

From: Brown, Sophie [REDACTED]
Sent: 16 July 2024 13:53
To: [REDACTED] Ian Johnson; Venturini, Bruno (Guest)
Cc: Jessica Riches; PlanningSSD
Subject: AL/11/24/OUT - Land East of Westergate - Flood model 2024
Attachments: LIT 17617 - Non-real time Hydraulic model review East_Westergate_ICM.xlsm

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Dear All,

We have received the model review back from our national Evidence and Risk Team. The model is currently deemed **not fit for purpose**, so can not be used to properly inform on the flood risk associated with the proposed crossing of the Lidsey Rife.

Please see the attached excel spreadsheet (please address red and amber boxes) and below comments.

The reviewer has highlighted that the key issues with the model to focus on are:

- The model can't be re-run. It doesn't get past the initialise phase. Check the initialise phase of job runs and investigate failed nodes/links.
- Improved documentation making it much clearer for the reader/reviewer what the changes made to the model are and any assumptions/justifications listed.
- Modify the junction in the area of interest to correctly route flow pathways.
- Review how the subcatchments are schematised to understand the effect this will have on flow.
- Check the upstream inflow boundary conditions into the model streams. Current schematic is a 1D outfall, should be 2D and refine the placement of the banklines.
- Correctly re-run the sensitivity runs as described in the modelling report.

We require the above to be satisfied before we can advise on the proposed development.

Kind regards

Sophie

Sophie Brown

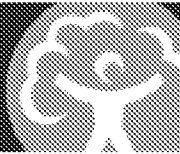
Planning Specialist, Sustainable Places Solent and South Downs
Environment Agency | Oving Road, Chichester, West Sussex, PO20 2AG

Working days: Monday to Thursday

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**Creating a better place
for people and wildlife**



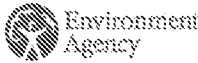
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Content details

Title	Non-real time Hydraulic Model Review Template
Audience	Environment Agency, Defra
Type	Template
Reference	LIT 17617
Version	6.0
Security marking	OFFICIAL

CONTROLLED CONTENT

NON-REAL TIME HYDRAULIC MODEL REVIEW



Type of review

Fluvial/tidal 1D model

Project	Land East of Westergate	Job Number		Required coastal standard (if applicable)	
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Model Type	1D/2D	Software	Other	2nd review	3rd review	4th review
Revision	1	Date	11/07/2024			
Area Client		Reviewer	CM			

REVIEW SUMMARY/CONCLUSION

Is the model suitable for intended use?

The model and associated report are poorly documented. There are no comments given in previous versions of the comment history which would aid the reviewer in determining the changes which have been made. Modifications to the model and associated data sources have not been assigned flags in a comprehensive way. There are some flags in the model but they are not given any description so do not add anything of value. The naming conventions of the model have not been managed, so many of the modelling objects have names that end in "!!" (meaning they are copies). The information given in the associated modelling report is also very high level, making it more difficult to understand the reasoning for different modelling decisions. It is not possible to ascertain from the modelling report, or the model data given, what work was done by WSP and what is the previous work of other consultants. Without this information it is difficult to distinguish what is new and what is old, and importantly what QA process was undertaken by the modelling team. The modelling report gives very little information on the depth of review undertaken prior to subsequent work.

Sims have not moved past the initialise stage of model runs, so we have not been able to confirm that the model runs are suitable. This is a critical part of the model review, which will need to be addressed by the modelling team. There have also been a number of GIS layers which were missing from the data transferred over. This data appears to be more illustrative and not necessary to complete model runs, but some confirmation on their presence and if they are needed should be included in the update to this review.

In the domain there are various modelling components which are not explained in the reporting - most notably the schematic of the upstream outfalls and the selection of buildings for subcatchments. In both cases, these appear to be schematised incorrectly and could have large potential impacts on the final modelling outcome/result. In both cases these could be older modelling decisions not made by the current modelling team, but there is no information in the report which suggests they have considered these issues and how they might affect the final model output.

The key issues with the model to focus on are:

- The model can't be re-run. It doesn't get past the initialise phase. Check the initialise phase of job runs and investigate failed nodes/links.
- Improved documentation making it much clearer for the reader/reviewer what the changes made to the model are and any assumptions/justifications listed.
- Modify the junction in the area of interest to correctly route flow pathways.
- Review how the subcatchments are schematised to understand the effect this will have on flow.
- Check the upstream inflow boundary conditions into the model streams. Current schematic is a 1D outfall, should be 2D and refine the placement of the banklines.
- Correctly re-run the sensitivity runs as described in the modelling report.

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 amendments 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 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 priority of the actions required (if any).

Colour coding used:

– Good practice.
Minimum response: No minimum.
Maximum expected response: No maximum.
Planning: No Objection.

– Consider for future studies. Negligible impact on the results that is unlikely to change the outcome of the study.
Minimum response: Acknowledge the comment in the spreadsheet and update the limitation section of the report.
Maximum expected response: Actions done to address the issue identified.
Planning: No Objection.

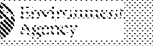
Note: Taking action to address issues would be expected and some issues may be addressed coincidentally by work on others.

– Follow recommendation. Potential impact on the results that may change the outcome of the study.
Minimum response: Comments justifying the approach taken and update the limitation section of the report if not sorted.
Maximum expected response: Actions done to address the issue identified.
Planning: Consider objecting to the application based on comments highlighted in this category.

Note: Taking action to address issues should be undertaken, some issues may be addressed coincidentally by work on others.

