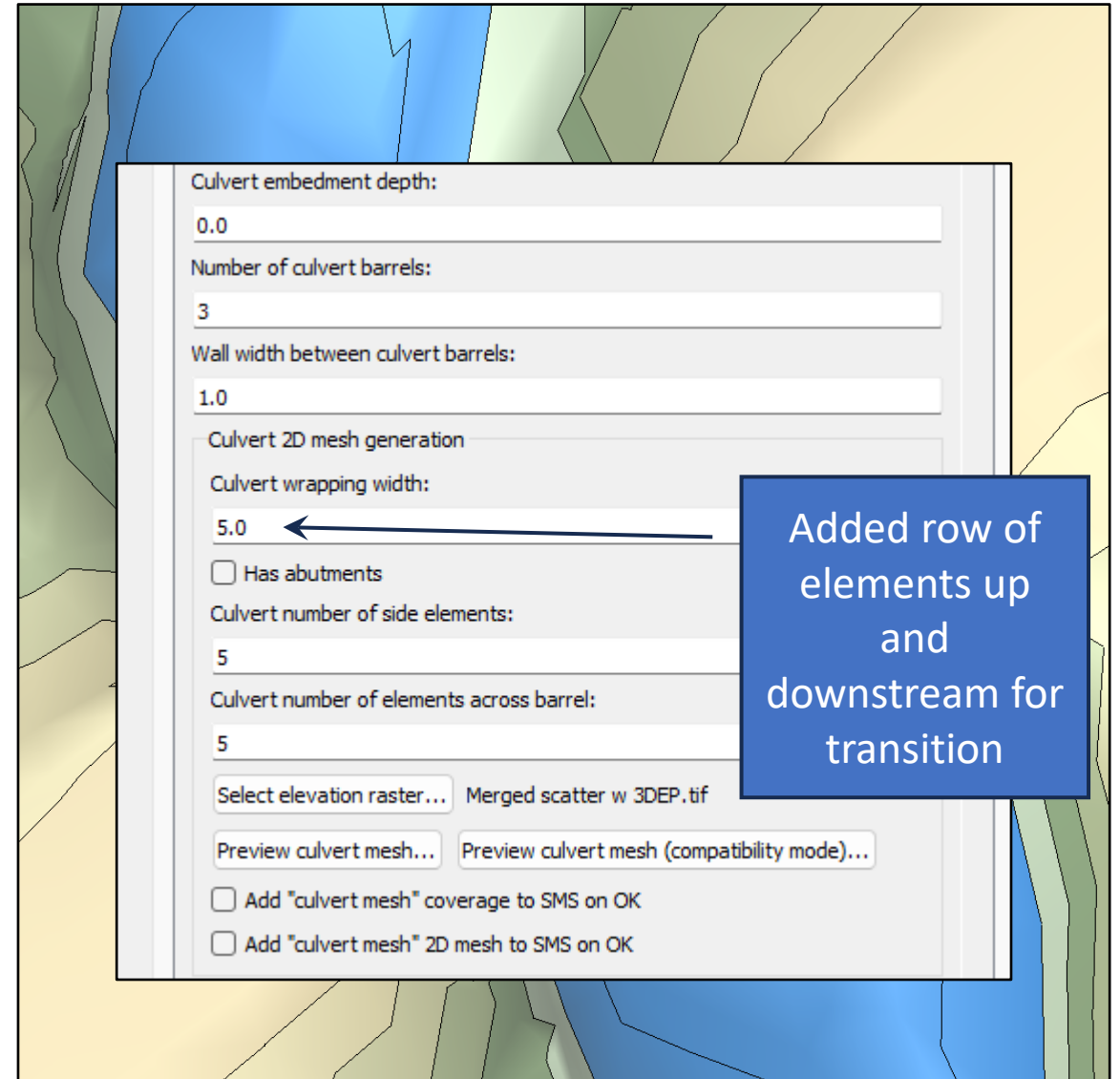
Workflow for Using 3D Structure Culverts

- Generate a new 3D Structure coverage
- Add road centerline arc, culvert group centerline arc, and abutment arcs (optional for skewed alignments)
- Add vertices along road centerline arc to define the number of elements
- Edit 3D Structure – Select Culvert type
- Enter crest profile
- **Enter culvert properties**
- Define overtopping parameters
- Preview mesh and edit parameters as needed
 - *Add 3D Culvert UGRID*
- Select options to:
 - *Add coverage to SMS*
 - *Add 2D mesh*



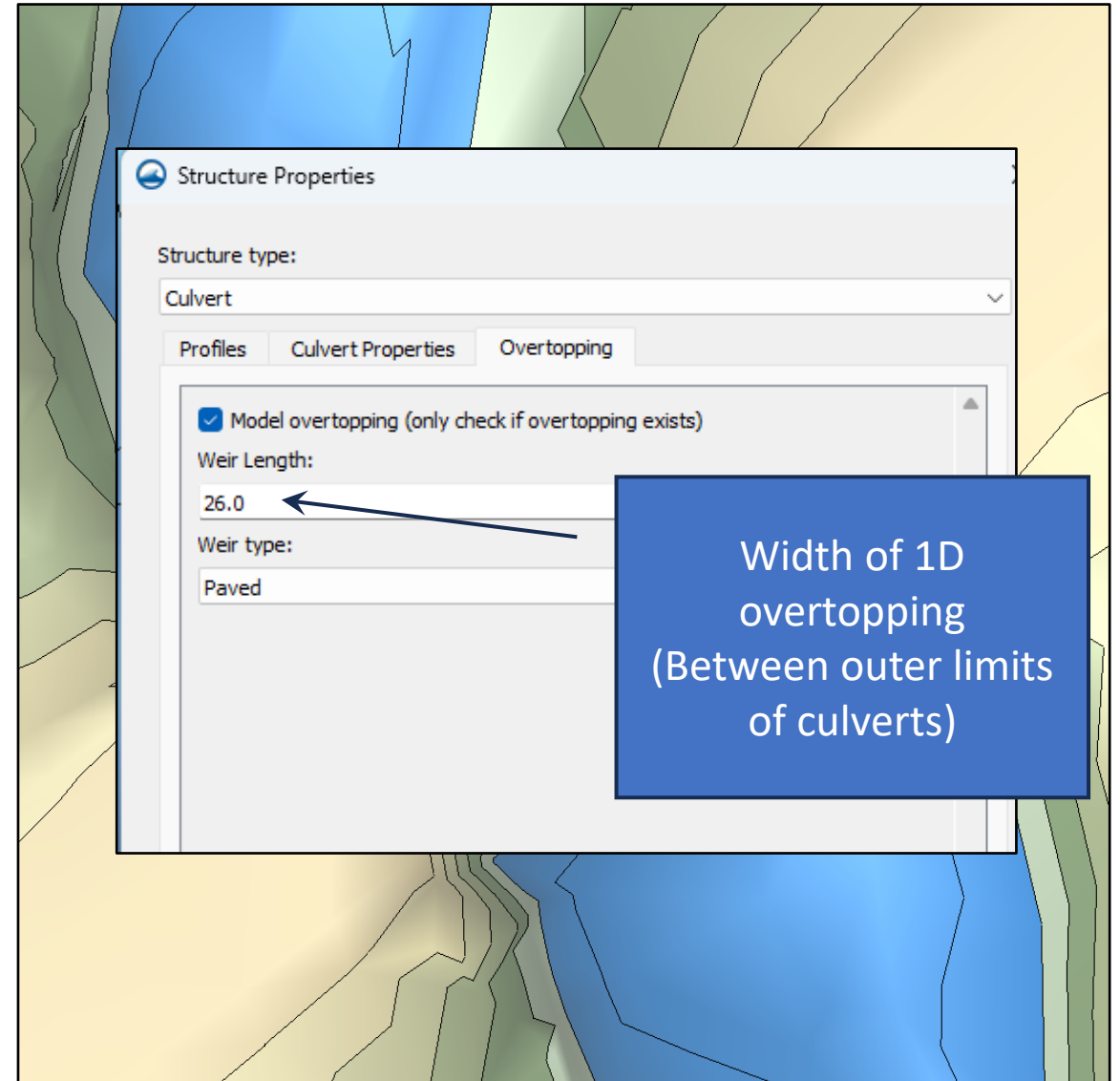
Workflow for Using 3D Structure Culverts

