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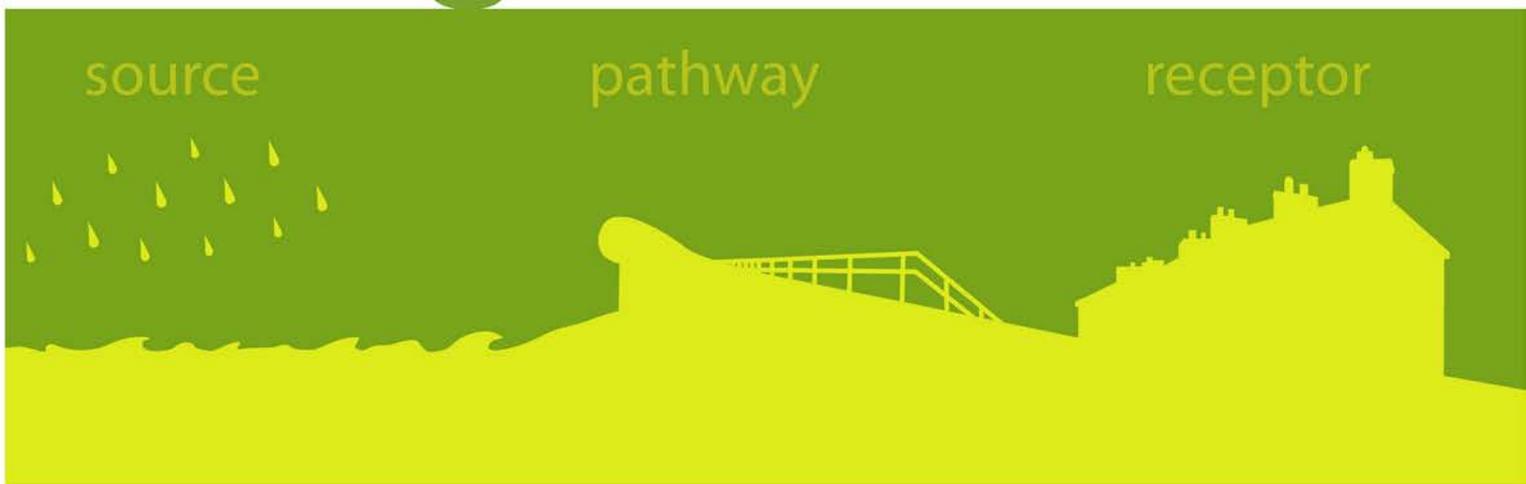


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## Benchmarking the efficiency of FCRM asset maintenance costs: Phase 2

Extended summary report – SC140026/R

We are the Environment Agency. We protect and improve the environment.

Acting to reduce the impacts of a changing climate on people and wildlife is at the heart of everything we do.

We reduce the risks to people, properties and businesses from flooding and coastal erosion.

We protect and improve the quality of water, making sure there is enough for people, businesses, agriculture and the environment. Our work helps to ensure people can enjoy the water environment through angling and navigation.

We look after land quality, promote sustainable land management and help protect and enhance wildlife habitats. And we work closely with businesses to help them comply with environmental regulations.

We can't do this alone. We work with government, local councils, businesses, civil society groups and communities to make our environment a better place for people and wildlife.

**Published by:**

Environment Agency, Horizon House, Deanery Road, Bristol, BS1 9AH

[www.gov.uk/government/organisations/environment-agency](http://www.gov.uk/government/organisations/environment-agency)

ISBN: 978-1-84911-399-1

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Email: [fcerm.evidence@environment-agency.gov.uk](mailto:fcerm.evidence@environment-agency.gov.uk)

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**Author(s):**

Harvey Frost, Ravi Kanabar, Meloria Meschi

**Dissemination Status:**

Publicly available

**Keywords:**

Efficiency, maintenance, cost benchmarking

**Research Contractor:**

FTI Consulting LLP

**Environment Agency's Project Manager:**

Harry Walton

**Theme Manager:**

Owen Tarrant

# Evidence at the Environment Agency

Scientific research and analysis underpins everything the Environment Agency does. It helps us to understand and manage the environment effectively. Our own experts work with leading scientific organisations, universities and other parts of the Defra group to bring the best knowledge to bear on the environmental problems that we face now and in the future. Our scientific work is published as summaries and reports, freely available to all.