– Must do. Has an impact on the results that may have a significant impact on the outcome of the study.
Minimum response: Comments thoroughly justifying approach from applicant based on evidence and update the limitation section of the report if not sorted.
Maximum expected response: Actions done to address the issue identified.
Planning: Objection - Application to be objected if comments are highlighted in this category.

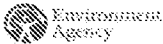
Note: If no action is taken the response must clearly demonstrate why the issue raised is not relevant and the approach employed is justified backed up with evidences. If issues highlighted red are ignored, then submissions should always be sent back.

MODEL APPROACH & SUMMARY														
														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
1.1	What model approach has been adopted? Is it appropriate? (e.g. new 1D/2D build, existing model truncation, 1d only?).	Amber	ICM model is a modification of an already existing ICM model of the area. 1D-2D overland flow is appropriate to account for the interactions between water sources, storm networks and across the catchment. Subcatchments used for routing of direct rainfall but only partially complete. River reach junctions are not properly formed with banks not well-defined.	Review the subcatchment and bankline representations, as detailed in model build sections and update model or add justification to model report.										
1.2	Software used, including versions?	Green	Report states that model licensed to user was 2015 Infoworks Aldingbourne Model, opened by reviewer in ICM.	update to the most recent version of ICM is advisable but not essential.										
1.3	Model Version Reviewed	Amber	Name of network being reviewed: RF2022_Run_100yr_WSP out model_Updated from JBA_v2_com130_V84 Different network to latest (v90) which appears in the geoplan. Unclear what scenario is equivalent to v84.	Better documentation of the version control, explanation of which network to look at, with references in the model report explicitly saying which model versions are the correct versions.										
1.4	Are all model files provided?	Amber	Missing model files from the GIS layer, ICM sent warnings about missing shapefiles and tifs, which have previously been loaded.	Update on what this data is and whether it is relevant. Also it should be documented in the modelling report.										
1.5	Does the model run?	Red	Models begin initialisation but this continues indefinitely. The model fails at this location. Node 19.018 (break node) Link: 19.018.1 (Clvin link) Unclear what the source of the fail is. Model results provided show some instability at this location.	This instability needs to be addressed and understood. This node/link has been identified as a point of failure but there are potentially other locations which also fail.										

EVENTS & SCENARIOS														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
2.1	What events have been simulated (Q5, Q100, Q100CC, Q1000)? Are they sufficient to meet the project requirements?	Green	Q100 event has been simulated, for present day and two climate change conditions (20 year and 25 year epochs), with a 10.25hr storm duration, using a winter profile.	Other events could be run to make sure the EA model is accurately reproduced across a range of flows.										
2.2	Is a development being modelled? If so are appropriate scenarios modelled to assess the impact?	Amber	Development being modelled is looking at 1 in 100 year plus climate change scenario, so current events chosen are appropriate. There is a map in the FRA which contains the red line boundary, but how this translates to ICM is not clear. Ideally shapefile should be available to bring into ICM GIS Manager.	Make shapefile of the red line boundary available and focus on model outputs in this region.										
2.3	Flood Mapping scenarios?	Red	Report explains scenarios to be related to the cutting of the original EA model. Baseline and sensitivity scenarios have been defined but as discussed these are not currently correctly run.	Correctly run all flood mapping scenarios.										
2.4	Have climate change runs been undertaken?	N/A	Climate change runs have been undertaken alongside the 100 year present day event. There are two scenarios which increase the direct rainfalls by 20% and 25%, which corresponds respectively to 36% and 64% flow increases.	climate change to be covered in hydrology review										
2.5	Has a study for quantifying uncertainty been undertaken? If yes, what are the results?	Amber	A sensitivity model run has been included, with a scenario of +20% Manning's n and reduction of Railway Arch culvert area. Review of the model objects seems to show the relevant objects as not being updated correctly (see Model_Sensitivity tab). No uncertainty analysis undertaken.	Review the objects of interest for the sensitivity analysis, check if the parameter values are correct and re-run if not.										