- Generate a new 3D Structure coverage
- Add road centerline arc, culvert group centerline arc, and abutment arcs (optional for skewed alignments)
- Add vertices along road centerline arc to define the number of elements
- Edit 3D Structure – Select Culvert type
- Enter crest profile
- **Enter culvert properties**
- Define overtopping parameters
- Preview mesh and edit parameters as needed
 - *Add 3D Culvert UGRID*
- Select options to:
 - *Add coverage to SMS*
 - *Add 2D mesh*



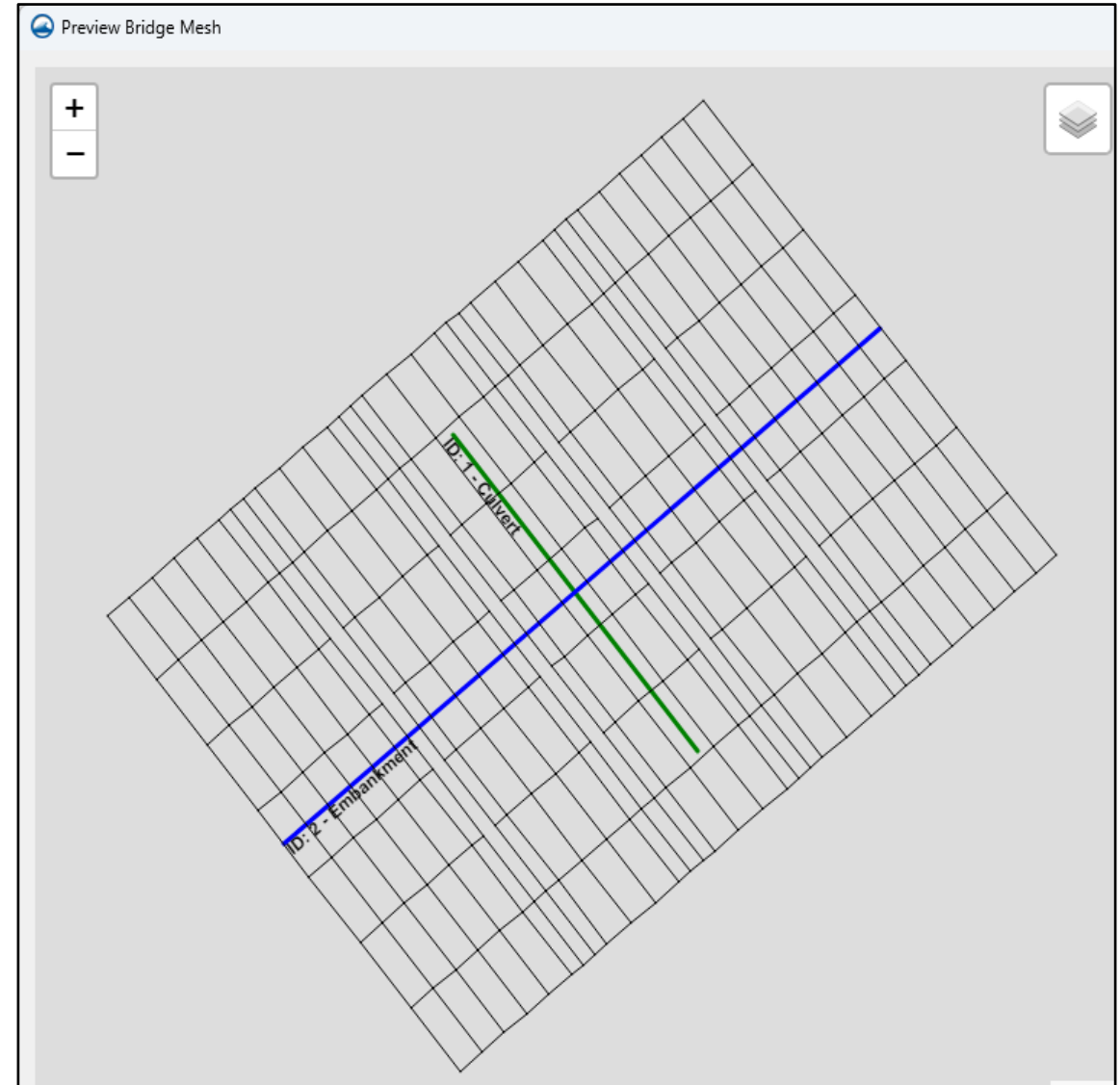
Workflow for Using 3D Structure Culverts

- Generate a new 3D Structure coverage
- Add road centerline arc, culvert group centerline arc, and abutment arcs (optional for skewed alignments)
- Add vertices along road centerline arc to define the number of elements
- Edit 3D Structure – Select Culvert type
- Enter crest profile
- Enter culvert properties
- **Define overtopping parameters**
- Preview mesh and edit parameters as needed
 - *Add 3D Culvert UGRID*
- Select options to:
 - *Add coverage to SMS*
 - *Add 2D mesh*



Workflow for Using 3D Structure Culverts

- Generate a new 3D Structure coverage
- Add road centerline arc, culvert group centerline arc, and abutment arcs (optional for skewed alignments)
- Add vertices along road centerline arc to define the number of elements
- Edit 3D Structure – Select Culvert type
- Enter crest profile
- Enter culvert properties
- Define overtopping parameters
- **Preview mesh and edit parameters as needed**
 - *Add 3D Culvert UGRID*
- Select options to:
 - *Add coverage to SMS*
 - *Add 2D mesh*



Workflow for Using 3D Structure Culverts

- Generate a new 3D Structure coverage
- Add road centerline arc, culvert group centerline arc, and abutment arcs (optional for skewed alignments)
- Add vertices along road centerline arc to define the number of elements
- Edit 3D Structure – Select Culvert type
- Enter crest profile
- Enter culvert properties
- Define overtopping parameters
- Preview mesh and edit parameters as needed
- Select options to:
 - *Add 3D Culvert UGRID*
 - *Add coverage to SMS*
 - *Add 2D mesh*

