

What hydraulic models need to include

Guidance to help design tender specifications

Reference number: GN 039

Document Owner: Flood Risk Management Board, Flood Risk Analysis sub-group

What is this document about?

The following points are raised to assist in the tendering works associated with Hydraulic Modelling for Flood Risk Management Schemes and appraisals, etc. It is offered to produce information consistent with the methodology used in the Flood Risk Assessment Wales (FRAW) 2019 Project

Who is this document for?

Flood Risk Management Authorities in Wales

Modelling Approach

You must construct a hydrodynamically linked 1D/2D model to reflect the complex nature of flooding mechanisms within an area.

We recommend that you [use the Environment Agency report Benchmarking the latest generation of 2D hydraulic flood modelling packages](#)

Hydrology

Your fluvial estimates must be in line with our flood estimation technical guidance and you must submit a flood estimate calculation record.

You can [find GN008 flood estimation technical guidance and calculation record](#) on our website.

Climate change

You must apply to your model the fluvial, tidal and pluvial climate change allowances set out in [Welsh Government: adapting to climate change: guidance for Flood and Coastal Erosion Risk Management authorities in Wales \(PDF, 859KB\)](#)

Topographic and LiDAR surveys

Your model must include topographical survey data for:

- the river channel

- in-channel structures
- any significant floodplain structures

We also recommend that you include data for top of bank survey at suitable intervals.

If you are using existing channel survey data, you will also need to do a check survey. This is to make sure that the channel has not changed in shape or size due to a flood event.

You can [access LiDAR terrain data from the Lle geo-portal](#) and use this to represent the floodplain within the 2D domain.

Breach and blockage guidance

You should agree breach and block parameters and locations with the NRW flood risk analysis team local to your area.

We recommend that you also [read our guidance OGN100 modelling breach and block scenarios](#)

Modelling parameters, events and scenarios

You must consider the following elements as part of any model build:

- **Model extent** is the model boundary (extent) appropriate and are the 1D and 2D domains in the correct areas?
- **Upstream and downstream boundaries** do they extend far enough to capture the appropriate model extents and impact on the site?
- **Chose appropriate building representation**, for example “stubby” buildings elevated to 300mm above the highest point of the ground level adjacent to the building, **or** surveyed building thresholds.
- **Consistent and realistic Manning’s roughness n values applied across the model**
Use Chow, 1959 for 1D in-channel and FRAW 2D Mannings table, which you can find in [Appendix 1](#).
- **Calibration against any known local flood events** flood levels and spatial extents
- **Sensitivity analysis:**
 - flow (+/- 20%)
 - Manning’s n (+/- 20% in both 1D and 2D domains)
 - downstream boundary (adjust as appropriate)
 - building representation
 - effect of grid size and orientation
- **Check model cell size** is appropriate for the project objectives, appropriate model timestep, and LIDAR resolution.
- **Model outputs** required:
 - depth

- velocity
- water surface elevation
- flow direction
- hazard UK
- inundation extent
- defended area
- standard of protection.

- **Fluvial events** to be considered for each of the following scenarios

Return Periods:										
Q2	Q5	Q10	Q30	Q30CCc	Q30CCu	Q75	Q100 Q100+ CCc	Q100+ CCu	Q200	Q1000
CCc = climate change central estimate										
CCu = climate change upper estimate										

- **Consider third party impacts** this is the difference between any baseline model and any design/as built model outputs.

Reporting

You must provide a comprehensive model report and model log. This should explain the methodology, results, conclusions, key assumptions, and recommendations for all modelled events and scenarios.

You should use the model log to track the changes between each model build.

Quality assurance

You must quality assure all model builds before submitting them to us for review.

We expect our model checklist to be used as a starting point for quality assurance. You can [download GN028 model checklist from our website](#)

We recommend that an independent party quality assure the model rather than the consultant who designed it.

Modelling to support a flood consequence assessment

We have guidance for models that support flood consequence assessments that you can use. You can [download GN028 Modelling for flood consequence assessment](#) from our website.

We expect our model checklist to be used as well.

Modelling to support a flood map challenge

We have guidance on flood map challenge models. You can [download GN029 flood map challenge](#) from our website.

You must submit a flood map challenge form with your models, and you can [download GN029 flood map challenge form](#) from our website

Deliverables

You must submit to us:

- Model in digital format and relevant run and check files (Benchmarked software)
- Modelling report (PDF/Word)
- GIS outlines (ESRI format)

Appendix 1

FRAW 2D Mannings Table

Descriptive group	Feature codes (Multi-Coloured Manual)	n value
Roads Tracks and Paths	10119 (Manmade) 10172 (Tarmac) 10183 (Pavement)	0.2
General Surface	10054 (Step)	0.025
Roads Tracks and Paths	10123 (Tarmac or dirt tracks)	
General Surface	10056 (Grass, parkland)	0.03
Structures	10185 (Roadside structure)	
Water	10089 (Inland) 10210 (Tidal water)	0.035
Land (unclassified)	10217 (Industrial yards, car parks)	
(Default value)	(9999)	
General Surface	10053 (Residential yards) 10093 (Unspecified)	0.04
Heritage and Antiquities, Land	10096 (Landform, historic interest, slope)	
Water, Land	10099 (Cliff) 10203 (Foreshore)	
Structures	10193 (Pylon)	
Rail	10167 (Unspecified)	0.05
Natural Environment (Coniferous / Non-coniferous Trees)	10111 (Heavy woodland and forest)	0.1
Land; Heritage and Antiquities	10076 (Unspecified)	0.5
Building	10021 (Unspecified) 10062 (Glasshouse)	0.015/0.5
Structures	10187 (Generally on top of buildings)	