10 NETWORK														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
3.1	Model overview. Node Summary 1d length	OK	Nodes Total: 1505 Nodes Manholes: 719 Nodes Storage: 1 Nodes Break: 750 Nodes Outfall: 30 Nodes Pond: 0 Nodes 2D: 5 Pipes: 879 Channels: 0 Rivers: 265 Bridges: 11 Orifice Fixed: 16 Orifice Variable: 0 Pump Fixed: 4 Pump Variable Speed: 0 Pump Screw: 0 Pump Roto Dynamic: 0 Pump Variable Frequency Drive: 0 Sluice Fixed: 14 Sluice Variable: 0 Weir Fixed: 1 Bar Screens: 15 Flap Valves: 8 Culvert Inlets: 157 Culvert Outlets: 161	no action										
3.2	Have appropriate distances between sections and/or nodes been used (dx)?	Green	As per Fluvial Design Guide, most channels are appropriately spaced (less than 20' channel width), with few exception near the following cross-sections: 1.029 7.048 7.049	Review the fluvial design guide and how it is applicable for ICM models. Add a note in report about cross-section spacing. Review the location of cross-sections such that changes in river width and gradient are captured in addition to acceptable chainage between sections.										
3.3	Are out of bank flows represented in 1d? If so, how has it been done and is it appropriate?	Green	No. out of bank flows represented by 2D zone. Representation done with the use of banklines and inline banks which are located at local high points in the DTM. In some areas online storage is represented as a river reach, this would have been better as a storage node. See 2D review section for more details.	not best practice in all locations but no changes required.										
3.4	Is the model geo-referenced?	OK	Model is referenced to British National Grid.	no action										
3.5	Do the cross sections and bed profiles look reasonable?	Amber	Most cross sections look reasonable. There are a few where the banks suggest that online storage is present. In this case, a single cross section does not correctly represent this feature. Example cross sections: 5.013 21.006	Review these; consider the use of a storage area which could better represent the attenuation.										
3.6	Chainage – compared to surveyed sections	N/A	Survey data not provided as a part of the review.	no action										
3.7	Does conveyance look appropriate?	Green	Conveyance looks mostly appropriate. Conveyance of sections at the river reach downstream of the area of interest shows some irregularities in the conveyance graphs. River reach ID: 1.014kds.	Review conveyance and panel markers to understand irregularities in conveyance plot.										
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	Gauged flow not provided as a part of the review.	no action										
3.9	Bank Markers. Are they used and if so are they suitably located?	Green	Bank markers appears to be largely suitable.	Instances of bank markers being out of place or repeated across sections, could review and modify to make improvements.										
3.10	What approach to channel roughness has been used?	Green	Roughness zones have been applied to the locations of the channels, meaning that the channel roughness of the river reaches will inherit these values. The evidence to support roughness selection, or where roughness was updated, has not been presented in the report.	update report										
3.11	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?	Amber	Channel roughness's are mostly within the normal range. There are two channels with higher roughness values (199,208) which are just within the acceptable boundaries of Chow.	Confirm that these sections are being accurately represented.										
3.12	What method has been used to estimate roughness (USGS, Chow, etc. based on survey, photographs)? Are they appropriate	Green	Method of roughness estimation not detailed in the report to be added to the report.	Add roughness methodology to the report.										

1D BOUNDARY CONDITIONS														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
4.1	1d boundary model domain; is there glass walling anywhere in the modelled reaches?	Green	Model uses normal depth condition	no action										
4.2	How have the inflows boundaries been applied?	Amber	Outfalls have been placed at the upper end of the river reaches, which are intended to serve as interfaces from the direct rainfall further upstream. Some upstream points are missing these inputs.	Upstream points need checking (for example, see breakpoint 6.016, which has a large channel upstream currently disconnected).										
4.3	How is the downstream boundary(s) applied?	Green	Comprised of outfalls located far downstream of the point of interest. Model suitability lowers DS of the scheme but it is good enough to provide a DS boundary.	no action										
4.4	If tidal - how has the boundary been derived?	N/A	No tidal component needed in this model.	no action										
4.5	Have appropriate locations been chosen for the downstream model extents?	Green	Downstream extent is beyond railway culvert, which is appropriate to ensure there won't be backwater effects. We note some instability where water backs up at the throttle.	no action										



1D STRUCTURES

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5.1	Are all structures represented? If not have explanations for structures not modelled been given in the Log/report?	N/A	All structures were a product of previous iterations of model build. No further reference made to changes in structures in the modelling report.											
5.2	Are invert levels correct compared to survey data?	N/A	No survey data given for review.	no action										
5.3	Do bridges surcharge? If so has orifice flow been enabled?	N/A	2 Bridges present in the 2D zone, one of which is expected to surcharge.	doesn't apply to ICM										
5.4	Are there spills around the structure or over the top represented appropriately?	Amber	A blend of approaches. Spills are represented through the use of inline banks. Bridge decks use the weir equation. Conduits have been modelled with an irregular weir to capture any overtopping flows. Some structures causing initialisation issues	update the report to identify any structures that have been updated. Fix initialisation issues.										
5.5	If there are any movable structures have they been modelled correctly?	N/A	No movable structures listed in the modelling report.	no action										
5.6	Structure coefficients - Have they been changed from default values?	Green	For all bridges: Discharge coefficient of 1.7 used Modular limit of 0.9 used For conduits, Colebrook-White roughness = 0.8mm Manning's roughness = 0.02	No observations presented to support these values however standard assumptions so no action required.										

1D RUN PARAMETERS

1D RUN PARAMETERS														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
6.1	What time step has been used for the 1D model? Is it appropriate?	Green	5 second timestep used, results outputted every 5 minutes.	1 second max timestep for final runs is preferred. However 5 seconds is acceptable. Report to be updated to show timestep sensitivity.										
6.2	What initial conditions have been used? Steady state, hotstart file?	Green	2D Initial conditions used which set soil moisture content of infiltration zones to 100%.	Not clear what the use of infiltration zones is, if the soil moisture content is set to 100%, as will produce 100% runoff? Add some justification/commentary in the model report.										
6.3	Have any of the parameters and advanced parameters been changed from the default. If so, has it been justified?	OK	Advanced modelling parameters are the same.	no action										

