

## **FLOODsite (Integrated Flood Risk Analysis and Management Methodologies) - Research Relevant to the Dams Industry?**

MW MORRIS, HR Wallingford Ltd, Wallingford. UK.

PG SAMUELS, HR Wallingford Ltd, Wallingford. UK.

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**SYNOPSIS.** The FLOODsite Project is an Integrated Project under the EC 6th Framework Programme ([www.floodsite.net](http://www.floodsite.net)). The project value is ~€14M and is being implemented by 36 partner organisations, drawn from 13 different participating countries. To achieve the goal of integrated flood risk management, FLOODsite brings together managers, researchers and practitioners from a range of government, commercial and research organisations, all devoted to various, but complementary, aspects of flood risk management.

The FLOODsite project covers the physical, environmental, ecological and socio-economic aspects of floods from rivers, estuaries and the sea. Work is divided into over 30 project tasks with pilot applications in Belgium, the Czech Republic, France, Germany, Hungary, Italy, the Netherlands, Spain, and the UK. Many of the topics of research and the tools being developed are directly or indirectly relevant to the dams industry, since they address common issues such as hydraulic loading, structure performance, flood risk management, dealing with uncertainty and training / uptake of knowledge. Specific examples of research included within these areas are analysis of extreme loading conditions, breach initiation and formation, social, environmental and economic impacts, pre- event and event management, analysis of flood defence systems and dealing with modelling and decision uncertainty.

This paper provides a brief introduction to the FLOODsite Project and highlights key areas where the research is of relevance to the UK dams industry.

## IMPROVEMENTS IN RESERVOIRS

### WHAT IS FLOODSITE?

FLOODsite is the largest ever EC research project on flood risk management, with an EC “grant to the budget” of nearly €10 Million, with another €4 Million from the research community involved. The project, which started in 2004, is scheduled to take 5 years to complete, and involves approximately 150 researchers from 13 countries. HR Wallingford leads the project consortium of 36 partners which includes many of Europe’s leading institutes and universities and the project involves managers, researchers and practitioners from a range of government, commercial and research organisations, specialising in aspects of flood risk management.

FLOODsite is interdisciplinary, integrating expertise from across the physical, environmental and social sciences, as well as spatial planning and management. There are 35 project tasks divided into 7 research themes, also including pilot applications in Belgium, the Czech Republic, France, Germany, Hungary, Italy, the Netherlands, Spain, and the Thames Estuary in the UK (See Figure 1). FLOODsite covers the physical, environmental, ecological and socio-economic aspects of floods from rivers, estuaries and the sea.

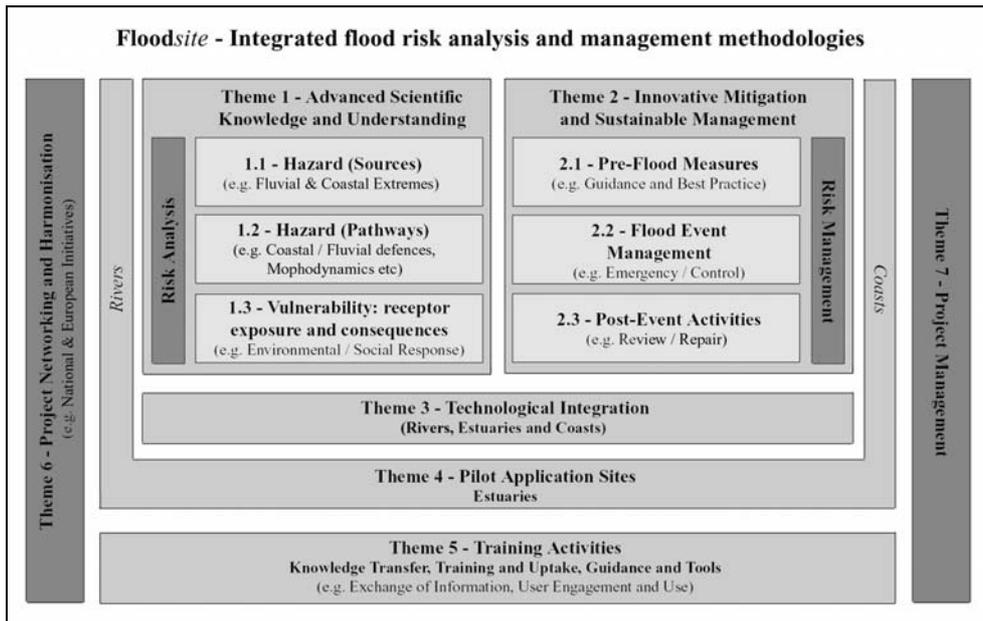


Figure 1 Research programme structure for the FLOODsite Project

The FLOODsite project is arranged into seven “Themes” covering the project science, integration, training activities, networking and management. Within these themes there are over 30 project tasks. The objectives of the Themes are as follows (see also Figure 1):

