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Using computer river modelling as part of a flood risk assessment

Best Practice Guidance

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Notes:

This document concentrates on computer river modelling. However, many of the principles apply equally to coastal modelling.

The principles also apply to Flood Consequence Assessments carried out in Wales.

Whilst allowances should be made for Climate Change, these have not been quantified in this Guidance. These should be assessed at the time of modelling using the latest Environment Agency standards.

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1. INTRODUCTION

1.1 Purpose of this Document

This document is guidance for carrying out a flood risk assessment where computer river modelling is necessary. Flood risk assessments are carried out by individuals, developers, consultants or Local Planning Authorities for a variety of reasons (e.g. for development purposes).

The Environment Agency's Policy is to take a risk-based approach to managing flood risk using an approach consistent with that commonly applied to other hazards. This means that flood risk management decisions are informed by flood risk assessment. It is recommended that others take the same approach.

The purpose of this document is to give general best practice guidance on the standards that should be used when carrying out computer modelling of watercourses in order to complete a flood risk assessment. Further details about undertaking Flood Risk / Consequence Assessments for the construction industry are given elsewhere, in particular in CIRIA Report C624¹.

Further information may be required for land use development purposes as detailed in PPG25 (also having regard to draft PPS25) or TAN15.

It is only intended to give an overview of best practice to be considered when carrying out modelling in order to increase awareness and understanding. Further more detailed guidance for modelling for specific purposes is contained elsewhere. When starting / procuring modelling works you should always ensure you have used the appropriate detailed specification.

1.2 Modelling and Flood Risk Assessment

It should be recognised that it is not always necessary to produce a hydraulic model for all flood risk assessments. A decision on whether to construct a model should be made based on the scale and nature of the potential flood risk, as well as the scale of the project and the existing information available on flood risk. In many less complex assessments simple hydrological and hydraulic analysis may be all that is required. CIRIA Report C624 recommends a staged approach to Flood Risk Assessment. Following such a staged approach allows the need for a model, and the extent of such a model, to be determined. If there is any doubt whether a model is required, this should be discussed with local Environment Agency Staff (Development Control Teams for Land Use Planning, Flood Risk Mapping & Data Management Teams for other) at the earliest opportunity. Suitable information to assist with the modelling may also be available so early dialogue is recommended.

However, even if a model is not constructed, an assessment of the impact of any proposed development on runoff should be carried out using Flood Estimation Handbook² (FEH) techniques in almost all cases. DEFRA/Environment Agency R&D Technical Report W5-074/A "Preliminary Rainfall Runoff Management for Developments"³ provides further information on runoff assessment for developments.

1.3 Appropriate Modelling Staff Involved

Suitably qualified and experienced personnel should be used to carry out the work described in this document.

¹ Lancaster, J., Preene, M. and Marshall, C. 2004, CIRIA Report C624, Development and Flood Risk – Guidance for the Construction Industry, CIRIA, London.

² Centre for Ecology and Hydrology, 1999. Flood Estimation Handbook. Wallingford, CEH. Further details are available at <http://www.nwl.ac.uk/feh/> or from CEH on 01491 838800

³ HR Wallingford (2004) Preliminary rainfall runoff management for developments: Users Guide. Defra / EA R&D Technical Report W5-074/A, HR Wallingford, Wallingford.

1.4 Requirements at Specific Locations

Requirements at specific locations should always be discussed with local Environment Agency staff to ensure that any site-specific factors are identified, which may require special treatment when carrying out the modelling.

2.0 OBJECTIVES OF THE MODEL STUDY

The objectives and the required outputs of the modelling exercise should be defined at the outset. These should be reviewed at regular intervals and at completion.

At an early stage, the design condition should be clarified. This may, for example, include a freeboard and an allowance for climate change. Further information on freeboard is in R&D W187⁴.

3.0 MODEL BUILDING

A one-off request for information held by the Environment Agency at the very beginning of the project is recommended since this affects selection of method etc, and could prevent further information coming to light at a later stage and complicating matters.