2D MODEL BUILD

DIGITAL TERRIAN MODEL														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
7.1	Number of domains?	N/A	doesn't apply to ICM	no action										
7.2	Area of 2d domain/s	OK	6597.501ha. Domain could have been further reduced in size which would have improved performance.	no action										
7.3	What dataset has been used to define the DTM elevations? LiDAR, Photogrammetric DTM?	Green	According to the modelling report, the ground model is a mosaicked DTM of 1m and 2m resolution ASCII tiles. These tiles are derived from Lidar. The source is not specified.	update report with source										
7.4	What grid resolution has been used? Is it suitable to accurately represent flow paths, e.g. between buildings?	Green	Mesh zones have been deployed across the area of interest to reduce the mesh sizes. In this area, mesh sizes range between 25-50 m ² , which appears suitable in relation to the layout of buildings. This could be improved by using terrain sensitive meshing and setting a max elevation change between elements.	no action										
7.5	Has the DTM been rotated to optimise flow route representation?	N/A	doesn't apply to ICM	no action										
7.6	Is there any obstruction to flow?	N/A	no obstructions in the area of interest in 2D	no action										
7.7	Has additional site specific topographic survey data been used?	Green	Site topo of point of interest has been included, does not seem to be used for the network build.	Discussion of comparison of topo vs Lidar should be included in the modelling report.										
7.8	How have buildings been represented within the DTM?	Green	Buildings have not been represented in the DTM, but as separate flow constricting objects (see 2D_structures tab).	Would be more appropriate to model the buildings as raised platforms due to the hydraulics of surface water flooding.										
7.9	Are defences/embankments/bank crests accurately represented?	Red	Model report specifies there are no defences along the modelled watercourses. No survey present to check bank heights. A check of river reaches shows that some crests are not aligned with the bank heights. For example, right bank of 20.014, rows 13-14 has a bank height section of 10.015 mAOD to 9.898 mAOD. However in the Lidar there is a crest elevation of 10.4-10.6 mAOD for this section of reach. Inside of the mesh zone of interest there are also some examples of the same problem. For example, river reach 1.0251, row 10 the bank level is 8.897 m AOD, however there is a crest of 9.2 m AOD. River reach 1.027.1 also need review as the right bank has been schematised in such as way that it appears to be on the slope of a larger channel.	Review banklines and correct where appropriate.										
7.10	If post-development scenarios are required have the proposed ground levels and building been represented appropriately?	N/A	No post-dev modelling performed, therefore future use of model only acceptable as a baseline and additional modelling inputs needed for post-development modelling.	no action										

2D ROUGHNESS														
Item No.	Item Checked	RAG	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG	2nd Review Comments	2nd Review Response (DATE)	RAG	3rd Review Comments	3rd Review Response (DATE)	RAG	4th Review Comments	4th Review Response (DATE)
8	What manning's n values have been used to define floodplain roughness? Have they been applied correctly?	Green	Baseline roughness of 0.06 applied across the 2d zone, which is suitable for floodplain roughness. Other roughness zones across the domain range between 0.04-0.1, which are all within the range given by Chow. Flags not used.	Flags should be added to model which corresponds to commentary in model report justifying roughness values.										
8.1	What methods have been used to estimate roughness?	Amber	No details given about sources or reasoning for roughness values. Model report states roughness has been set to different values but doesn't specify method.	Specify reasoning for changes in roughness in report										
8.2	Is the representation of different roughness areas sufficiently accurate and detailed?	Red	See above, no supplementary information is given to determine if this is true.	See above.										

2D BOUNDARIES														
2D BOUNDARY CONDITIONS														
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9.1	Have any boundaries been used in the 2D domain? If so detail.	Green	Boundary of the 2D zone has been given a normal condition to allow flow to leave any point downstream. No details in modelling report to but normal condition is generally the most appropriate condition.	Comment on suitability of normal condition for the DS boundary conditions in the model report.										
9.2	Is the model boundary suitably large? i.e. the flood extent should not reach the boundary.	OK	Downstream boundary is suitably large for the area of interest, with the relevant downstream boundary	no action										
9.3	Has rainfall been applied directly to the 2d model domain?	OK	Rainfall has been applied directly to the 2d domain, it is not applied to subcatchments	no action										
9.4	Coastal - How has the wave overtopping been applied?	N/A		no action										

2D STRUCTURES

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10.1	Have any structures been included in the 2D domain? If so how have they been represented?	Green	Buildings represented as porous polygons. With a porosity of 0.025 (97.5% reduction in flow), and infinite crest height. In essence, buildings have been modelled as obstructions to flow. Subset of buildings have also been represented as subcatchments. (see 1D_2D_Surface_Water tab)	Comment on the use of porous polygons in the modelling report and consider if representing the buildings as raised platforms would be more appropriate. Given the depths of pluvial flows, using a raised platform will more realistically represent the flow constrictions, overland flow can also be deflected by minor walls etc. review critical flow paths to ensure that these are accounted for.										
10.2	Are invert levels correct compared to survey data?	N/A	No survey data supplied.	no action										
10.3	How have defences been represented? Zline? If there are flood zone scenarios have the defences been excluded adequately?	N/A	As mentioned in the report, no defences present in the model.	no action										
10.4	Have appropriate loss coefficients and roughness values been used?	N/A	no 2d bridges, buildings already discussed	no action										

2D RUN PARAMETERS

INITIAL CONDITIONS & OTHER RUN PARAMETERS														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
11.1	What time step has been used for the 2D model? Is it appropriate?	Green	2d timestep linked to 1d, see previous comments in 6.1	no action										
11.2	Have initial water levels been applied? Are they correct?	Green	ground infiltration at 100% no discussion in report	discuss in report										
11.3	Are the other 2D model parameters reasonable (e.g. flooding & drying, eddy viscosity). Are they different from default?	N/A		no action										

