2-D Hydraulic Model Review Checklist

Project Description: _____ **Reviewer:** _____

Stream Name(#) / Reach _____

Project File Name: _____ **Date:** _____

Additional Information: _____

FHWA: 2D Hydraulic Modeling Reference Document: *www.fhwa.dot.gov/engineering/hydraulics/pubs/hif19061.pdf*

Item	Reviewed/ Completed	Comment	Action Needed (blank none)	Response to Comment/Resolution	Screen Shot	Link
Pre-Review/Submittal Best Practice Considerations						
Use the Merge Triangles option to reduce the number of mesh elements and CPU time					☐	
Trim the model domain to exclude large areas outside of the floodplain					☐	
For steady flow models use the Simulation End output option to avoid large file sizes					☐	
Clean up and organize map project data to include only what is needed for review					☐	
Name simulations and other coverages with short, easy to understand labels					☐	
Complete the project metadata and notes to provide explanations where needed					☐	
Consider using the Advanced Simulations option to run multiple flows for the same mesh					☐	
Use the Steady Flow option for steady flows, unless the unsteady option is needed to improve stability					☐	
Consider using initial conditions for each simulation to minimize runtime. Starting with a restart file or initial WSEL can significantly reduce runtime.					☐	
Consider using an initial and secondary timestep to optimize runtimes (Model control/advanced settings)					☐	
Optimize simulation timestep and simulation time to minimize CPU time					☐	
Use restart or WSEL initial conditions to minimize CPU times					☐	
Provide a copy of the simulations Summary Report					☐	
Internal Quality Control (QC) review should be performed prior to submittal					☐	
Project Information						
Project name, location, and objective provided.					☐	
Software and version identified - Current version used at start of project					☐	
Modelers qualifications provided.					☐	
Documentation of modeling approach and assumptions provided.					☐	
Other information					☐	
Terrain Data						
Confirm project coordinate system, horizontal and vertical datums and units, and any scaling factors.					☐	
Review sources of terrain data and accuracies					☐	
For Lidar data confirm vegetation and structures have been filtered out of the original data.					☐	
For raster terrain data, confirm an appropriate pixel size (3-5 ft or smaller best for detailed hydraulics)					☐	
Bathymetry						
Confirm that channel survey data is included for the area of interest.					☐	
Review channel data in other areas, and confirm that the channel section is appropriately represented					☐	
Other information					☐	
Additional Survey						
Was site survey data incorporated into the terrain data?					☐	
Bridge/Culvert/Structure Data						
Review structure elevations and compare with model simulation data					☐	
Terrain mapping review						
If multiple data sources were merged, review the transitions and data consistency.					☐	
Confirm that the point spacing or pixel size is reasonable relative to the mesh element size. (e.g. 10m DEM data is not sufficient for detailed 2D modeling.					☐	
Confirm that breaklines were used where necessary (primariliy along banklines and linear features)					☐	
Compare the mesh represntation of the terrain with the original terrain mapping. Confirm that all key features are reprented well (e.g. no gaps in embankments, berms etc.)					☐	
2D Mesh						
Is the upstream reach length sufficient to avoid boundary condition influences?					☐	
Is the downstream reach length sufficient to avoid boundary condition influences?					☐	
Are the lateral extents sufficient?					☐	
Are the number and range of element sizes appropriate for the project objective?					☐	
Are the element lengths generally similar to the flow depth? (shorter elements can cause instabilities)					☐	
Are key project features correctly represented with a element edges aligned along the entire feature?					☐	
Is the mesh density higher where greater detail is needed?					☐	
For detailed bridge hydraulics, are multiple elements included between piers (5 or more preferred)					☐	
Are there mesh quality concerns? (primary concern is very small interior angles)					☐	
Boundary Conditions						
What is the source for the inflow data?					☐	
Are unsteady or steady simulations performed?					☐	
Confirm that the correct flow conditions (values) were used for each simulation.					☐	
Is the inflow distribution option appropriate? (Conveyance is most common)					☐	
Are the key inflows and outflows represented correctly?					☐	
Confirm that the inflow and outflow boundary locations are correct and that they span the maximum flood width at each location.					☐	
Review downstream tailwater boundary and how they were computed (normal depth, critical depth, known water surface, other?)					☐	