Theme 1 – Risk analysis: Scientific knowledge and understanding

- 1.1 To improve understanding of the primary drivers of flood risk (waves, surges, river flow etc.) through research targeted at key issues and processes that contribute most to current uncertainty in flood risk management decisions.
- 1.2 To Improve understanding, models and techniques for the analysis of the performance of the whole flood defence system and its diverse components, including natural and man-made defences (e.g. seawalls, embankments, dunes) and the extent of inundation.
- 1.3 To understand the vulnerability and sensitivity of the receptors of risk and to improve and harmonise the methods to evaluate societal consequences and to estimate flood event damages

Theme 2 – Innovative mitigation and sustainable flood risk management

- 2.1 To evaluate flood risk management measures and instruments after the event (ex-post) and to develop sustainable flood risk management strategies and evaluate these prior to implementation (ex-ante) under consideration of a wide range of different physical and societal conditions.
- 2.2 To improve flood risk mitigation measures that are applied during the flood event, through improved technology for flood warning in small flash-flood catchments and through measures for emergency evacuation.

Theme 3 – Frameworks for technological integration

- 3.1 To integrate the scientific, technological and procedural advances to support long term flood risk management decisions.
- 3.2 To integrate the scientific, technological and procedural advances to support flood event management decisions.
- 3.3 To develop a framework for the identification and quantification of the influence of uncertainty in the process of flood risk management.

Theme 4 – Pilot application sites

- 4.1 To provide real sites with real and specific problems upon which tools, techniques and decision support systems may be developed and tested.
- 4.2 To provide feedback into the research and development process from flood risk managers and river, estuary and coastal stakeholders.
- 4.3 To ensure the FLOODsite deliverables are of real value, practicable and usable.

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### Theme 5 – Training activities (Knowledge transfer, training and uptake, Guidance and tools)

- 5.1 To provide a series of Best Practice Guidance based upon the research outcomes
- 5.2 To disseminate, and support transfer of knowledge to the stakeholder communities
- 5.3 To provide public educational tools (web-based)

### Theme 6 – Project networking, harmonisation and monitoring

- 6.1 Link with external research and policy development activities
- 6.2 Provide internal coherence within the FLOODsite consortium (e.g. through the development of a common language of risk for flood management)
- 6.3 Integrate review and assessment into the project activities

### Theme 7 – Project co-ordination

- 7.1 To ensure effective and efficient overall management of the project, including administrative and financial aspects, communication with the commission, exploitation of results etc.

The project will deliver:

- An integrated, European, methodology for flood risk analysis and management
- Consistency of approach to the causes, impacts and control of flooding from rivers, estuaries and the sea
- Techniques and knowledge to support integrated flood risk management in practice
- Dissemination of this knowledge including the development of training media
- Networking and integration with other EC national and international research.

The FLOODsite Management Team has set out a vision for the project as:

- The results of our research will make a difference to the way flood risks are managed within member states of the EU and more broadly
- The partners will work together to support implementation of the research results in practice
- Implementation of the research results will ultimately benefit the citizens of Europe, through a reduction in flood risk and an improvement in resilience in the face of flooding
- The team will produce peer-reviewed scientific publications from their research.

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The early outcomes of the project include a common definition of the concepts in flood risk management, improved flood forecasting in small catchments, guidelines on the estimation of flood damages and improved understanding of the failure processes of embankments. By the end of the second project year over 130 papers have been presented or prepared for publication on the project science. Access to this material is available via the project website at [www.FLOODsite.net](http://www.FLOODsite.net)

### RELEVANCE TO THE UK DAMS INDUSTRY?

Since the primary focus of the FLOODsite Project is in improving Flood Risk Management practice, there are many aspects of the research work that are of relevance to the UK dams industry.