1D/2D MODEL LINKS														
MODEL LINKS														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
12.1	How have the 1D/2D models been coupled, is it appropriate?	Amber	Main 1D-2D linkages are via the river reaches, specifically the banklines. These have been given inline bank structures to allow exchange between 1D and 2D. Upstream ends of river reaches are linked to 2D domain with a bankline and inline bank, connecting to an outfall. The schematic here seems to be allowing 2D overland flows to enter the 1D systems when they reach sufficiently far downstream. For 1D-2D linkages, the 2D outfall should be used as this allows the free exchange of water in both directions. The use of a bankline should be reviewed to cover the top end of the river reaches. The current schematic is producing irregular mesh element geometries which can be corrected at relatively low effort. The schematisation located upstream of break node 1.024!! needs to be reviewed. It appears to be a very unusual representation of a local hydraulic system, and it is unclear what the intended use is. Banklines need additional work at the junctions, particularly within the point of interest. See storage area 1.018!. Model runs are showing that there is a flow pathway which flows directly over the channel junction, but as there are not correctly schematised inline banks / banklines, it is not entering the watercourse correctly.	Review of linkages as described in the comment. Either change the way these are schematised in the model, or add some notes about the schematics in the report.										
12.2	Is the digitisation of the links acceptable?	N/A	see comments above	see comments above										
12.3	Is the 2d representation of the river channel comparable in width with the 1d model cross sections?	OK	Widths appear to match between 1D and 2D.	no action										
12.4	Representation of 1D output in 2D domain	N/A		no action										
12.5	Have any default link parameters been changed (i.e. to improve stability)?	OK	For river banks, the following loss parameters used: Discharge coefficient = 1.1 Modular limit = 0.9	no action										

SURFACE WATER MODELLING													
Item ID	Item Checked	RAG	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG	2nd Review Comments	2nd Review Response (DATE)	RAG	3rd Review Comments	3rd Review Response (DATE)	RAG	4th Review Comments
15.1	Check the geographical coverage of the model relative to the surface water catchment for the study. Is the model coverage sufficient for the study or project?	OK	model appears to cover the topographic catchment to the rivers of interest. Catchment delineation could have been discussed in the report for clarity.	no action									
15.2	Have contributing areas been applied appropriately? Are the sub-catchment boundaries geocoded? Do the impermeable area assumptions appear correct?	Red	Subcatchments have been used to collect stormwater from buildings located on site. However, only a subset of buildings have been given subcatchments. These have slightly different geometries to the previous polygons, indicating that they are sourced from a different dataset. It appears from the modelling report that the subcatchments were added in a previous version of the model, however it is still unclear why so many of the buildings are disconnected from the storm sewer system. At the point of interest, in the mesh zone with the smallest elements, approximately 25% of the buildings have been schematised as subcatchments. If these buildings were connected to a storm system and routed to the nearest channel (higher likelihood than disconnected buildings), then there would probably be a significant change in the river discharges.	Review the subcatchment arrangements for the areas upstream of point of interest. Modify the model to include more subcatchments or add some text to the report outlining how this is a limiting factor to the current model runs. Consider accounting for paved areas as impermeable along with roofs.									
15.3	How has the surface water network been represented, is it suitably detailed?	Amber	Storm network has been included in the model, and all of the parameters appear to be included and accounted for. No background information has been supplied to check whether the level of detail is suitable. With reference to above, many of the buildings appear disconnected from the network. This needs to be confirmed as appropriate.	Determine suitability of subcatchment layout and if it properly represents stormwater drainage. Present in report.									
15.4	Does the overall model connectivity match the sewer records?	Amber	No sewer record has been provided.	provide sewer record									
15.5	How are receiving watercourses represented in the model? Is this appropriate?	Green	Receiving watercourses are appropriately represented in the model. Issues regarding the upstream boundary, inline storage, 1d structure stability etc. discussed elsewhere.	no action									
15.6	Has storage compensation been applied? Is this appropriate?	OK	this isn't a network model, so aspects like this aren't essential, compensation not applied.	no action									
15.7	Has storage compensation been applied? Is this appropriate?	OK	this isn't a network model, so aspects like this aren't essential, compensation not applied.	no action									
15.8	Are there any backfalls in the model and do these look realistic where they exist?	Green	There are 48 links with a gradient less than 5. One example is 15.024, a 1, shows a gradient of -0.12. This is due to the US invert level being listed as 7 m AOD and the SB level being 7.22m AOD. This does not match what is seen in the DTM at these locations. There are similar examples for the backfalls which are larger, occurring at the locations there are culverts.	Locations should be reviewed and checked that the backfalls are sensible.									
15.9	Have sediment depths and roughness coefficients been applied appropriately and are they within the expected ranges?	Amber	Roughness appears to be modelled appropriately as discussed in the 1D model section, although there is no justification given by model report so not able to confirm.	Confirm justification for the different roughness values used.									
15.10	Are all significant outfalls included in model with appropriate detail?	Green	All significant outfalls (culvert outlet, flap valves) have relevant parameters to run correctly. No survey data available to confirm accuracy of parameters. However, as discussed in 1D-2D linkage sections, there are some schematics with outfalls that appear to be quite unusual model choices. These should be reviewed.	Review outfalls and determine their suitability. Add a note to the model report.									
15.11	Are all significant storage tanks included in model with appropriate detail?	Green	One storage node present in model, called SZ359665P. This is modelled as the downstream end of a conduit, with a fixed pump that takes water and add it to another culvert. No further details known to ascertain whether this is an appropriate schematic.	Review this schematic, and determine its validity. Add note to model report.									
15.12	Are all significant pumping stations included in the model with appropriate detail?	Green	Small number of pumps in model, but in locations far away from point of interest. They have acceptable parameter values in the geoplan and are not specified in the modelling report.	update report									
15.13	Has any infrastructure been omitted from the model network? If so what is the justification for this that? Is this appropriate?	Green	11 conduits omitted according to the modelling report, to improve the model stability. As demonstrated these are far downstream from the development of interest.	update model report to list conduits removed and why.									
15.15	Is the runoff model appropriate and have the parameters been applied correctly?	Green	Runoff model used simulates the roofs as runoff surfaces. No description given in modelling report, so likely performed before latest updates. Runoff rate is 0.95 which is suitable.	Review and confirm that the runoff surface parameters specified are satisfactory and will not impact the outputs of the model.									
15.16	How has the design rainfall been generated and applied? Is this appropriate?	OK	FEH2022, Justification given in the modelling report.	no action									