3.1 Choice of Model

The modelling software chosen should be capable of producing the required output. It will generally be appropriate to choose commercial hydraulic/river modelling software that is in widespread use. In certain circumstances, for example where the applicability of a model to a specific situation has not been previously demonstrated, it may be necessary for those conducting the flood risk assessment (FRA) to have independent benchmarking tests carried out to demonstrate model performance using standard data. Examples of how this may be achieved under a range of scenarios are provided in the Defra/Environment Agency R&D Report 'Benchmarking of hydraulic river modelling software packages' (W5-105) which is available via the Joint Defra/Environment Agency Flood and Coastal Erosion Risk Management R&D Programme [website](#).⁵

In reporting on any hydraulic modelling carried out as part of the FRA, a technical description of the model should be provided, including the name and version of the software used, referring to published papers/reports where appropriate to provide technical detail and to demonstrate the applicability of the model(s) to the situation in question. These references may need to be provided to the Environment Agency if required. If no publications are available then a more detailed technical description should be provided within the FRA, along with examples of relevant previous applications and/or the results produced by applying the model to standard tests (as outlined above, or similar).

Also, at this stage, the choice should be made between a fully hydrodynamic 1D or 2D model or a steady-state backwater model, flood routing model or combination of methods.

A full hydrodynamic model must be used if the study area contains either structures whose operation varies with time (e.g. pumps, sluices, and tidal outfalls) or a tidal estuary where tidal water levels increase going up the estuary⁶. This should also be employed in complex tidal/fluvial situations and where the watercourse is subject to rapid increases and decreases in flow. If there is significant floodplain storage and complex flow routes on the floodplain then 2D modelling of the floodplain may be more representative. In other cases, either a steady-state or hydrodynamic model may be chosen. It should be noted that a steady-state model is unlikely to give a reasonable estimation of water levels where storage is present.

⁴ Environment Agency: Fluvial Freeboard Guidance Note. Technical Report W.187.2000.

⁵ Flood & Coastal Defence R&D Programme, Benchmarking Hydraulic River Modelling Software Packages, R&D Study: W5-105/TR1, Defra / EA, March 2004.

⁶ This is typically the case in estuaries of significant rivers and can be seen by inspection of the tide tables.

3.2 Survey Data

The model should be based on a topographic survey of the watercourse. The upstream and downstream limits should be defined by the objectives of the flood risk assessment, rather than to the limits of the project / study area (see Section 3.7). The lateral extent of the survey should be sufficient to include the full extent of flooding. Guidance on this extent may come from flooding records and from the Flood Map. The extent of the survey work should be defined jointly by those undertaking the river modelling and those undertaking the survey in conjunction with advice from Environment Agency Flood Risk Mapping & Data Management staff.

The survey (and the model on which the survey is based) should continue far enough downstream so that uncertainty in the boundary condition does not significantly influence the estimated flood levels.

The cross sections surveyed should be representative of the channel and floodplain and the spacing between cross sections and orientation should be determined from the appropriate software documentation and textbooks⁷. Consideration shall be given to the additional survey information that may be required between cross-sections in areas where detailed flood depths or extents are needed. This can be achieved by either adding further cross sections or surveying additional spot levels.

During the survey, information on structures, flood routes, potential blockages / obstructions to the channel and channel roughness should also be gathered.

Survey data should be obtained using dual frequency GPS equipment, however, some minor and low risk developments do not justify the cost and time required to produce this type of survey. In these cases it **may** be acceptable to base the survey on OSBMs and this is at the discretion of the Agency's Development Control Officer based on the appropriateness 'test' in PPG25.

All levels must be based on Ordnance Survey Datum (further guidance on survey standards should be obtained by reference to the Environment Agency [National Survey Specification](#)). All cross sections and other survey information shall be located in plan relative to the National Grid. It is considered best practice that an insured and Chartered Land Surveyor complete the Survey.

