Defra / Environment Agency
Flood and Coastal Defence R&D Programme

R&D Technical Summary W5-105/TS

Benchmarking of hydraulic river modelling software packages

Background to R&D project

In 1993 the National Rivers Authority (NRA) initiated a 'Benchmarking Study' of hydraulic river models with Stage 1 defining a series of tests. In 1995 Stage 2 of this project was initiated, which involved all river modelling packages then in use by the NRA being subjected to the tests defined by Stage 1 of the project. The project was completed under the Environment Agency in 1997, and the title amended to 'Benchmarking and Scoping Study of Hydraulic River Models' so as to reflect the overall substance of the study. Applying the benchmarking process has enabled the Environment Agency and other Operating Authorities to identify and apply the best models and practice in the use and application of hydraulic modelling.

Many of the eleven packages in the original test are no longer supported commercially, and the others have undergone significant upgrades since the 1995 versions previously tested. Of particular note, HEC-RAS now has an unsteady-state module, so a direct comparison of its capabilities with those of ISIS and MIKE 11 is now possible. In addition, the Environment Agency has since rationalised the software provided to its staff, leaving just three river modelling packages currently supported, namely ISIS, MIKE 11 and HEC-RAS.

With the ever-increasing demands for hydraulic river modelling by the Agency, other Operating Authorities and their consultants, there is the need to re-benchmark ISIS, MIKE 11 and HEC-RAS to ensure that best practice in hydraulic modelling is consistently achieved. This is particularly important given the wide range of studies that are needed and the fact that many flood risk assessments are being carried out by smaller consultants, for whom HEC-RAS is particularly attractive, being available to download free of charge from the internet.

Results of the R&D Project

Twelve test specifications have been prepared as stand-alone documents, with accompanying data sets and with the results reported separately. They have been developed with the principal objective of assessing software numerical accuracy, capability and reproducibility. It is envisaged that the test specifications will be refined and added to in the future.

Software versions current at the start of the project (March 2002) were adopted for a new series of tests. The results of the testing have identified the capabilities of the three software packages for a given set of prescribed modelling scenarios. In addition the project has identified where the software packages have very similar or diverse performances as well as some instances where their application should be considered with caution.

A key finding, common across many tests, was the need to be aware of the potential problems in using default values of various coefficients and parameters in the model. In many cases it was found that the default values were inappropriate, although guidance on when to alter the default - and to what value - was often lacking in model documentation.

Use of R&D Outputs

The test specifications and test results are intended to be a supplementary resource for Defra, Agency and other Operating Authority staff, research contractors and consultants, academics and students for assessing

the applicability and performance of river modelling software packages against defined best practice for their various modelling requirements.

The specifications are also intended to be used by others for one or more of the following purposes: (a) by novice modellers as a training exercise; (b) by software suppliers for testing updates of the packages; and (c) by other software houses to test their products against those already tested. If tests for upgraded or new packages are carried out appropriately, and have been independently verified, then the Agency will consider placing those results on the website.

Datasets for each test and for each of the three software packages covered by the project are also provided. in order to offer material for training exercises; to allow software updates to be readily tested by using identical data to that used in the original tests; and to give other software houses raw data to convert for use by their own packages.

This R&D Technical Summary relates to R&D Project W5-105 and the following R&D outputs:

- **R&D Technical Report W5-105/TR0 Benchmarking of hydraulic river modelling software packages – Project overview** June 2004 (ISBN 1 8443 2290 4)
- **R&D Technical Report W5-105/TR1 Benchmarking of hydraulic river modelling software packages – Test specifications.** June 2004
- **R&D Technical Report W5-105/TR2 Benchmarking of hydraulic river modelling software packages** (divided as follows)
  W5-105/TR2A – Test A (Subcritical, Supercritical & Transitional Flows). June 2004
  W5-105/TR2B – Test B (Looped System). June 2004
  W5-105/TR2C – Test C (Triangular Channels). June 2004
  W5-105/TR2D – Test D (Weirs). June 2004
  W5-105/TR2E – Test E (Ippen Wave). June 2004
  W5-105/TR2F – Test F (Monoclinal Wave). June 2004
  W5-105/TR2H – Test H (Pumps). June 2004
  W5-105/TR2I – Test I (Embankments). June 2004
  W5-105/TR2J – Test J (Bridges). June 2004
  W5-105/TR2K – Test K (Culverts). June 2004
  W5-105/TR2L – Test L (Contraction & Expansion). June 2004
  W5-105/TR2O – Test O (Tidally Influenced Outfall). June 2004
- **Datasets for each of the above 12 tests (zipped) -**
  Available on request from FCERMscience@environment-agency.gov.uk

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The above outputs are available on the Defra / Environment Agency webpages for the Joint Flood and Coastal Erosion Risk Management R&D Programme. These are currently at www.environment-agency.gov.uk/floodresearch, and will be incorporated into the new Defra-hosted webpages at www.defra.gov.uk/environ/fcd/research (use the search tool located on the project information and publications page). W5-105/TR1 and 2 and datasets are e-published only.

Copies of W5-105/TR0 are held at the EA Information Centre. They can be purchased from the EA National Customer Contact Centre by emailing enquiries@environment-agency.gov.uk or by telephoning 08708 506506.

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