



# Breach formation

## Rapid methods of assessment

### FRMRC2 has produced:

- A simplified, quick-to-run model for predicting breach through flood embankments.
- The method is based on detailed analysis of the physics behind embankment breaches and a qualitative analysis of breach modelling techniques.

### Intended readership and users:

- Operating authorities, in particular asset management teams
- Developers of simulation tools and other researchers

### Where to find more information:

[www.floodrisk.org.uk](http://www.floodrisk.org.uk)

## Summary



Models for predicting flood risk within a river or coastal system need the rapid and accurate prediction of breach formation and discharge. A key aspect of accurately predicting the breach flood volume is understanding of the physics behind embankment breach processes. It is also necessary to understand the uncertainties involved in predicting the process through some form of rapid breach assessment tool.

An analysis of the physics and the impact of various modelling assumptions were undertaken and lead to the development of A Rapid Embankment Breach Assessment tool (called AREBA).



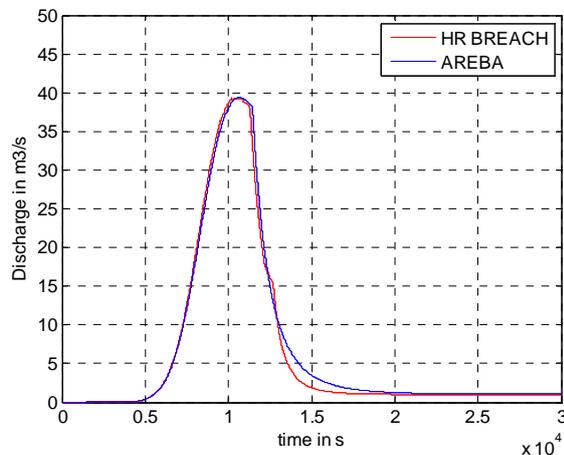
AREBA provides rapid prediction of the potential flood hydrograph for both overflow and internal erosion (piping) processes, assuming either surface or head cut erosion processes. The model also allows for the effects of surface grass cover. The model is applicable for simple homogeneous earth embankments. AREBA models the physics behind breaching in a simplified manner and:

- Incorporates the effects of horizontal and vertical flow contraction on the breach discharge in 1D flow models
- Deals with geotechnical instabilities of the landside slope, breach side slopes, and soil above a pipe.
- Includes a simplified description of breach growth.



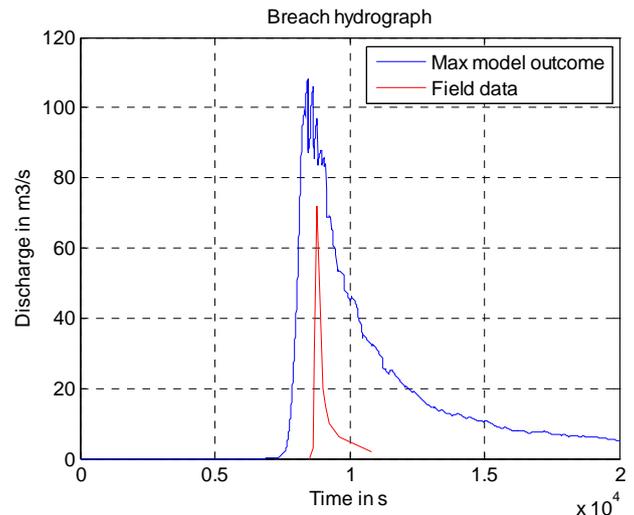
For the development of AREBA a new set of equations was developed to obtain the shear stress as a function of the distance along the landside embankment slope. AREBA has been benchmarked against the HR BREACH model, showing promising results while keeping the runtime below one second.

The figure below shows an example comparison between HR BREACH and AREBA for one of the benchmark test runs (for surface erosion failure on an embankment with 1:3 slopes).



AREBA has been validated against IMPACT field data ([www.impact-project.net](http://www.impact-project.net)) and USDA-ARS HERU field data. For every model input parameter the possible maximum and minimum value were assessed.

Assuming a uniform distribution between the two extremes, envelopes were created between which the outcome of the field data is expected to lie. The envelopes were used to assess the ability of the model to reproduce hydrographs of embankment failures.



It was concluded that using the new AREBA model for rapid breach prediction, including for example, within system flood risk modelling, should provide a significant improvement in accuracy of flood risk prediction as compared to current practice.

#### Other sources of information

[www.floodrisk.org.uk](http://www.floodrisk.org.uk)

#### Research Team

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- Department of Environment, Food and Rural Affairs/Environment Agency Joint Research Programme
- United Kingdom Water Industry Research
- Office of Public Works Dublin
- Northern Ireland Rivers Agency

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