

HYDRAULIC MODEL REVIEW



Project	Holcombe/Mondi Mill, Ramsbottom	Job Number	SO/2020/12 0565/01
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Model Type	1D/2D	Software	ISIS/FMP-TUFLOW
Revision	1	Date	26/10/2020
Area Client	GMC	Reviewer	mb

REVIEW SUMMARY/CONCLUSION	
Is the model suitable for intended use?	The EA Mid Irwell model has received a few minor updates for this FRA. All alterations are acceptable. Results show that flooding on site commences at 1:20 and is flooded at the 1:100, except for the SW corner. As modelled the proposal does not exacerbate flood risk elsewhere.

MODEL REVIEW PROCESS
Hydraulic Model reviews are an essential component of the Hydraulic Modelling Quality Assurance (QA) process that provides confidence in a model's suitability for its intended purpose. Evidence that the model has undergone QA may be requested by external parties and hence all reviews should be written with an expectation that they could be read externally. Should any issue(s) be raised during the review process, which require attention, the reviewer should detail the action(s) required in sufficient detail to allow the modeller to complete the changes as appropriate. Completion of this Model Review document does not automatically constitute model approval. Once the suggested changes have been completed, the reviewer may require that the model be resubmitted for further review to establish whether the actions have been completed satisfactorily. Only once all the actions have been completed satisfactorily, will the model be approved and the quality assured by the reviewer. It is recommended that the reviewer makes good use of the fluvial design guide chapter 7 http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter_7_Background.aspx and the user manual/help guides for the appropriate modelling software. Depending on the work being reviewed some questions or entire sections may not be relevant, in which case they can be deleted. On completion of the review the reviewer may choose to use the following colour coding system to alert the modeller to the actions required (if any). Colour coding used: Green – Good practice – not strictly necessary in this case but good practice for future studies. Amber – Useful – please follow recommendation if time allows. Red – Must do.

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PROJECT BACKGROUND AND APPROACH

PROJECT DESCRIPTION & REQUIREMENTS

The applicant has used the EA's existing Mid Irwell model to assess flood risk to a proposed development site within FZ3. The purpose of the modelling is to show risks to the site and ensure risk is not increased elsewhere.

MODEL APPROACH & SUMMARY

Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
1.1	What model approach has been adopted? Is it appropriate? (e.g. new 1D/2D build, existing model truncation, 1d only?).	EA River Irwell hydraulic model has been truncated to create a site specific 1D/2D model			
1.2	Software used, including versions?	FMP 4.5.1.6163.			
1.3	Node Summary and river length?	6km, 283 nodes			
1.4	Model Version Reviewed	004 and 010			
1.5	Are all model files provided?	yes			
1.6	Does the model run?	yes			

EVENTS & SCENARIOS

Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
2.1	What events have been simulated (Q5, Q100, Q100CC, Q1000)? Are they sufficient to meet the project requirements?	baseline and proposed scenarios for the 1:20, 1:100, 1:100 (+30%) and 1:100 (+35%) AEP events,			
2.2	Is a development being modelled? If so are appropriate scenarios modelled to assess the impact?	yes			

2.3	Flood Mapping scenarios? Defended, undefended, climate change	defended and climate change			
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1D Model Build

1D NETWORK					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
3.1	Model overview: Node Summary 1d length	6km, 283 nodes			
3.2	Have appropriate distances between sections and/or nodes been used (dx)?	Appropriate			
3.3	Are out of bank flows represented in 1d? If so, how has it been done and is it appropriate? Extended channel sections, storage areas; or secondary channel sections	no			
3.4	Is the model geo-referenced (gxy/ixy file available?)	yes			
3.5	Do the cross sections and bed profiles look reasonable? When compared with survey data where possible and if not OS mapping or photographs Review of random sample required if large number of sections.	Reasonable. Most come from EA model. No survey available			
3.6	Chainage – compared to surveyed sections The reviewer should check the distance between sections in the model against the survey	no survey available, chainage inherited from EA model			
3.7	Does conveyance look appropriate? Do channel conveyance values vary outside the ratios of 0.7 and 1.4 between adjacent river sections? (Are panel markers needed or in the correct place)	Appropriate			

3.8	If gauged flow is available, is there good flow reconciliation between the statistical estimates and the modelled, for given return periods?	N/A			
3.9	Bank Markers. Are they used and if so, are they suitably located?	yes, appropriate			
4	What approach to channel roughness has been used? Uniform approach or varying bed and banks?	most unchanged from EA model - varying			
4.1	What manning's n value(s) have been used for the channel? If it is 1d only what values and how have they been applied in the flood plain?	0.04 - clean, winding, some pools and shoals			
4.2	What method has been used to estimate roughness (USGS, Chow, etc. based on survey, photographs)? Are they appropriate	unchanged from EA model			