3.3 Hydrometric Data

The Environment Agency may hold existing hydrographic and floodplain survey data which may be of use in a flood risk assessment. Environment Agency staff may be able to provide further information on the appropriateness of survey.

River flow, river level and rainfall data relevant to the model should be collected where these exist. The prime source of this data will be the Environment Agency. An understanding of the uncertainty and confidence within this data should be developed.

Another source of hydrological data is data contained within the [Flood Estimation Handbook](#). The [UK HiFLOWS Project](#) also provides up to date information.

3.4 Historic Information

Information on historic flooding (e.g. newspaper articles, photos, flood marks) should be collected and utilised to guide the survey extent and to aid the modelling process. Such data is particularly valuable as it can provide information on historic flooding prior to the periods covered by hydrometric data. A search of the Internet can often provide useful information⁸. However, the effect of any alterations and additions to the watercourse and associated structures since the date

⁷ For example, the online manuals supplied with modelling software

⁸ The Chronology of British Hydrological Events, <http://www.dundee.ac.uk/geography/cbhe> , may contain some useful information

of the recorded event needs to be considered. Historic information is likely to be held by the Environment Agency Area office.

3.5 Previous Modelling

The Environment Agency may hold existing river models that may be of use in a flood risk assessment. Such models may, for example, have been produced during previous flood risk mapping studies, the design of flood alleviation schemes and/or previous flood risk assessments in the area.

Where existing models are available, consideration should be given as to whether these could be used as part of the flood risk assessment. You should be aware that there may be cost, licensing and intellectual property rights (IPR) issues associated with the use of models which will need to be resolved before any previous modelling is used.

If models or survey data are provided by the Environment Agency or third parties it is recommended that check surveys are undertaken at key locations to ensure that the data provided is compatible with current conditions.

The Environment Agency may not own the Intellectual Property Rights to hydraulic models that it holds. We therefore may not be able to release information with a licence for its use.

Ownership of the IPR or an approved IPR licence will be required by the Environment Agency if it is planned to use the modified model to update the Environment Agency's flood risk mapping products and risk assessment products to represent the as built situation.

3.6 Hydrological Assessment

A hydrological assessment of the flood flows should be made using the methodology described in the Flood Estimation Handbook and the Environment Agency's Guidelines on use of the Flood Estimation Handbook⁹.

The hydrological assessment should use, wherever available, local data to improve the estimation of flood flows.

If a hydrodynamic model is used for the modelling, the hydrological assessment should include consideration of peak flows, flood volumes and shape of the flood hydrograph. If the problem includes storage (e.g. reservoir storage or a tide-locked watercourse) it is essential that the critical duration storm for storage (which often differs from the critical duration for peak flow) is identified. If a steady-state model is used, this may be limited to just consideration of peak flows.

Hydrological inputs should be estimated for a range of return periods up to and including the design flow (typically the flow with an annual probability of exceedence of 1%), and should include an appropriate allowance for climate change.

3.7 Model Building

It may be appropriate to speak to Area Environment Agency staff prior to commencing any model building.

(a) General

The model should be built to represent the key flood flow routes, flood storage and structures in the study area. The defined study area should be sufficient to demonstrate the effects of any development on locations away from the site of the proposed development.

⁹ Environment Agency, 2000. *Flood Estimation Handbook Guidelines (Parts 1 and 2)* Bristol, Environment Agency

(b) Upstream Boundaries (Inflows)

The upstream boundary or boundaries should be developed under the hydrological assessment described in Section 3.6. For some models, one single upstream inflow per flood event may be sufficient, whilst for others, many upstream boundaries may be needed if a number of tributaries or other inflows are present. The choice of location of the upstream boundaries should be based on hydraulic considerations, not on the upstream limit of the development. The upstream boundary should be far enough upstream to allow the full impact of the development on upstream water levels to be identified.