Review 1D hydraulic structure boundary condition locations and parameters. (More under structures)					☐	
Material Roughness						
Review the number and type of materials used. Are they appropriate for the application?					☐	
Verify that the material polygons were delineated based on GIS landuse data, aerial image or other appropriate source.					☐	
Verify that the materials definiition extends to the limits (or beyond) the mesh domain limits.					☐	
Verify that the material types are correctly assigned.					☐	
Review the Manning's n-values for each material and verify they are within acceptable ranges.					☐	
Check if Manning's n-values were calibrated to measured data or if sensitivity analyes were performed in lieu of calibration.					☐	
Hydraulic Structures						
Review the locations and geometry of each structure and verify they are consistent with hydraulic report information or other documentation.					☐	
Bridges and 2D Culverts						
Verify the structure geometry compared to the provided asbuilts or hydraulic report (invert elevations, low chord elevations, length, width, etc.)					☐	
Verify that the mesh resolution through the structure zone is appropriate for detailed hydraulic analyses. (5-7 elements per bridge span, 2-3 elements wide for small culverts, 5+ elements wide for large culverts are reasonable resolutions)					☐	
For detailed hydraulics, verify that piers are represented as holes in the mesh. The dimensions of the hole should represent the average dimensions that are obstructing the flow.					☐	
Where bridge pressure flow may exist, verify that a bridge deck is defined (pressure flow arcs or 3D structure definition).					☐	
If there is potential for bridge deck overtopping, verify that the overtopping option is selected and the correct width is set.					☐	
Verify that each bridge structure (deck) spans the entire opening, and into the terrain on both banks.					☐	
Verify that the Manning's roughness coefficient for the bridge ceiling is within the recommended range of 0.05 to 0.1					☐	
1D Culverts						
Verify that the mesh elements generally align with the culvert and have element faces that are located close to the culvert inverts (When the 2D overtopping option in SMS is selected, the mesh alignment is not important)					☐	
Culvert BC arcs should be placed at the culvert invert locations and should generally represent the width of the culvert(s)					☐	
HY-8 Culvert BC arcs should be located at the culvert invert locations and the HY-8 elevations should be consistent with the mesh elevations at the invert locations.					☐	
Verify that the overtopping crest length in HY-8 is equal to the BC arc length if the 1D overtopping (default) option is used. For the 2D overtopping approach, verify that the crest length in HY-8 is set very small (~0.1).					☐	
Confirm that the Total Head option is selected for any culverts that have an approach velocity.					☐	
Verify that the correct crossings are assigned for each HY-8 culvert in SMS/SRH-2D					☐	
Obstructions						
Verify that all obstructions are in a single coverage and that coverage is included as a simulation component					☐	
Verify that the elevation of the obstruction arc is set to the bottom elevation of the obstruction.					☐	
Verify that the obstruction width and drag coefficient are set correctly (see 2D reference manual)					☐	
The obstruction arc should align with the centerline of the obstruction, with the appropriate dimentions and coefficients enterred in the obstructions dialog.					☐	
Other Structures						
What other structures are represented (weirs, gates, link BCs with rating curves, sinks/sources)?					☐	
Verify that all 1D structures are represented with 2 arcs (one upstream and one-downstream).					☐	
Review all geometry and input parameters for other hydraulic structures.					☐	
Model Controls and Simulations						
How many simulations are included?					☐	
Are they labeled appropriately and do they include the correct components.					☐	
Verify that timestep is within an acceptable range. (1-20s is reasonable, smaller than 1s can be ok but not common)					☐	
Verify that simulation times are long enough to reach a steady flow condition or to capture the peak hydrograph for unsteady flow.					☐	
Turbulence model should be set to the Parabolic Method with a coefficient of 0.7					☐	
Turbulence model should be set to the Parabolic Method with a coefficient of 0.7					☐	
Model Results						
Verify that the NetQ reached zero (for steady flow conditions)					☐	
Verify that the Mass Balance Plot indicates negligible errors (typically less than 1-2%)					☐	
For steady flow simulations, verify that the number of wet elements reached a constant condition.					☐	
Confirm model stability at monitoring points.					☐	
Confirm stability and continuity at monitoring lines.					☐	
Review shear stress results and look for unrealistic spikes (often indicates bad mesh geometry)					☐	
Review Froude numbers and confirm they are predominantly less than 1.0.					☐	
Verify that velocities within reasonable ranges? (Unrealistically high local velocities are often associated with small interior mesh angles or other instabilities.)					☐	
Look for abrupt changes in depth (these can indicate inconsistencies in terrain data).					☐	
Verify that the WSEL limits (flood limits) and flow paths look reasonable. In areas of shallow flow and overtopping, the mesh representation of the terrain should be reviewed.					☐	
Review profiles and cross sections in the vicinity of key features (bridges, cuvlerts, overtopping embankments, etc.)					☐	
Verify that pressure flow at bridges is being represented correctly in the results.					☐	

Dataset Comparisons						
For comparisons of two conditions (i.e. existing vs proposed) are differential surface contour datasets generated? Do the differences look reasonable?					☐	
Review profile and cross section plot comparisons of WSEL and velocity.					☐	
Review differential surface plots to compare terrain vs. mesh elevations, existing vs. proposed WSEL, etc.					☐	
Review summary comparison tables of existing vs. proposed, floodplain vs. floodway, etc.					☐	
Model Calibration						
Was calibration performed? If so, does the model data match the calibration data?					☐	
If no calibration, were any sensitivity analyses performed?					☐	
Bridge Scour Hydraulic Parameters						
Identify the number of scour coverages and events that were evaluated for scour.					☐	
Verify the source of soil gradation that was used to define the d50 for scour analyses.					☐	
Verify that the contracted section arc is aligned with the bridge and spans the bridge opening					☐	
Verify that the approach section is located upstream of the bridge at a location upstream of where the velocity vectors indicate overbank flow returning to the channel.					☐	
Verify that the approach section is NOT located in a locally high velocity area (this will underpredict scour)					☐	
Verify that the bank arcs are located at the toe of slope or top of bank at the approach and contracted sections. The location should be consistent.					☐	
Verify that the Pier Arcs are aligned with the center of the piers and the pier arc properties are set appropriately.					☐	
Verify that the Abutment Toe arcs are located in the general abutment toe location, within the flow area, and the configuration type is set correctly.					☐	
Verify that all arcs are set as the correct type					☐	
For non SMS/SRH-2D analysis, verify that the hydraulic parameters were extracted to represent averaged hydraulic conditions in the main channel and each overbank.					☐	
For non SMS/SRH-2D analysis, verify that the contracted section hydraulic parameters are adjusted to reflect bridge skew and pier skew.					☐	
General Comments						