Structure Properties

Structure type:
Culvert

Profiles Culvert Properties Overtopping

☐ Assign properties to individual arcs

Culvert length (upstream to downstream):
26.0

Culvert ceiling manning roughness coefficient:
0.028

☒ Add 3D Culvert UGrid to SMS on OK

Culvert type:
Circular

Circular culvert diameter:
8.0

Upstream culvert invert elevation:
5086.0

Downstream culvert invert elevation:
5085.5

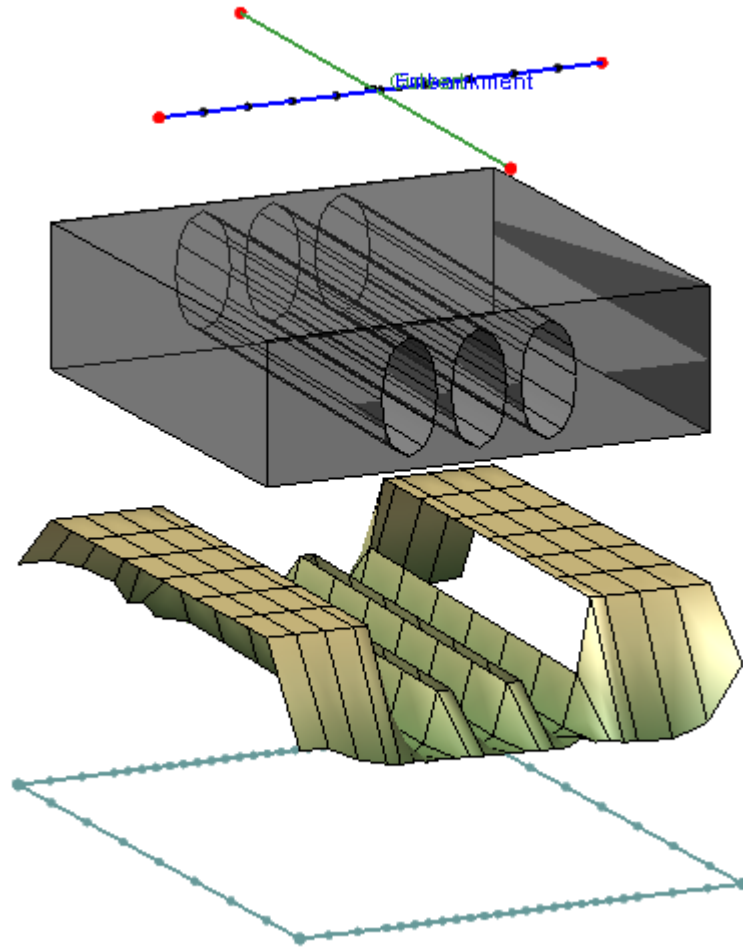
Select elevation raster... Merged scatter w 3DEP.tif

Preview culvert mesh... Preview culvert mesh (compatibility mode)...

☒ Add "culvert mesh" coverage to SMS on OK

☒ Add "culvert mesh" 2D mesh to SMS on OK

Workflow for Using 3D Structure Culverts



Additional Notes

- Currently limited to box culvert and circular culverts
- More complex shapes (e.g. arch culverts) may be modeled as bridges
- Culvert Invert elevations are automatically generated with the mesh
- Culvert crown elevations are represented by the 3D structure 'framework' (UGRID)
- Holes are added in the mesh to represent the culvert walls

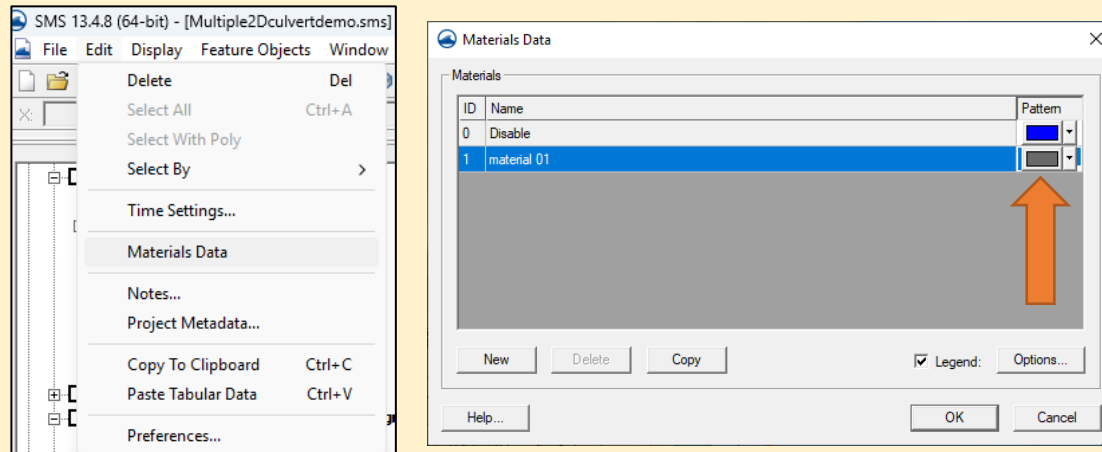
Workflow for Using 3D Structure Culverts

Next Steps...

- Set UGRID parameters to view 3D culvert framework

Edit the generic *Materials Data* from the main menu.

Set your color of choice for *material 01*

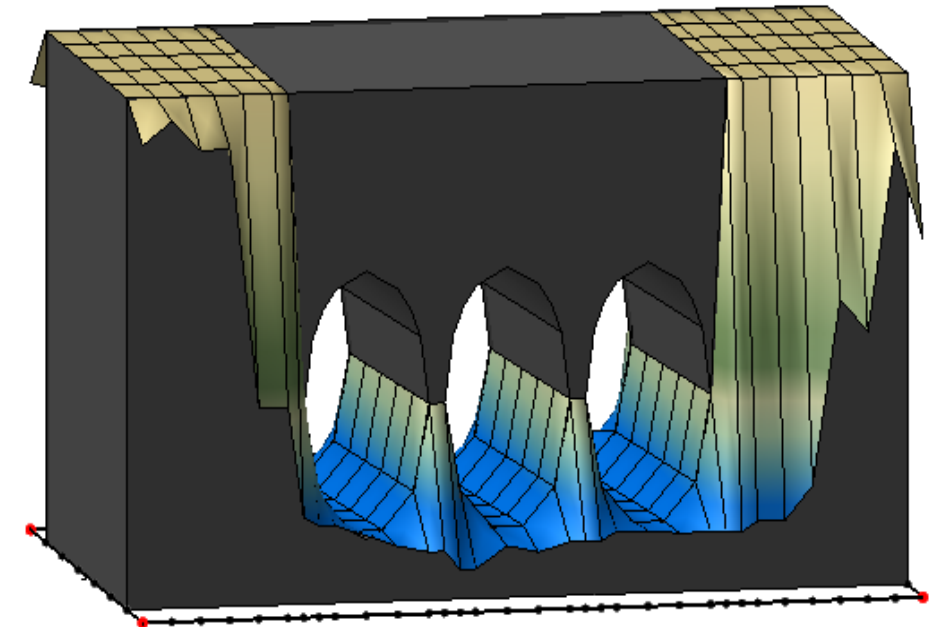
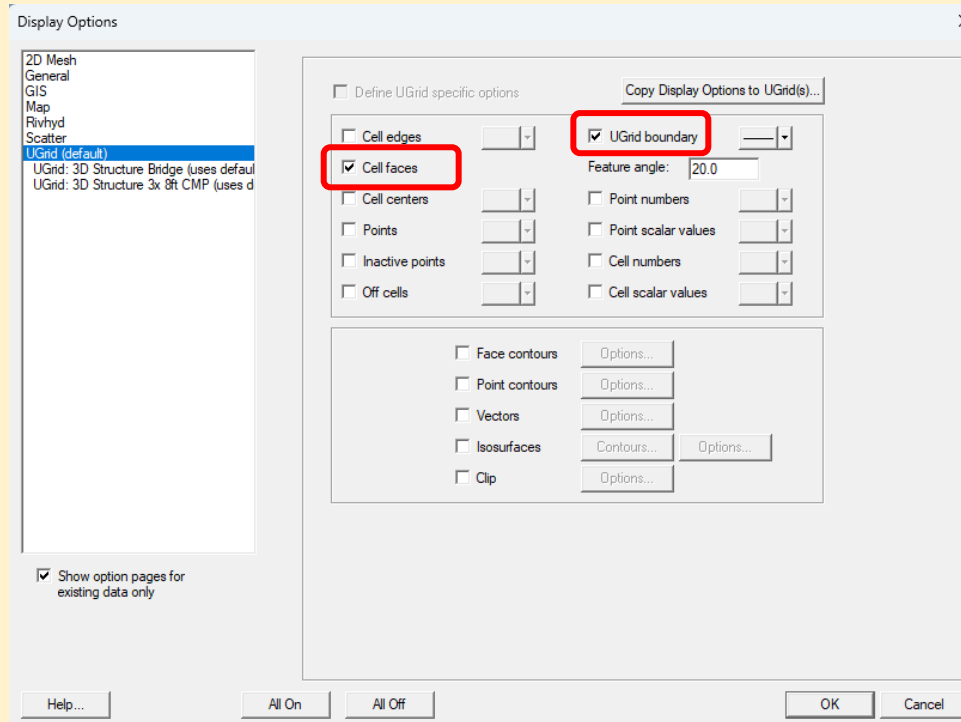