(c) Downstream Boundary (Levels)

The downstream boundary should be at a location where the relationship between level and flow is well defined, e.g. a weir. Where this is not possible, it should be sufficiently downstream of the area of interest so that any errors in the boundary will not significantly affect predicted water levels at the proposed development site. For a typical fluvial river, a rule of thumb is that a backwater effect extends a length $L=0.7D/s$, where D = bankfull depth and s = river slope. Hence if the downstream boundary is greater than L from the site it is likely that any errors in the rating curve at the boundary will not affect flood levels at the site. If the downstream boundary is tidal, it should be a location where a tidal curve can be accurately defined. Any tidal boundary should take into account both the astronomical tide (i.e. the tide caused by the gravitational effects of the Moon and the Sun and reported in published tide tables) and storm surges (i.e. the elevation of tidal levels caused by weather conditions). Careful consideration of combined probabilities¹⁰ may be required in such cases. The Environment Agency holds extensive extreme tide information from Flood Risk Mapping Studies.

(d) Hydraulic Coefficients

The coefficients used in the model (e.g. channel roughness, weir coefficients) should be determined with guidance from standard textbooks. These texts should be referenced in the modelling report. Work is ongoing to produce guidance relevant to the UK, but in the meantime standard works such as Chow¹¹ and Hicks & Mason¹² can provide some guidance. Further information on roughness can also be obtained from the Defra / Environment Agency Conveyance Estimation System (CES) – <http://www.river-conveyance.net/>.

4. MODEL CALIBRATION, VERIFICATION AND SENSITIVITY TESTING

4.1 Calibration

Wherever practicable, the hydrological assessment and the hydraulic model should be calibrated against recorded flows and/or water levels from observed flood events. If calibration data is available, the model should be calibrated using at least three separate events. If no calibration data is available, a 'reality check' on the predicted levels and flows can often be carried out from photographs, historic information and anecdotal accounts of flooding.

The coefficients used in the calibration process should only be varied within the possible ranges suggested in the standard textbooks. The calibration of steady-state models should consider flow and flood levels. Calibration of hydrodynamic models should also consider the timing of the flood peak, flood volume and shape of the flood hydrograph.

4.2 Verification

If calibration is carried out, at least one separate observed event should be run through the model after the calibration to verify the adjustment of parameters.

¹⁰ Defra / EA R&D Programme. Joint probabilities - dependence mapping & best practice, FD 2308/TR1. HR Wallingford. 2003.

¹¹ Ven Te Chow, *Open Channel Hydraulics*, McGraw-Hill 1959.

¹² D.M.Hicks & P.D.Mason. *Roughness Characteristics of New Zealand Rivers*. 1999.

4.3 Sensitivity Testing

The model should be tested by adjusting the key parameters within it. These parameters should include at least model inflows, downstream boundary condition, channel roughness and key structure coefficients. The range of parameters used in sensitivity tests should reflect uncertainties, possible changes due to climate change and variations in hydraulic coefficients (e.g. from seasonal changes or periodic maintenance).

Sensitivity to blockage of critical structures should also be tested. R&D W5A-061¹³ includes current understanding & some interim guidance.

5. REPORTING

5.1 General

A report should be written describing the modelling. The objective of this report is to enable an evaluation of the model and results to be carried out if necessary. It also should be a self-contained report that will provide sufficient information to allow future use of the model by the Environment Agency including if necessary replicating the work undertaken. The detail of the report should be appropriate to the complexity of the modelling.

5.2 Items to be Included

The key items to be included in the report are:

Statement of Objectives

The report should provide an explanation of the reasons the modelling exercise has been undertaken and the planned objectives of the exercise. It should indicate any deviations from the original objectives or planned project outputs, and outline the reasons why these occurred.

Method statement and Justification

The report should include a clear method statement, which makes it clear how the modelling has been carried out to fulfil the objectives.