MODEL STABILITY

1D MODEL STABILITY														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
13.1	Errors/Comments/Warnings?	Amber	Warnings in the model logs related to the presence of flow reversals near many banks. Likely due to surface water pooling and entering into the watercourses. Warnings related to depths at various sections exceeding the section height. Also some warnings about inverts and soffits being above ground levels, which will be justifiable given the culvert systems present in the	Warnings should be summarised and explained in the report, to show evidence that model diagnostics taken place.										
13.2	Convergence	Red	Models currently not able to be re-run due to convergence issues, relating to: Node 19.018 (break node) Link: 19.018.1 (Clvin link) All models failing. See Model Approach tab.	Seen action in Model Approach tab.										
13.3	Does a basic check of animations and graphed outputs give an indication of good model stability?	Amber	Model results which have already been sent us shown reasonable stability, with small oscillations present in the model but at levels which are mostly acceptable. Conduit 1.014_us has been checked, as this is downstream of the point of interest. There is evidence of instability, but this could be due to the complex out of bank flows at this location which appear to be oscillating. Stability will need to be reconfirmed once models can be re-run.	Confirm stability after re-run of models.										

2D MODEL STABILITY														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
14.1	Is mass balance within tolerable limits?	Green	Mass balance volume errors are very low in the model results supplied, maximum of 0.0026%. This will need to be checked again	Mass balance error will need checking following updated model runs. Summarise model mass balances.										
14.2	Are CE and dV values relatively stable and remain so once the run has got going.	Amber	Vast majority of new nodes have no mass balance error, but there is one with a mass error of ~37%. This is node 1.0301.	Review node and attempt to modify to reduce mass error.										
14.3	Errors/Comments/Warnings?	Green	Some minor warnings for 2D area: "W2508: hw_mesh_zone, BRC, max_triangle_area, Maximum triangle area recommended to be greater than minimum element area on 2d zone catchment" "W2285: hw_2d_zone, catchment, mesh_data, Element 67125 has area (0.013m2) less than 50% of minimum element area (100.000m2)"	Add information on model warnings in diagnostic section of report, review and consider if improvements can be made.										
14.4	Negative Depths	OK	No negative depths recorded.	no action										
14.5	Does a basic check of animations and graphed outputs give an indication of good model stability?	Green	Overview of model runs shows that the model has generally good stability, with cases of out of bank flows oscillating.	Review out of bank flows and determine if changes needed given the placement of oscillations. Make reference in modelling report.										
14.6	2d extents and outputs	Green	Outputs as seen in the geoplan are suitable. Some instability around drowned 1d rivers but DS of the area of interest.	no action										

MODEL OUTPUTS & CALIBRATION

CALIBRATION/VERIFICATION														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
15.1	Have calibration runs been completed? Is data for calibration available? Gauge data, extents, anecdotal etc.	N/A	Model has been updated to match prior EA runs, but no calibration data provided. There was flooding recorded in 1993 that could be used to verify model results. This will be covered in the hydrology review.	no action as this is a model review										
15.2	Are the simulated hydrograph peaks reasonably similar to the recorded peaks?	N/A												
15.3	Is the shape of the simulated hydrograph and therefore the volume suitably similar?	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?	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?	N/A												

MODEL SENSITIVITY

SENSITIVITY TESTING & UNCERTAINTY														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
16.1	Have appropriate model parameters been chosen for sensitivity testing? Testing levels include: 1) Roughness coefficients ± 20% ± Manning's n 2) 200 to 10 and 10 to 200 3) Roughness coefficients ± 20% ± 100% (not assessed) 4) Sensitivity to downstream boundary 5) River network discontinuity	Green	Sensible parameters have been chosen for sensitivity testing. Roughness and downstream blockages have been chosen as suitable sensitivity tests and reviewer agrees these should be assessed.	Please update the report to show how sensitive peak water levels are, adjacent to the area of interest, for the standard sensitivity tests. Please summarise how sensitive the model is to various parameters and state percentage change.										
16.2	Do the results of the tests show the models to be particularly sensitive to certain parameters?	Red	Checks have been made on the results file for the sensitivity analysis model. It was found that the roughness has not been modified by 20% and the arch culvert has not had the cross sectional area reduced.	Correct the scenario/network and re-run the sensitivity tests. Modelling report partially summarises outcome of sensitivity test, but it does not quantify meaning of "high" sensitivity, and the differences of scenario to baseline are not quantified. This should be added to the modelling report once the model scenarios are run properly.										
16.3	Have confidence limits for model results (+/- mm) been presented? How were they derived and does this seem sensible?	Amber	no confidence limits presented	please present confidence limits										