Workflow for Using 3D Structure Culverts

Next Steps...

- Set UGRID parameters to view 3D culvert framework

Edit the Display Options for UGRIDs



UGRID 3D Structure with Culvert Mesh

Workflow for Using 3D Structure Culverts

Next Steps...

- Set UGRID parameters to view 3D culvert framework
- Copy culvert footprint to mesh generator coverage and edit coverage

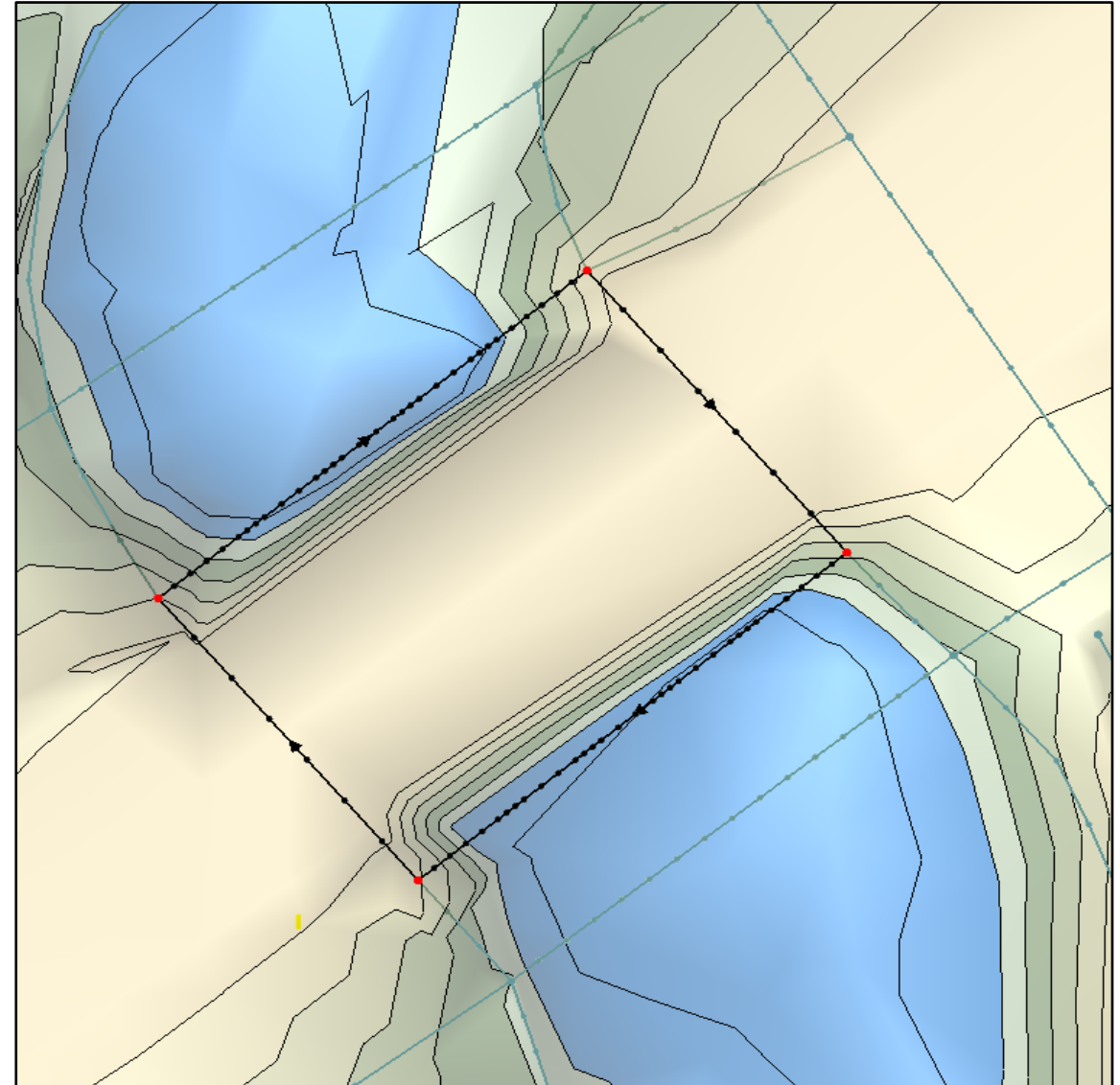
Connect adjoining arcs to culvert polygon.

IMPORTANT! Do Not move any nodes/vertices on the bridge footprint. Arcs may be connected to vertices on the footprint.

Add additional structures as needed.

Clean arcs and build polygons.