A justification of the methodology should also explain why the model has been used for this application, giving detailed reasons why the modelling tool is applicable/appropriate to the situation (e.g. fully dynamic or steady-state backwater model). It should indicate any perceived advantages or disadvantages of applying the chosen tool.

Technical description

Only a brief technical description is required if the tool is well known to the Environment Agency / widely applied (seek advice from Environment Agency staff). If the model is less widely known or applied, then a more detailed development history is required, giving examples of previous applications. The version number of the model used should be reported, and how the model outputs compare with those of other packages when applied to standard tests (see 3.1 above).

The schematic showing how individual parts of the model are connected should be provided.

Data sources

All data used in the model must be listed in reports and made available for inspection.

Methods of data capture and/or sources of data must be made clear in the report, as should the processes by which the raw data were converted.

Any reference to earlier work should be clearly referenced, and applications or development of existing models should be subject to the same rigorous inspection methods.

¹³ Scoping study into the hydraulic performance of bridges and other structures, including effects of blockage, at high flow. *EA/Defra R&D Programme*. July 2004.

The ownership of the data collected and the format of the data should be stated.

Uncertainty in data sources should be referenced especially where data have been discounted due to low confidence.

Parameters

The derivation of the parameters (e.g. channel roughness) used within both the hydrological assessment and the hydraulic model should be stated.

Calibration/Verification

Where calibration has been undertaken, the method used must be clearly illustrated and the number of independent data sets used for verification must be displayed. The model results must be presented against observed values for key locations for each verification data set, and descriptive statistics applied to describe the error band in the model.

Sensitivity Analysis

The results of the sensitivity testing should be described and the potential effect these could have on the model output should be discussed.

Audit Trail

The audit trail developed should be described in unambiguous detail.

Limitations

Any limitations of the model or modelling technique should be highlighted. The impact of such limitations on the present or future use should be clearly stated.

Conclusions

The report shall include concluding remarks, which highlight key issues from other sections and draw attention to the critical locations and/or structures within the model.

Where in the above section (5.2), the model is referred to this should be taken to include the hydrological assessment. The hydrological assessment must be reported to the same level of detail as the hydraulic modelling. The same key items will apply to both modelling and hydrology.

5.3 Format of Reporting

The report should be in a format that is easy to copy and transmit electronically, and must include all plans and schematics. Adobe pdf files are therefore preferred.

5.4 Other Deliverables

Copies of the model data files should be supplied together with sufficient instructions to allow these models to be run and viewed, for example, a text file containing timestep, runtime etc. A data file containing initial conditions should also be provided.

5.5 Future Use

A statement should accompany the report and model data on the allowable future uses of the model and its associated documentation.

Ownership of the Intellectual Property Rights (IPR) or an approved IPR licence will be required by the Environment Agency if it is planned to use the modified model to update the flood risk mapping products and risk assessment products to represent the as built situation.

6. QUALITY ASSURANCE AND AUDIT TRAIL

Throughout the study, a well-defined audit trail should be defined and reported. This should include all relevant documentation and should link with the appropriate quality assurance procedures of the organisation carrying out the study. Provision should be made to make the relevant documentation available to others who may use the model in future.

Glossary of terms

Backwater Curve - The longitudinal profile of the water surface (in a non-uniform flow in an open channel) when the water surface is not parallel to the river bed. This is caused by a restriction such as a dam or weir, increasing the depth of the water above the normal water level that would result if the restriction were removed.

Backwater Effect - The effect where a dam or other restriction raises the surface of the water upstream from it above the normal water level.

Backwater Flooding - Flooding caused by downstream conditions such as a channel restriction and/or high flow in a stream at a confluence downstream of the flooding.

Backwater Model – A model built to represent the backwater effect.

Calibration – The process of adjusting parameter values in a model to try and match recorded data, so that the model can be taken as a good representation of reality.

Combined Probability – The chance of two or more independent events occurring concurrently.

Critical Duration Storm – The duration of storm necessary to produce the maximum instantaneous peak flow or volume at a specific location in a drainage system, for any given flood event probability.