This report is the result of research commissioned and funded by the Joint Flood and Coastal Erosion Risk Management Research and Development Programme. The Joint Programme is jointly overseen by Defra, the Environment Agency, Natural Resources Wales and the Welsh Government on behalf of all Risk Management Authorities in England and Wales:

<http://evidence.environment-agency.gov.uk/FCERM/en/Default/FCRM.aspx>.

You can find out more about our current science programmes at: <https://www.gov.uk/government/organisations/environment-agency/about/research>.

If you have any comments or questions about this report or the Environment Agency's other scientific work, please contact [research@environment-agency.gov.uk](mailto:research@environment-agency.gov.uk).

Professor Doug Wilson  
**Director, Research, Analysis and Evaluation**

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# 1 Introduction

The Environment Agency spends £214m per year (2016/17 figures) to maintain flood risk management assets. FCRM assets are defences, structures, channels, operable assets or natural features that reduce the risk of flooding to people and properties. Maintenance work is fundamental to the cost-effective management of these assets.

The Environment Agency commissioned FTI Consulting to advise on methods of benchmarking the cost efficiency of activities within its Flood and Coastal Risk Management (FCRM) asset maintenance programme. This project is in connection with Environment Agency's ongoing programme of work to track and improve asset management efficiency.

This note is a non-technical summary of the project's findings and is structured as follows.

- what is meant by 'cost efficiency' for asset maintenance
- why the Environment Agency should measure it
- how efficiency should be measured and why alternative rudimentary methods should not be used
- the work carried out to compile and prepare a suitable dataset
- the approach used for efficiency benchmarking
- the findings from the analysis
- an evaluation of the project's success
- recommendations for further work

The overall conclusion is that, while a robust method is identified, data quality is not yet good enough to apply it. The report is helping the Environment Agency to focus efforts to improve data quality.

## 2 What is meant by 'cost efficiency'?

Cost efficiency entails producing a given level of output (for example, maintaining the flood defence assets in a given FRM system to a defined standard) at the least possible cost of doing so.

To be cost efficient, asset managers should:

- use inputs (for example, staff, equipment, machinery) to their full potential
- choose the least costly combination of inputs

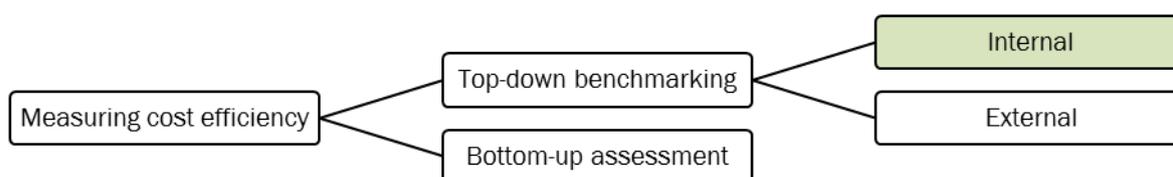
If, instead, inputs are not fully utilised (for example, equipment is lying idle) and/or unnecessarily expensive combinations of inputs are used (for example, using many hours of expensive manual labour when the same task could be accomplished much quicker and cheaper if the appropriate machine was hired), the Environment Agency would incur a higher cost than necessary to produce that output. This is cost inefficiency.

### 3 Why measure cost efficiency?

If FCRM maintenance work could be done more cost efficiently, then the same level of funding could be used to maintain a greater number of assets at their required condition, or to a higher standard where identified, that is, to deliver even greater value for money. Identifying best performers is a precondition to being able to spread best practice.

The first step in improving cost efficiency is to identify if there is scope for efficiency improvement.<sup>1</sup> The general approaches are summarised in Figure 4.1.

**Figure 4.1 Approaches to measuring cost efficiency**



There are 2 broad approaches to measuring efficiency: ‘bottom-up’ assessment<sup>2</sup> and ‘top-down’ benchmarking (the focus of this project).