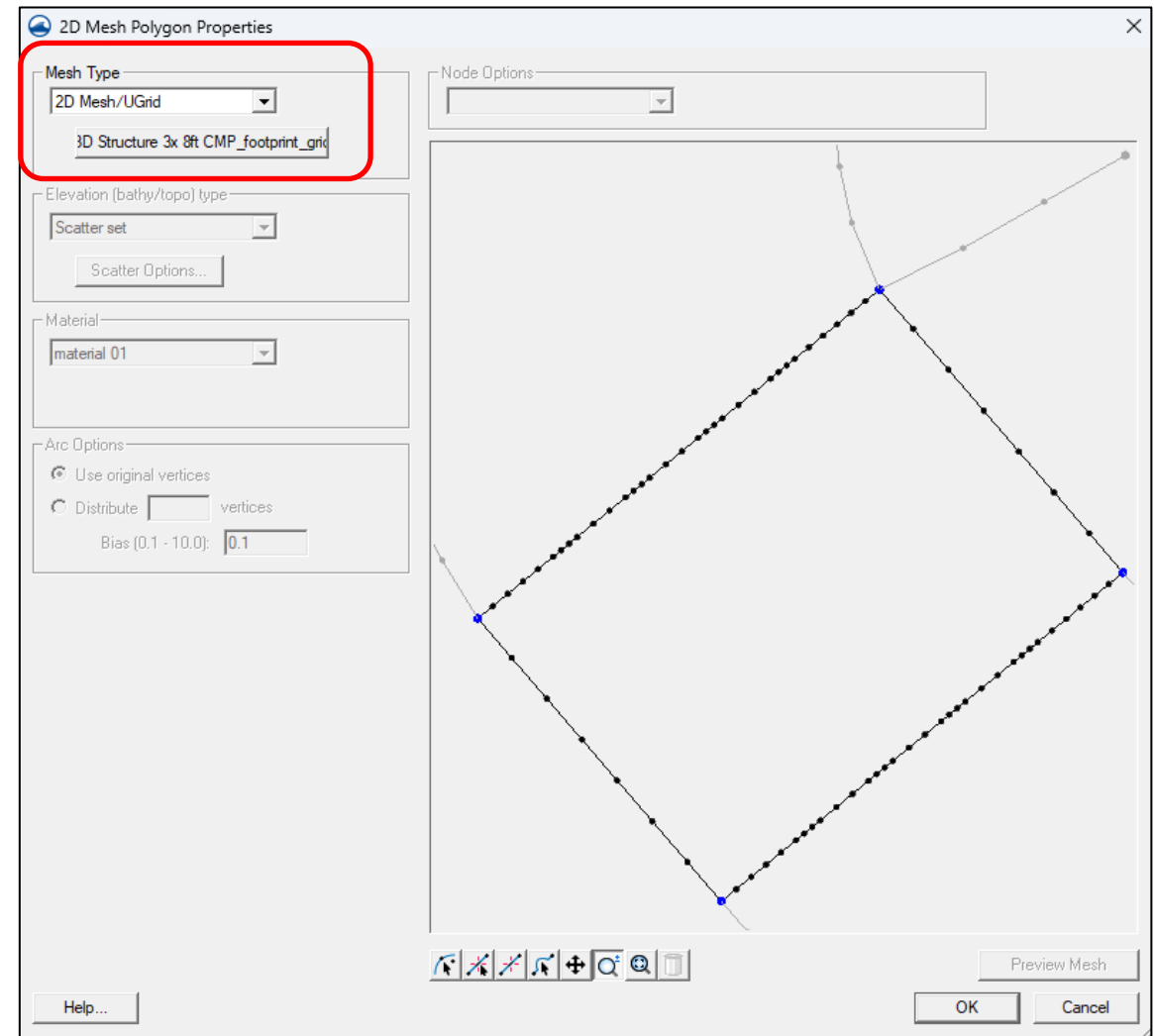
Assign terrain source to polygons (scatter or raster).



Workflow for Using 3D Structure Culverts

Next Steps...

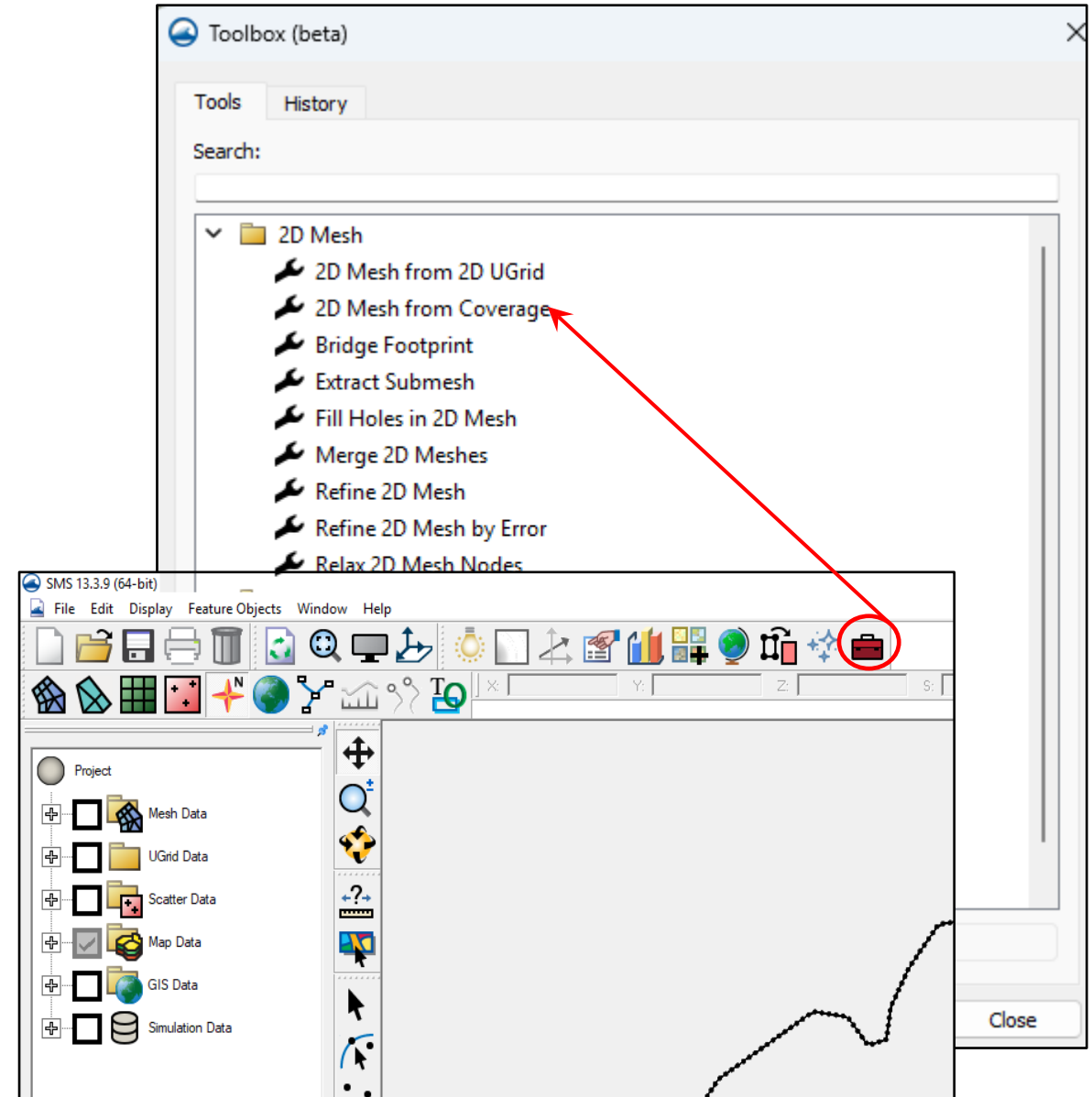
- Set UGRID parameters to view 3D culvert framework
- Copy culvert footprint to mesh generator coverage and edit coverage
- Set culvert footprint mesh type to '2D Mesh/UGRID' and select culvert mesh
- Use the Toolbox: Mesh from coverage tool to generate the mesh
- Link 3D Structure Culverts to the simulation
- Set simulation parameters, run simulation, and review results



Workflow for Using 3D Structure Culverts

Next Steps...