AUDIT TRAIL														
AUDIT TRAIL														
Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
17.1	Was a model run log provided?	Red	Model run log not provided to give additional details regarding the model setup and details.	Provide model log.										
17.2	Was a suitable file naming, structure & management system used?	Amber	It was possible to distinguish model events in the naming convention but not very much else.	Consider a more appropriate naming convention.										
17.3	Were check files provided?	N/A		no action										
17.4	Were comments provided within the model?	Amber	No comments provided in the model.	Add comments to model where appropriate.										
17.5	Was there good version control? Is the model history detailed where applicable?	Red	No information on version control and commit history in the model.	Add notes to commit history. Clearly signpost at what commit version the model was received and comment on review conducted at this moment.										
17.6	Were Errors / comments / warnings made available?	Amber	Refer to model stability tab.	Refer to stability tab.										
17.7	Was a technical overview of the model and its background provided	Amber	Modelling report provides some information about the model but not much to assist in a model review.	Provide more details about technical details of model beyond just listing the different objects.										
17.8	Were notes on how the model operates under different flow conditions provided?	N/A		no action										
17.9	Was an explicit statement of any concerns about the accuracy of the model or its ability to represent reality provided?	Green	Modelling report explains particular circumstances for which intended use of model is applicable - the 36% CC event baseline flood extents.	no action, sensitivity comment address elsewhere										
18	Is there anything else missing or are there suggestions for additional information or clarification?	Green	JBA's model build report, survey, sewer records and evidence that modellers reviewed the incoming model sufficiently.	provide the review of the incoming model before updates, provide JBA model build report and any survey.										
18.1	Comment on the quality of the reports:	Amber	The quality of the reporting is quite poor, with figures and tables that give information on the model but does not help the reviewer understand the modelling choices made. More clarity would be useful for the modelling report, with a clearer overview of the prior review done of the model and more in depth descriptions of model runs and networks/scenarios used.	Review of the report, correct typos, add legends to figures, make figures clearer.										
18.2	is a freeboard analysis necessary? If yes have you review the report? What are is the agreed freeboard?	N/A	baseline model so not applicable	no action										

Additional Information

Item No.	Item Checked	RAG 1	1st Review Comments	1st Review Actions	1st Review Response (DATE)	RAG 2	2nd Review Comments	2nd Review Response (DATE)	RAG 3	3rd Review Comments	3rd Review Response (DATE)	RAG 4	4th Review Comments	4th Review Response (DATE)
100.1														
100.2														
100.3														
100.4														
100.5														
100.6														
100.7														
100.8														
100.9														
101														

TABLE 1. The 100 most common plant species (How, 1986)			
	Number	Area	Percentage
Major stream - minor stream gap width at			
1. <i>Menyanthes</i>	1.00	0.01	0.001
2. <i>Salix</i>	1.00	0.01	0.001
3. <i>Salix</i>	1.00	0.01	0.001
4. <i>Salix</i>	1.00	0.01	0.001
5. <i>Salix</i>	1.00	0.01	0.001
6. <i>Salix</i>	1.00	0.01	0.001
7. <i>Salix</i>	1.00	0.01	0.001
8. <i>Salix</i>	1.00	0.01	0.001
9. <i>Salix</i>	1.00	0.01	0.001
10. <i>Salix</i>	1.00	0.01	0.001
11. <i>Salix</i>	1.00	0.01	0.001
12. <i>Salix</i>	1.00	0.01	0.001
13. <i>Salix</i>	1.00	0.01	0.001
14. <i>Salix</i>	1.00	0.01	0.001
15. <i>Salix</i>	1.00	0.01	0.001
16. <i>Salix</i>	1.00	0.01	0.001
17. <i>Salix</i>	1.00	0.01	0.001
18. <i>Salix</i>	1.00	0.01	0.001
19. <i>Salix</i>	1.00	0.01	0.001
20. <i>Salix</i>	1.00	0.01	0.001
21. <i>Salix</i>	1.00	0.01	0.001
22. <i>Salix</i>	1.00	0.01	0.001
23. <i>Salix</i>	1.00	0.01	0.001
24. <i>Salix</i>	1.00	0.01	0.001
25. <i>Salix</i>	1.00	0.01	0.001
26. <i>Salix</i>	1.00	0.01	0.001
27. <i>Salix</i>	1.00	0.01	0.001
28. <i>Salix</i>	1.00	0.01	0.001
29. <i>Salix</i>	1.00	0.01	0.001
30. <i>Salix</i>	1.00	0.01	0.001
31. <i>Salix</i>	1.00	0.01	0.001
32. <i>Salix</i>	1.00	0.01	0.001
33. <i>Salix</i>	1.00	0.01	0.001
34. <i>Salix</i>	1.00	0.01	0.001
35. <i>Salix</i>	1.00	0.01	0.001
36. <i>Salix</i>	1.00	0.01	0.001
37. <i>Salix</i>	1.00	0.01	0.001
38. <i>Salix</i>	1.00	0.01	0.001
39. <i>Salix</i>	1.00	0.01	0.001
40. <i>Salix</i>	1.00	0.01	0.001
41. <i>Salix</i>	1.00	0.01	0.001
42. <i>Salix</i>	1.00	0.01	0.001
43. <i>Salix</i>	1.00	0.01	0.001
44. <i>Salix</i>	1.00	0.01	0.001
45. <i>Salix</i>	1.00	0.01	0.001
46. <i>Salix</i>	1.00	0.01	0.001
47. <i>Salix</i>	1.00	0.01	0.001
48. <i>Salix</i>	1.00	0.01	0.001
49. <i>Salix</i>	1.00	0.01	0.001
50. <i>Salix</i>	1.00	0.01	0.001
51. <i>Salix</i>	1.00	0.01	0.001
52. <i>Salix</i>	1.00	0.01	0.001
53. <i>Salix</i>	1.00	0.01	0.001
54. <i>Salix</i>	1.00	0.01	0.001
55. <i>Salix</i>	1.00	0.01	0.001
56. <i>Salix</i>	1.00	0.01	0.001
57. <i>Salix</i>	1.00	0.01	0.001
58. <i>Salix</i>	1.00	0.01	0.001
59. <i>Salix</i>	1.00	0.01	0.001
60. <i>Salix</i>	1.00	0.01	0.001
61. <i>Salix</i>	1.00	0.01	0.001
62. <i>Salix</i>	1.00	0.01	0.001
63. <i>Salix</i>	1.00	0.01	0.001
64. <i>Salix</i>	1.00	0.01	0.001
65. <i>Salix</i>	1.00	0.01	0.001
66. <i>Salix</i>	1.00	0.01	0.001
67. <i>Salix</i>	1.00	0.01	0.001
68. <i>Salix</i>	1.00	0.01	0.001
69. <i>Salix</i>	1.00	0.01	0.001
70. <i>Salix</i>	1.00	0.01	0.001
71. <i>Salix</i>	1.00	0.01	0.001
72. <i>Salix</i>	1.00	0.01	0.001
73. <i>Salix</i>	1.00	0.01	0.001
74. <i>Salix</i>	1.00	0.01	0.001

