Project Summary

Reducing the Risks of Embankment Failure under Extreme Conditions
(DEFRA / Environment Agency R&D Project FD2411)

Background
There are some 35 000km of coastal and flood defence embankment in England and Wales. Effective performance of these embankments is critical to provide sustainable Flood or Coastal Defences, including the management of extreme flood events. Ensuring this effectiveness requires the design and management of embankments to be considered within a comprehensive framework.

Embankments can become less effective over time, or may have performed less effectively in the past, for a number of reasons including:
- experiencing greater loading than they have been designed or managed to withstand;
- changes in the required standard of service or other functional requirement;
- deterioration from their intended condition - as constructed or maintained; and
- shortage or lack of relevant data on which to base their design and/or management

This is particularly relevant in relation to the increasing loading that will continue to be placed on defences due to climate change, and increasing extreme events.

Key Objective
The need for improved guidance on the design and management of embankments across coastal and fluvial areas has been confirmed through discussions with practitioners and researchers, plus an initial examination of (a) the science base, and (b) current practice. This has been done in the DEFRA / Agency R&D programme through the Concerted Actions in (1) fluvial defences, (2) coastal defences, and (3) operation and maintenance. Experience from the UK Autumn Floods (2000) confirmed that need.

The design and management of flood and coastal defence embankments needs to draw on several disciplines including hydraulics, geotechnics, survey and other inspection techniques, modelling and data analysis, and risk management. During the past decade there have been a range of developments, research projects and initiatives from which Operating Authorities can learn and develop improved methods to enhance performance. It is therefore beneficial to develop a systematic approach to the design and management of embankments through which a significant improvement in the competence of defences and their performance in relation to the cost of constructing and maintaining them may be achieved.

This will be achieved through a project aimed at enabling Operating Authorities to understand and address critical issues related to the effective performance of flood and coastal defence embankments. This will include the development of a risk-based framework for their design, inspection and maintenance relating to potential mechanisms and consequences of failure.

Project Programme
To achieve this objective, DEFRA and the Environment Agency have funded a 9-month R&D project to review current knowledge and practice, identify needs and opportunities and define a structure for future design and management of embankments, including appropriate further research. The scope of the project includes:

- confirmation of issues affecting embankment integrity
- review of (or access to existing information on) current “good practice”;
- review of relevant information in the science, engineering or technology base;
- overview of relevant on-going DEFRA, Agency and other, particularly European, R&D projects;
- discussion/correspondence with practitioners and researchers to envision how practice in this area might reasonably advance in future years;
- confirmation of specific issues driving potential future embankment-related R&D or other related activities;
- identification of potential future outputs and benefits, leading to a list of priority projects;
- production of guidance on current best practice
More specifically, some of the past initiatives that will be reviewed include:

- NRA / EPSRC scoping study on geotechnical issues relating to embankments (1995);
- the recent CIRIA project on Infrastructure Embankments;
- developments in embankment management under the Reservoirs Act 1975;
- current practice and developments in Europe and the US (e.g. Rijkswaterstaat, European Commission research and US agencies such as the US Army Corps of Engineers, US Department of Agriculture, US Bureau of Reclamation, Federal Emergency Management Agency, Flood Plain Managers etc.);
- follow up to the Environment Agency “Lessons Learned” report and to other specific documented events;
- work on catchment modelling and flood spreading under Broad Scale Modelling Theme;
- past and current activities within the Building Research Establishment (BRE);
- information from specific improvement schemes and day to day O&M activities

with key deliverables including:

(i) Review of the science base – including a literature review and consideration of on-going research.
(ii) Review of current practice focussing on current best practice. (This will provide Flood Defence practitioners with sufficient information to enable them to begin to follow improved methods).
(iii) Prioritised future programme for DEFRA / Agency Embankment R&D, including the specification of R&D projects or other activities for early start up of work in priority areas.
(iv) Workshop for the presentation, discussion and dissemination of project findings and issues.

The project is being undertaken by HR Wallingford in conjunction with Posford Haskoning to provide a team that covers the wide range of issues raised by this project. The programme of work is also closely meshed with the European Funded IMPACT project, through which R&D focussed on embankment performance at failure is being undertaken, and from which the project may also benefit from knowledge and practice of many European and International partners. Recommendations from this project for future implementation in the UK will therefore build upon current best practice around the world.

The programme of work is set out below:

For more information on this project please contact:

**Mark Morris**
HR Wallingford Project Manager
Email: m.morris@hrwallingford.co.uk
Tel: +44 (0) 1491 822283

**Mervyn Bramley**
DEFRA / EA Engineering Theme Leader & Project Manager
Email: mervyn.bramley@environment-agency.gov.uk
Tel: +44 (0) 1454 624429