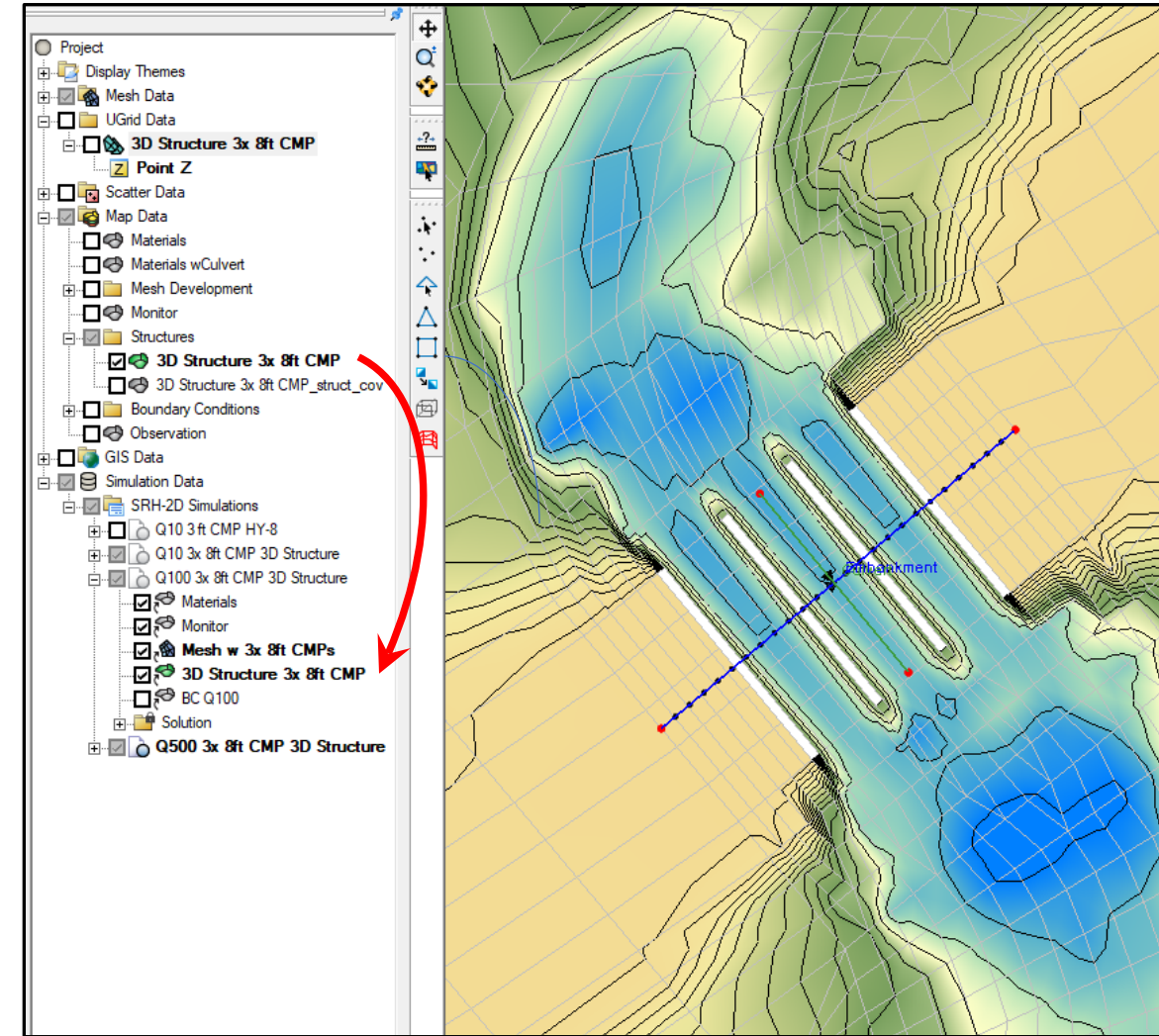
- Set UGRID parameters to view 3D culvert framework
- Copy culvert footprint to mesh generator coverage and edit coverage
- Set culvert footprint mesh type to '2D Mesh/UGRID' and select culvert mesh
- Use the Toolbox: Mesh from coverage tool to generate the mesh
- Link 3D Structure Culverts to the simulation
- Set simulation parameters, run simulation, and review results



Workflow for Using 3D Structure Culverts

Next Steps...

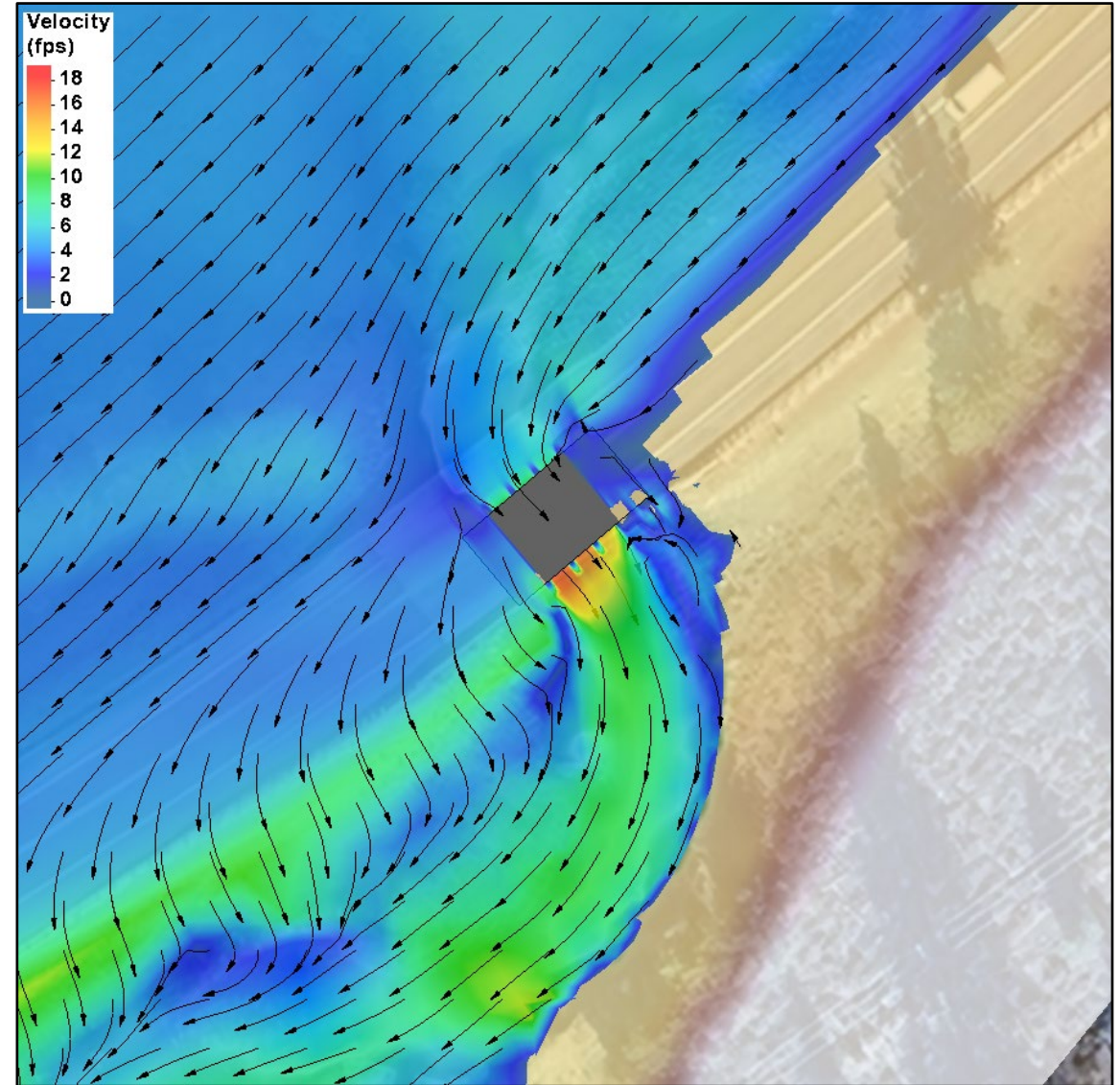
- Set UGRID parameters to view 3D culvert framework
- Copy culvert footprint to mesh generator coverage and edit coverage
- Set culvert footprint mesh type to '2D Mesh/UGRID' and select culvert mesh
- Use the Toolbox: Mesh from coverage tool to generate the mesh
- **Link 3D Structure Culverts to the simulation**
- Set simulation parameters, run simulation, and review results



Workflow for Using 3D Structure Culverts

Next Steps...