Manning's New Closed Conduits			
Flowing Partly Full (Chow, 1959)			
Type of Conduit and Description	Surface	Channel	Maximum
1. Steel			
a. Smooth			
Circular and welded	0.01	0.012	0.015
Circular, riveted	0.01	0.012	0.015
Rectangular, welded	0.01	0.012	0.015
b. Cast Iron			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
2. Aluminum	0.01	0.012	0.015
3. Concrete	0.01	0.012	0.015
a. Wrought Iron			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
b. Corrugated Metal			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
c. Cast			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
d. Steel			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
e. Aluminum			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
f. Concrete			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
g. Cast			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
h. Steel			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
i. Aluminum			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
j. Concrete			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
k. Cast			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
l. Steel			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
m. Aluminum			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
n. Concrete			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
o. Cast			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
p. Steel			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
q. Aluminum			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
r. Concrete			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
s. Cast			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
t. Steel			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
u. Aluminum			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
v. Concrete			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
w. Cast			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
x. Steel			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
y. Aluminum			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015
z. Concrete			
Circular	0.01	0.012	0.015
Rectangular	0.01	0.012	0.015

Mand's n for Corrugated Metal Pipe (AISI, 1980)		n
3. Average 247 x 22 inch (all diameters)		
16" diameter		0.025
18" diameter		0.012
20" diameter		0.011
4. Average 247 x 22 inch		
12" diameter		0.021
14" diameter		0.015
16" diameter		0.010
18" diameter		0.019
20" diameter		0.03
5. Average 247 inch (all diameters)		
12" diameter		0.027
14" diameter		0.022
16" diameter		0.023
18" diameter		0.022
20" diameter		0.027
6. Average 247 inch (all diameters)		
12" diameter		0.027
14" diameter		0.022
16" diameter		0.023
18" diameter		0.022
20" diameter		0.027
7. Average 247 inch (all diameters)		
12" diameter		0.025
14" diameter		0.018
16" diameter		0.03
18" diameter		0.025
20" diameter		0.025

Model	Review Type	RAG	Coastal standard	Software	Model Type	Area Name	Tab List	QAR Sheet
Coastal wave transformation only	Red	Strategic	ISIS/FMP	1D only	Cumbria and Lancashire	Model_Approach	FRA / Pre-App / ERR	
Coastal 1D inundation	Amber	Appraisal	FMP/TuFlow	2D only	Devon and Cornwall - East	1D_Model_Build	PDU	
Coastal 1D-2D inundation	Green	Design	Estry/TuFlow	1D/2D	Devon and Cornwall - West	1D_Boundary_Conditions	CDF / CSF / MMF / MCF	
Coastal 2D inundation	OK		TuFlow		Cambridgeshire and Bedfordshire	1D_Structures	Other	
Fluvial/tidal 1D model	N/A		MIKE11		Essex, Norfolk and Suffolk	1D_Run_Parameters		
Fluvial/tidal 1D-2D model			MIKE21 HD		East Midlands	2D_Model_Build		
Fluvial/tidal 2D model			MIKE21 SW		Greater Manchester Merseyside and Cheshire	2D_Boundary_Conditions	A - Design	
Surface water model			MIKEFLOOD		Hertfordshire and North London	2D_Structures	B - Appraisal	
Display all sheets			SWAN		Kent and South London	2D_Run_Parameters	C - Strategic	
			SWAN/EuroTop/TuFlow		Lincolnshire and Northamptonshire	1D_2D_Surface_Water	U - Unsatisfactory	
			Other		North East	Coastal_boundary		
					Thames	Wave_Transformation		
					West and East Sussex	Wave_Overtopping		
					Hampshire and Isle of Wight	Unked_1D_2D	Scored 4	
					Dorset and Wiltshire	Model_Stability	Scored 2	
					Somerset and West of England	Model_Outputs_Calibration	Scored 5	
					Shropshire Herefordshire Worcestershire and Gloucestershire	Model_Sensitivity		
					Staffordshire Warwickshire and West Midlands	Audit_Trail	1 Very good	
					North Yorkshire, East Ridings and Hull		2 Good	
					South and West Yorkshire		3 Fair	
							4 Poor	
							5 Very poor	
							Not Previously assessed/known	
							Yes	
						No		

[illegible]