



## EXECUTIVE SUMMARY (FINAL)

The IMPACT project addresses the assessment and reduction of risks from extreme flooding caused by natural events or the failure of dams and flood defence structures. The work programme is divided into five main areas, addressing issues originally identified by the EC CADAM project. Research into the various process areas has been undertaken by groups within the overall project team. Some work package areas interact, but all areas are drawn together through an assessment of modelling uncertainty and a demonstration of modelling capabilities through an overall case study application.

The IMPACT Project research programme comprised 5 technical work packages as follows:

- WP2: Breach formation
- WP3: Flood propagation
- WP4: Sediment movement
- WP5: Uncertainty analysis
- WP6: Geophysics and data collection

### WP2: Breach formation:

Research here focused on our ability to predict breach formation through a dam or flood defence embankment. The core work linked field and laboratory testing (to collate reliable data sets and understand basic breach formation processes) with numerical model testing, comparison and development. In addition, consideration was given to factors affecting breach location (links via WP6) and also the uncertainty associated with breach modelling was investigated (WP5). Core research work comprised undertaking 5 large scale field tests (embankments 4-6m high tested to failure), 22 (1:10 scale) laboratory tests, extensive numerical modelling using field and laboratory data (leading to model validation and development) and development of a methodology for identifying the relative risk of breach location in linear defences. The research programme was successful in collating extensive field and laboratory data sets which allowed model performance assessment and development. Guidance is given on modelling capabilities and accuracy. At the time of completion this work represents the current state of the art worldwide in the prediction of breach formation through embankments.

Associated research (WP6) aimed to establish whether or not breach location could be related to embankment soil or other field parameters. This was undertaken through the collation and analysis of data relating to a large number of embankment failures in Hungary and the Czech Republic. Whilst extensive data sets were collated and analysed, the quality of data prevented a direct correlation. However, useful knowledge regarding typical breach processes and breach growth was attained.

### WP3: Flood propagation:

Research here focussed on the advancement of scientific knowledge and understanding, and the development of predictive tools, for the simulation of the catastrophic inundation of valleys and urban areas. The scope of work divided broadly into two areas: *Urban flooding* and *Flood propagation in natural topographies* (flood routing). Both topics were approached in a similar manner - by means of a combination of desk, experimental, field and computer work. Desk work comprised conceptual experiment design and model development as well as analysis of laboratory data and simulations output. Experimental work was devoted to understanding flow characteristics and to acquisition of reliable data for model testing and validation. Field data was sought for the same purposes. Computer work comprised programming model developments and performing simulations of selected flood scenarios.

A comparison of modelling approaches for simulation of catastrophic urban flooding was undertaken and the advantages and disadvantages of the various approaches identified. Issues surrounding the accuracy of numerical modelling, and the focus for future developments of 2D inundation models were also identified.

### WP4: Sediment movement:

Research here focussed on investigating sediment movement during extreme flood conditions, how it may influence flood conditions and how it may be modelled. Sediment movement in the 'near' and 'far' fields



was investigated, namely movement immediately downstream of a breach or failure (near field) and morphological response (in the far field) including channel widening, braiding etc. The approach adopted for research comprised a mixture of laboratory and numerical modelling, culminating in analysis and application to a case study.

The level of science for sediment movement is far ‘younger’ than with, say, breach or flood propagation. It should be recognised that the prediction of sediment movement during extreme events differs from ‘traditional’ morphological modelling, since the process is rapid and dynamic whilst current morphological models assume long term steady state conditions. The research made significant advances in understanding the dynamic processes and confirming the significant role that sediment can play in affecting prediction of both flood water level and the timing of flood wave propagation. However, whilst prototype modelling approaches were developed and tested, the models still require further research and development before being suitable for use within the flood risk management community.

#### WP5: Uncertainty analysis:

The objective of work here was to demonstrate the uncertainty inherent within the flood modelling process and how this may affect end user use of the modelling data. The scope of work included development of an approach to assess modelling uncertainty and application to breach, propagation and sediment modelling through use of case studies.

Development of the approach and implications for end users was undertaken through group and end user feedback via the four project workshops. The uncertainty analyses demonstrated a high degree of uncertainty within the modelling work, stemming from a combination of uncertainty relating to environmental conditions (materials etc), assumptions for modelling, and the modelling process itself. With potential flood water depths varying by perhaps 30%, the consequences for applications such as emergency planning are significant. Two case studies were used; one to demonstrate uncertainty analysis for breach and flood propagation; the other to highlight sediment movement issues.

#### WP6: Geophysics:

Research here focussed on the testing and development of geophysical investigation techniques for flood defence embankments. The objective of the work was to establish whether or not an approach for the non intrusive, rapid assessment of embankment integrity could be developed using existing or modified geophysical investigation techniques. This work was undertaken through analysis and comparison of approaches using a series of field trials.

The research first allowed prioritisation on the performance and value of different techniques for integrity assessment. Work then focussed on the use of a system from the US that had previously been used for other applications. Trials demonstrated that this approach has significant potential for allowing non intrusive and relatively rapid (5-10km / day) integrity assessment. Further testing and development of this approach is now required to allow the full potential to be realised within the flood defence asset management community.

#### More information:

Detailed technical reports and '10 page' summary reports are available on each of these research areas and may be accessed via the project website at [www.impact-project.net](http://www.impact-project.net) . Results from the five technical work package areas have been structured according to the following deliverables:

- Field and laboratory data
- Benchmark tests of current models
- New approaches to breach formation modelling
- New approaches to flood propagation modelling
- New approaches to modelling sediment movement under extreme flood conditions
- Development of a geophysics based approach for the rapid assessment of embankment integrity
- Assessing modelling uncertainty
- Site specific case studies