Floodplain – Land adjacent to a watercourse over which water may flow in time of flood. This generally includes the defended floodplain, an area over which water would flow if flood defences were not present, or if flood defences fail.

Flood Routing Model – Process of determining progressively the timing, shape, and amplitude of the flow in a flood wave as it moves downstream at successive points along the river.

Hydrological Model – A mathematical model used to estimate the flow in a river that will result from rainfall. It will usually be based on such things as catchment size, geology and soil type, steepness, land use and storage within the catchment. The model will be calibrated and verified using recorded rainfall and flows, before using design rainfall to estimate the flows which might be expected in floods of different probabilities.

Hydraulic Model – A mathematical model used to predict possible future levels (and flows in a hydrodynamic model) taking into account the topography, shape and roughness of the river bed and floodplain, obstructions (e.g. weirs and bridges), and the inflows provided by the hydrological model etc. Models are calibrated using recorded historic flood data, where it is available.

Hydrograph – A graph showing the water level (stage), discharge, or other property of the flows in a river, with respect to time.

Hydrological Assessment – Carried out to understand the cycle of precipitation, consequent runoff, infiltration, and storage; eventual evaporation etc.

Intellectual Property Rights – The legal ownership of the content of the work in question.

Storage – Location where water is retained due to the lie of the land, man made influence or effect of tides / other river flows.

Steady-State Model – A hydraulic model in which the flow at any point in the model is constant with time (there can be many different flows but all are constant over time). This type of model cannot estimate the effects of storage on flood levels or downstream flows. Hydrodynamic models estimate flows and levels throughout a flood event, and can therefore take into account the effects of storage on flows and flood levels.

Topographic Survey – Survey to measure and record the physical features of an area in horizontal and vertical dimensions.

Tributary – A river or stream that flows into a larger river.

Upstream / Downstream Boundary – The limits of the model or assessment upstream and downstream of the site of interest.

Verification – The process of checking the accuracy of the outputs of the calibrated model in comparison with recorded data. If sufficient data is available it is good practice to calibrate the model using some recorded data, and verify the model using data from other flood events.

List of abbreviations

PPG25 – Policy Planning Guidance Note 25

TAN15 – Technical Advice Note 15

CIRIA – The Construction Industry Research and Information Association

DEFRA – Department for Environment, Farming and Rural Affairs

R&D – Research and Development

1D – One Dimensional

2D – Two Dimensional

FRA – Flood Risk Assessment

References

Lancaster, J., Preene, M. and Marshall, C. 2004, CIRIA Report C624, Development and Flood Risk – Guidance for the Construction Industry, CIRIA, London.

Centre for Ecology and Hydrology, 1999. Flood Estimation Handbook. Wallingford, CEH. Further details are available at <http://www.nwl.ac.uk/feh/> or from CEH on 01491 838800.

HR Wallingford (2004) Preliminary rainfall runoff management for developments: Users Guide. Defra / EA R&D Technical Report W5-074/A, HR Wallingford, Wallingford.

Environment Agency: Fluvial Freeboard Guidance Note. Technical Report W.187.2000.

Defra / EA, March 2004. Flood & Coastal Defence R&D Programme, Benchmarking Hydraulic River Modelling Software Packages, R&D Study: W5-105/TR1.

Environment Agency, 2000. Flood Estimation Handbook Guidelines (Parts 1 and 2) Bristol, Environment Agency.

Defra / EA R&D Programme. Joint probabilities - dependence mapping & best practice, FD 2308/TR1. HR Wallingford. 2003.

Ven Te Chow, Open Channel Hydraulics, McGraw-Hill 1959.

D.M.Hicks & P.D.Mason. Roughness Characteristics of New Zealand Rivers. 1999.

EA/Defra R&D Programme. July 2004. Scoping study into the hydraulic performance of bridges and other structures, including effects of blockage, at high flow.

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