Research does not address explicitly specific issues on the performance of dam structures but will offer tools and methodologies that will be relevant when considering flood risk issues associated with reservoir operation. For example, the research includes hydraulic loading, wave overtopping, breach formation, flood inundation modelling, flood mapping, estimating flood impacts (socio-economic) etc.

The following sections provide a brief introduction to some of the more relevant tasks within FLOODsite. More detailed information can be accessed through the project website at [www.floodsite.net](http://www.floodsite.net)

#### Task 1 Identification of Flash flood hazards

The key objective of Task 1 is to advance the understanding of the major atmospheric and hydrologic factors leading to extreme flood events, especially those affecting small to medium ungauged basins (those with area less than 500 km<sup>2</sup>). This topic reflects the prominence of flash flooding in European flood mortality statistics.

#### Task 2 Estimation of extremes

Task 2 is focusing on the improved understanding of extreme events (river, estuarine and coastal extremes, incl. marginal extremes, joint probabilities, temporal and spatial variability).

#### Task 4 Understanding and predicting failure modes

Research under Task 4 will gather the substantial body of existing information of defence failure mechanisms and extend knowledge in a number of critical areas including geotechnical instability, crest and rear face erosion by wave overtopping and block removal by wave impacts

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### Task 5 Predicting morphological changes in rivers, estuaries and coasts

The research in this task aims to improve our ability to predict morphological change in the short and longer term through detailed analysis of coastal and riverine morphological processes and changes and how these relate to flood defence structure performance.

### Task 6 Modelling breach initiation and growth

Research here aims to extend existing capabilities in breach modelling with a particular focus upon breach initiation as well as growth.

### Task 7 Reliability analysis of flood defence structures and systems

The potential complexity of the relationship between the condition of individual elements of a flood defence and its overall performance is poorly understood and difficult to predict routinely (i.e. the combination of failure modes and their interaction and change in time and space). This task will focus on developing reliability analysis techniques that incorporate present process knowledge on individual failure modes and interactions between failure modes (collated through Task 4 above), interactions between failure modes and length effects of flood defences.

### Task 8 Flood inundation modelling methodologies

Over recent years many flood inundation models and have been developed using a range of modelling approaches (1-D, 2-D, 3-D and hybrid approaches). This topic aims to develop a consistent hierarchy of flood inundation methodologies exhibiting a range of complexities and capabilities linked with a range of data requirements. ). It will then seek to develop these capabilities through the innovative use of remote sensed data to facilitate rapid model construction.

### Task 9 Guidelines for socio economic flood damage evaluation

The aim of this task to is to develop harmonised guidelines on the socio-economic evaluation of the most important types of flood damage based upon systematic collation of existing experience and research results.

### Task 10 Socio economic evaluation and modelling methodologies

The overall objective of this task is to focus research efforts on innovative methods to understand, model and evaluate flood damage.

### Task 11 Risk perception, community behaviour and social resilience

The purpose of this task is to understand better the impacts of floods on communities, and their ability to respond and recover from the impacts that they bring. Major objectives of the task are (a) to characterise types of communities with regard to their preparedness, their vulnerability and the resilience related to flood events by means of indicator sets; (b) to understand the driving forces of human behaviour before, during, and after

floods; (c) to summarise the fieldwork results in terms of acceptable flood risks; and (d) to learn lessons from case studies in Germany, Italy and the U.K.

Task 14 Design and ex-ante evaluation of innovative strategies for flood risk management

To assess the sustainability of different comprehensive strategic alternatives for flood risk management in different situations.

Task 16 Real time guidance for flash flood risk management

This task aims to identify the best method for allowing the evaluation of flash-flood risk at a regional level. The two existing approaches for this are: (1) using 'classical' detailed hydrologic models, and (2) using the so-called Flash Flood Guidance FFG concept (developed in the US) that directly links rain or discharge thresholds to levels of risk.

Task 17 Emergency flood management – evacuation planning

The objective is to develop a methodology and tools for identifying appropriate emergency evacuation and rescue plans. These plans will consider two cases, rapid-onset flash flooding with little warning and extensive inundation of defended lowland areas (e.g. the Dutch polders).