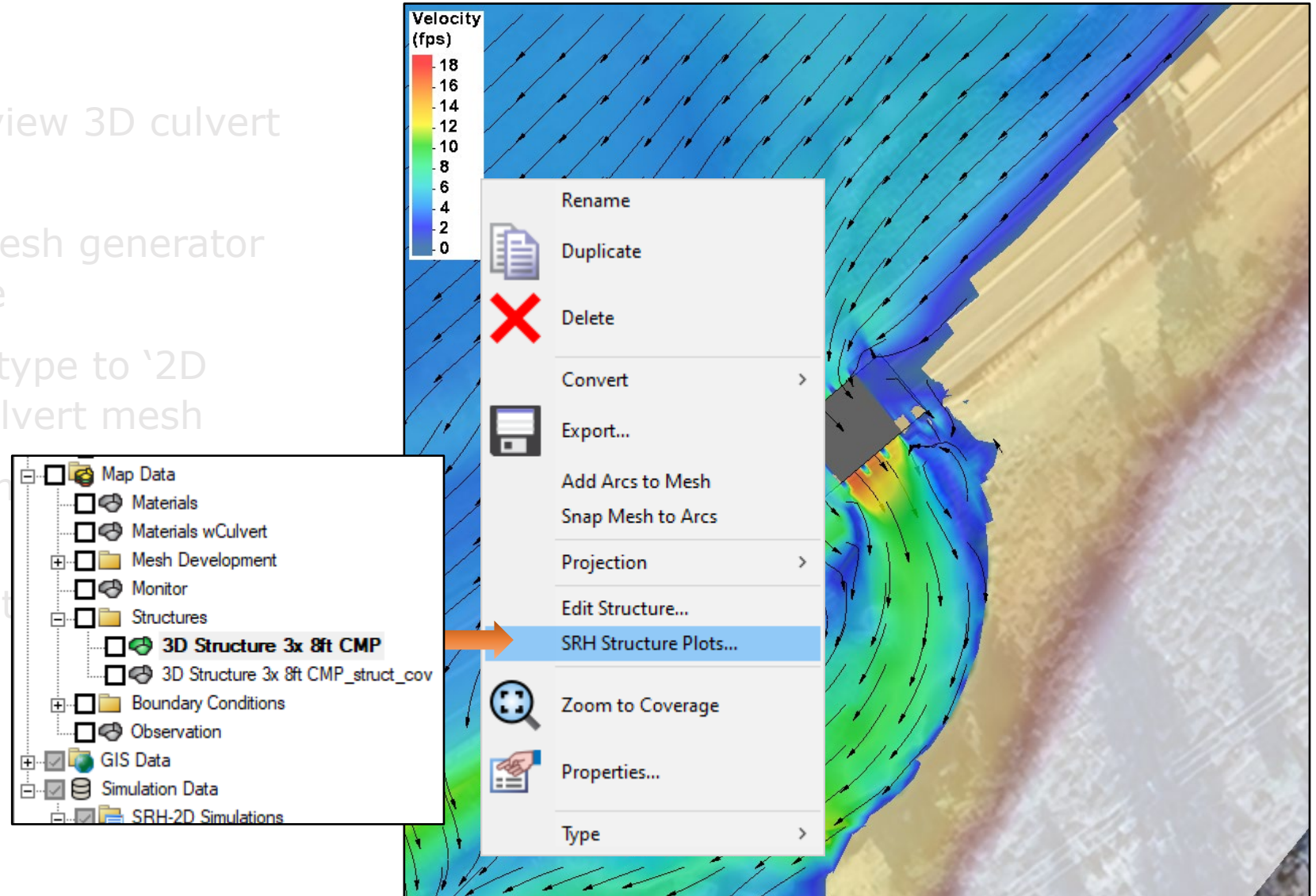
- Set UGRID parameters to view 3D culvert framework
- Copy culvert footprint to mesh generator coverage and edit coverage
- Set culvert footprint mesh type to '2D Mesh/UGRID' and select culvert mesh
- Use the Toolbox: Mesh from coverage tool to generate the mesh
- Link 3D Structure Culverts to the simulation
- Set simulation parameters, run simulation, and review results



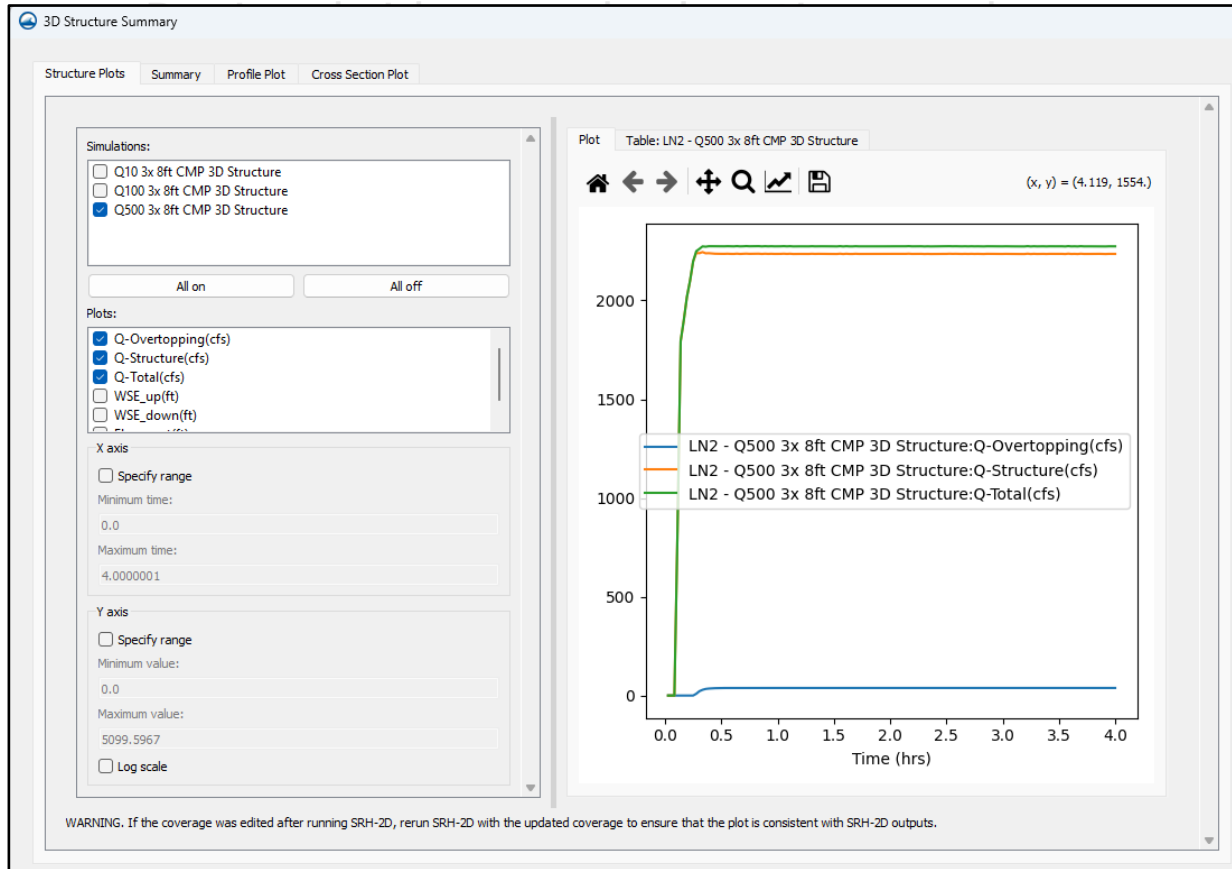
Workflow for Using 3D Structure Culverts

Next Steps...