1D BOUNDARY CONDITIONS					
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Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
4.1	1d boundary model domain; is there glass walling anywhere in the modelled reaches?	inherited from EA model; IRWE07_02185 - NO SPILL ATTACHED IRWE07_02184 - NO SPILL ATTACHED IRWE07_02183 - NO SPILL ATTACHED			
4.2	How have the boundaries been applied? Flow time boundary, FEH units..etc.	Single Flow-Time boundary that was output directly from the results of the EA River Irwell hydraulic model at model node IRWE07_02247.			
4.3	How is the downstream boundary(s) applied? Is it a rating curve (Q/H), Head/time? etc. Is the choice appropriate for the type of outflow?	Head-Time boundary was incorporated at the downstream extent of the truncated model domain and was output directly from the results of the EA River Irwell hydraulic model at model node IRWE06_01276.			
4.4	Have appropriate locations been chosen for the downstream model extents? Is it sufficient distance from site to have minimal impact ($L = 0.7 \times \text{depth} / \text{gradient}$)?	Appropriate			

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1D STRUCTURES

1D STRUCTURES					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
5.1	Are all structures represented? If not have explanations for structures not modelled been given in the Log/report? <i>If more than 10 structures, check of 10 most critical structures required only.</i>	Yes			
5.2	Are invert levels correct compared to survey data? <i>Check of all critical structures required.</i>	N/A			
5.3	Do bridges surcharge? If so has orifice flow been enabled?	yes at high return periods. Orifice flow not enabled. Inherited from EA model			
5.4	Are there spills around the structure or over the top represented appropriately? — <i>These could be in 1d or 2D, if a linked model.</i>	Appropriate			
5.5	If there are any movable structures have they been modelled correctly? <i>E.g. have control rules been agreed with the Agency</i>	N/A			
5.6	Structure coefficients - Have they been changed from default values? If changed, is there validation/verification data to justify the change?	N/A			

1D RUN PARAMETERS

1D RUN PARAMETERS					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
6.1	What time step has been used for the 1D model? Is it appropriate?	2 seconds			
6.2	What initial conditions have been used? Steady state, hotstart file?	Appropriate			
6.3	Have any of the parameters and advanced parameters been changed from the default. If so, has it been justified?	Inherited from EA model			

2D MODEL BUILD

DIGITAL TERRIAN MODEL					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
7.1	Number of domains?	2			
7.2	Area of 2d domain/s	195 Hectares			
7.3	What dataset has been used to define the DTM elevations? LiDAR, Photogrammatic DTM?	LiDAR			
7.4	What grid resolution has been used? Is it suitable to accurately represent flow paths, e.g. between buildings?	4m			
7.5	Has the DTM been rotated to optimise flow route representation? <i>Check Loc file or TCF</i>	No			
7.6	Obstructions to flow (or not an obstruction to flow)?				
7.7	Has additional site specific topographic survey data been used? <i>If topographic data sets have been overlaid, check that the resultant topography is correct</i>	Yes			
7.8	How have buildings been represented within the DTM?	Yes			
7.9	Are defences/embankments/bank crests accurately represented?	Yes			

7.10	If post-development scenarios are required have the proposed ground levels and building been represented appropriately?	Yes			
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2D BOUNDARIES & ROUGHNESS

2D BOUNDARY CONDITIONS					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
8.1	Have any boundaries been used in the 2D domain? If so detail.	no			
8.2	Is the model boundary suitably large? i.e. the flood extent should not reach the boundary. <i>Check that the largest modelled flood extent does not intercept model extent i.e. glasswall. Can check with the code layer</i>	some glass walling at highest return periods at a distance from site. Unlikely to affect results			
8.3	Has rainfall been applied directly to the 2d model domain? <i>If so, how has it been applied? Are runoff/infiltration coefficients appropriate?</i>	No			

2D ROUGHNESS					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
9.1	What manning's n values have been used to define floodplain roughness? Have they been applied correctly? <i>Typical Manning's n values can be found in the fluvial design guide chapter 7 page4:</i>	Inherited from EA model mostly. Value vary and look suitable			
9.2	What methods have been used to estimate roughness? <i>(USGS, Chow, etc. based on survey, photographs OS mapping)?</i>	Inherited from EA model mostly			
9.3	Is the representation of different roughness areas sufficiently accurate and detailed?	Yes			

2D STRUCTURES

2D STRUCTURES					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
10.1	Have any structures been included in the 2D domain? If so how have they been represented? (ESTRY control files?)	culvert through site			
10.2	Are invert levels correct compared to survey data?	N/A			
10.3	How have defences been represented? Zline? If there are flood zone scenarios have the defences been excluded adequately?	zln_zpt			
10.4	Have appropriate loss coefficients and roughness values been used?	yes			