Task 18 Development of a framework for long term planning

To provide a framework for the long-term planning of flood risk management using the skills base developed in Themes 1 and 2. The framework will include:

- An ability to integrate information on hazard processes, vulnerability and mitigation measures to differentiate between alternative long-term flood risk management strategies.
- An outline computer-based Decision Support System (DSS) that is relevant to all those involved in developing long-term flood risk management strategies including policy makers, their technical advisors and the general public.

Task 19 Development of a framework for flood event management planning

Task 19 will link knowledge and models from Themes 1 and 2 in a Decision Support System in support of emergency management planning and practice.

Task 20 Development of a framework for the influence and impact of uncertainty

To develop an approach and prototype software for propagating integral (total) uncertainty through integrated flood models.

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### Tasks 21-27 Pilot Studies

Tasks 21-27 each relate to a different Pilot Site within the project. Pilot sites are spread across Europe and include rivers, estuaries and coastal sites. The pilot sites are used interactively with the various research tasks to help ensure that the research work directly reflects and meets industry needs. The River Thames provides one of these pilot sites (Task 24). Research work here is closely linked with ongoing Environment Agency / Defra flood defence research and the Thames Estuary 2100 project.

### Tasks 28-31 Training, Dissemination and Raising Public Awareness

Tasks 28-31 form Theme 5 and are all related to communication and dissemination of the project work. An overall Communication and Dissemination (C&D) plan has been produced for the project under Task 28. Tasks 29, 30 and 31 deal with C&D via text based, web based and face to face (training) methods respectively.

Full details of the entire work programme may be found at: [http://www.floodsite.net/html/project\\_overview.htm](http://www.floodsite.net/html/project_overview.htm)

### OPPORTUNITIES FOR THE DAMS INDUSTRY?

HR Wallingford is acting both as overall project coordinator and also as technical researcher in many of the specific project tasks. In developing the proposal for this project, HR Wallingford also helped to ensure that the research goals were closely aligned with the recommendations of the DTI Foresight project on flooding, the themes of the Environment Agency / Defra joint research programme for flood and coastal erosion risk management and the Flood Risk Management Research Consortium (FRMRC) programme of work. Consequently, Defra and the Environment Agency are “affiliates” to the project consortium and also contribute to the overall project budget. An opportunity exists here to ensure that EA/Defra approaches to dam safety also build upon the extensive knowledge base that this work draws together along with the ongoing research work.

From the review of the project tasks above, particular topics in FLOODsite which would appear to be relevant to the dams industry would appear to be:

- Information from Tasks 1 and 3 for assess the probability of high inflows to the reservoir and joint probability with wind-generated waves
- The failure modes and probability for embankments (Tasks 4, 6 and 7)
- Methods for flood inundation modelling (Task 8)
- Emergency and evacuation planning (Tasks 17 and 19)
- Concepts of performance-based asset management (Task 24)

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- Socio-economic appraisal including damage potential and public attitudes (Tasks 9 to 11)
- Link between spatial planning and flood risk (Task 14)

The challenge will be to see what sort of regulation, if any, is needed and how information from this project is used within dam safety assessment and reservoir management work.

### More Information?

The project approach to dissemination of research is to make maximum use of the project website and to post research findings online at the earliest possible opportunity. An extensive website has been developed – and continues to expand – through which research reports, papers, conclusions etc may be found. In addition, users may also register to receive periodic newsletters which will advise upon research progress and key events.

[WWW.FLOODSITE.NET](http://WWW.FLOODSITE.NET)

## CONCLUSIONS

FLOODsite is an ambitious project which will maintain the world-leading position of Europe in knowledge and practice for flood risk management. The pilot studies draw together the development and testing of the project knowledge and will provide feedback from flood risk managers and river, estuary and coastal stakeholders. The use of the pilot sites and collaboration with executive agencies in several countries will ensure that FLOODsite deliverables are of real value, practicable and usable.

With the focus of research on Flood Risk Management there are many aspects of the research that should be of direct interest to the UK dams community. Research work is now well underway, with a research programme running from March 2004 until February 2009. Reports and associated research papers may be accessed online at [www.floodsite.net](http://www.floodsite.net)

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the FLOODsite Consortium is liable for any use of the information in this paper.

### REFERENCES

FLOODsite Consortium (2006). FLOODsite: Integrated Flood Risk Analysis and Management Methodologies. Annex 1 – Description of Work. 12th April 2006.