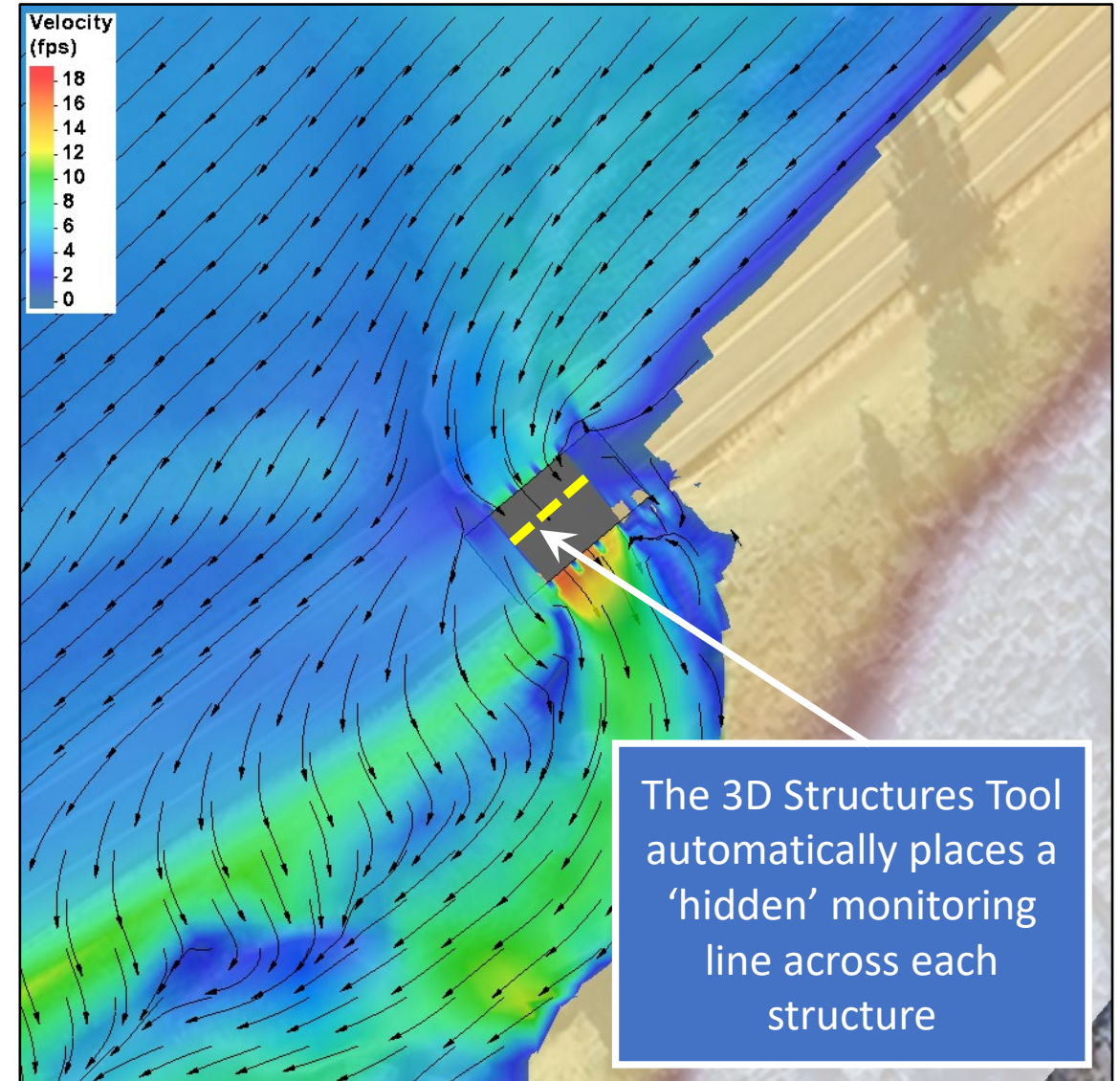
- Set UGRID parameters to view 3D culvert framework
- Copy culvert footprint to mesh generator coverage and edit coverage
- Set culvert footprint mesh type to '2D Mesh/UGRID' and select culvert mesh
- Use the Toolbox: Mesh from to generate the mesh
- Link 3D Structure Culverts to
- Set simulation parameters, and review results



Workflow for Using 3D Structure Culverts



- 'Drag and Drop' or 'Apply To' for each 3D structure
- Set simulation parameters, run simulation, and review results



Questions on using 3D Structure Culverts



Tips and Tricks

SMS Hot Keys and Helpful Tips

- General tips
- Select Feature hotkeys
- Multi-select tools
- Arc Drawing
- Plotting Features
- Structures
- View tools
- Simulation tips
- Display settings

Download from the
Webinar Series page
Webinar Resources

AQUAVEO®

SMS Hot Keys and Helpful Tips

(Updated November 11, 2025)

1. General

- Right-click on "Project" in the upper left of the Project Explorer and select "Open Project Folder" to open a File Explorer window in the SMS project directory.
- To back up or transfer a project, go to Main Menu ► File ► Save As Package. This saves all project information to a single ZIP file.
- Ctrl + D → Open Display Options
- Ctrl + T → Open Toolbox

2. Select Features

- Ctrl + A → Select All
- Ctrl + Shift → Draw a polygon to select multiple features
- Universal Select Tool → Select nodes, vertices, and arcs (hold Shift for multiple selection)

3. Multiselect Options

- Shift + Left Click → Toggle selected items (add/remove)
- Alt + Left Click → Add newly selected items to selection
- Ctrl + Left Click and drag → Draw arrow; all features intersected are selected
- Click and drag a box → Select all features within box
- Invert Selection → Right-click and choose "Invert Selection"

4. Arc Drawing / Editing

- Hold H or V while digitizing to lock horizontal/vertical direction
- Backspace → Remove previous click while digitizing
- Esc → Cancel digitizing
- Hold D and drag → Move an arc (works with Observation Coverage arcs for plots)

5. Plotting Features

- Right-click a Monitoring Line or Point → Open SRH-2D solution plots
- Select multiple Monitoring Lines or Points → Open SRH-2D solution plots
- Right-click a Simulation ► Tools ► View Simulation Plots



THANK YOU for participating!
Please contact us with any questions

Scott Hogan, PE

Principal Hydraulic Engineer

Scott.hogan@transportationhydraulics.com

Aquaveo Technical Support

support@aquaveo.com