2D RUN PARAMETERS

INITIAL CONDITONS & OTHER RUN PARAMETERS					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
11.1	What time step has been used for the 2D model? Is it appropriate? As a rule, the time step in seconds should typically be of the same numerical order as the half the cell size in metres. For steep models where high velocities are experienced, a smaller timestep may be required	2 seconds			
11.2	Have initial water levels been applied? Are they correct?	yes			
11.3	What initial conditions have been used? Steady state, hotstart file?				
11.4	Are the other 2D model parameters reasonable (e.g. flooding & drying, eddy viscosity). Are they different from default?	acceptable			

1D/2D MODEL LINKS

MODEL LINKS					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
12.1	How have the 1D/2D models been coupled, is it appropriate?	appropriate			
12.2	Is the digitisation of the links acceptable? Have any modifications to link levels been made? Do CN lines look appropriate?	appropriate			
12.3	Is the 2d representation of the river channel comparable in width with the 1d model cross sections?	appropriate			
12.4	Representation of 1D output in 2D domain	appropriate			
12.5	Have any default link parameters been changed (i.e. to improve stability)?	No			

MODEL STABILITY

1D MODEL STABILITY					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
13.1	Errors/Comments/Warnings?	Some inherited from EA model, not thought to affect results			
13.2	Convergence <i>Check zzd file and bitmaps</i>	100%			
13.3	Does a basic check of animations and graphed outputs give an indication of good model stability? <i>Check long section and time series plots</i>	Yes			

2D MODEL STABILITY					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
14.1	IS mass balance within tolerable limits? Mass balance error < ±1%	Yes			
14.2	Are CE and dV values relatively stable and remain so once the run has got going. CE- mass error, dV = change in model volume per display time in m3	Yes			
14.3	Errors/Comments/Warnings?	Inherited from EA model, not thought to affect results			
14.4	Negative Depths; <i>Check tuflow messages layer</i>	N/A			
14.5	Does a basic check of animations and graphed outputs give an indication of good model stability?	Yes			
14.6	2d extents and outputs Do extents look sensible? Are there clear flow routes? Any 'disconnected' areas? Check that area increases with return period.	Yes			

MODEL OUTPUTS & CALIBRATION

CALIBRATION/VERIFICATION					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
15.1	Have calibration runs been completed? Is data for calibration available? Gauge data, extents, anecdotal etc.	Inherited EA model N/A			
15.2	Are the simulated hydrograph peaks reasonably similar to the recorded peaks? Within 250mm is recommended in the fluvial design guide	N/A			
15.3	Is the shape of the simulated hydrograph and therefore the volume suitably similar? Scope guidance often suggests the mean error plus one standard deviation of the error should be within 150mm.	N/A			
15.4	Are simulated floodplain extents similar to recorded extents? Are flow routes similar?	N/A			
15.5	Has suitable effort been made to attempt and improve calibration. Have attempted changes been documented with a quantification of impact? Roughness changes, structure coefficient changes, antecedent conditions	N/A			
15.6	If no historic data is available, are the simulated flood outputs similar or very different from past modelling in the area? If there is a large difference, does it seem sensible?	Yes			

MODEL SENSITIVITY

SENSITIVITY TESTING & UNCERTAINTY					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
16.1	Have appropriate model parameters been chosen for sensitivity testing? Typical tests include: ☒ $\pm 20\%$ Mannings n (1D and 2D) ☒ Design Flow (upper and lower confidence intervals - 95%, or 68% if 95% is deemed too wide) ☒ Downstream boundary ☒ Key structure blockage(s)	Inherited EA model N/A			
16.2	Do the results of the tests show the models to be particularly sensitive to certain parameters?	N/A			
16.3	Have confidence limits for model results (+/- mm) been presented? How were they derived and does this seem sensible?	N/A			

AUDIT TRAIL

AUDIT TRAIL					
Item No.	Item Checked	Comments	Actions	Consultant Response (DATE)	EA Response
17.1	Was a model run log provided?	Yes			
17.2	Was a suitable file naming, structure & management system used?	Yes			
17.3	Were check files provided?	Yes			
17.4	Were comments provided within the model? Explanations of units or bridge names for example	Yes			
17.5	Was there good version control? Is the model history detailed where applicable?	Yes			
17.6	Were Errors / comments / warnings made available?	Yes			
17.7	Was a technical overview of the model and its background provided (usually covered in the model report)	Yes			
17.8	Were notes on how the model operates under different flow conditions provided?	No			
17.9	Was an explicit statement of any concerns about the accuracy of the model or its ability to represent reality provided?	No			
17.10	Is there anything else missing or are there suggestions for additional information or clarification?	No			