‘Top-down’ methods measure efficiency comparatively; either by comparing the Environment Agency to other organisations (‘external benchmarking’) or by comparing FCRM asset maintenance units within the Environment Agency, identifying the most efficient unit, and measuring efficiency relative to this best practice (‘internal benchmarking’ – the focus of this project).

The efficiency measures produced by internal benchmarking can be used to:

- identify and locate best practice within the Environment Agency’s maintenance programme
- identify the scope for efficiency improvements
- inform later phases of work to investigate what drives these units’ efficiency and how this best practice can be disseminated across the entire programme

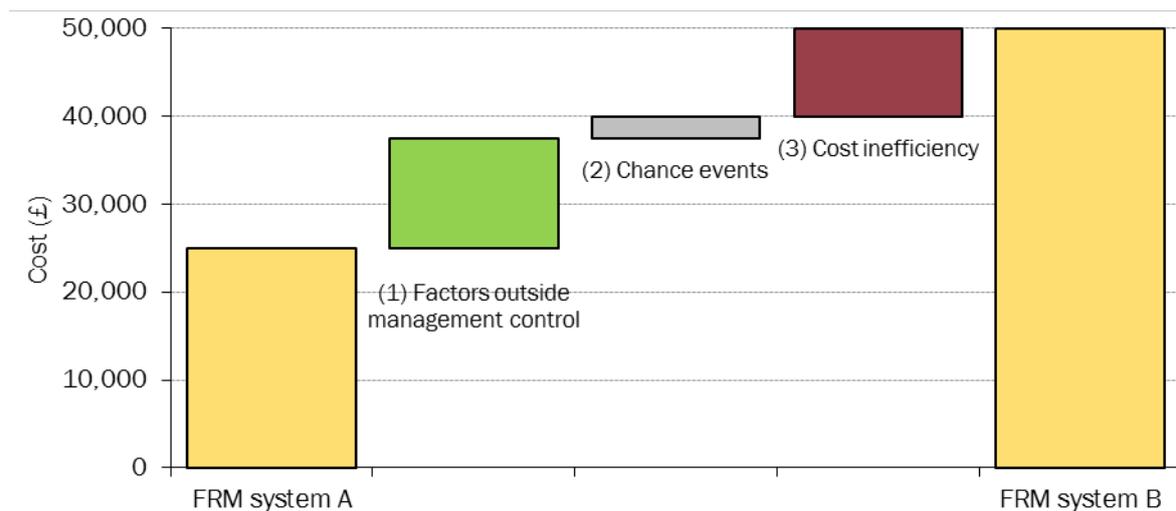
<sup>1</sup> ‘Efficiency improvements’ are distinct from ‘cost savings’. Costs savings can be achieved by cutting output (for example, doing less maintenance work or doing it to a lower standard). Efficiency improvement, however, involves reducing costs **without** sacrificing output – or alternatively, improving output, without increasing costs. Efficiency improvements lead to greater value for money. Cost cutting alone may not.

<sup>2</sup> These focus on identifying specific improvements in efficiency based on technologies or working methods, and often use engineering or time-to-task models. They are not the focus of this project.

## 4 How can cost efficiency be measured?

The Environment Agency's FCRM asset maintenance programme covers a wide variety of assets across 2,710 FRM systems spread throughout England – so variations in costs are to be expected. However, not all variations in cost are due to inefficiency. This is illustrated in Figure 5.1.

**Figure 5.1 Factors contributing to difference in costs**



For example, the Environment Agency may spend £25,000 maintaining one FRM system (A), but £50,000 maintaining another (B). However, this comparison tells us nothing about cost efficiency. There are many reasons, other than inefficiency, why system B could have higher maintenance costs.

- FRM system B could contain many more assets to maintain.
- FRM system B could be in a densely populated area which requires a higher standard of flood protection.
- FRM system B's assets could require more maintenance work because they are in a particularly poor condition, due to bad weather conditions and so on.

In general, variations in cost can be caused by differences in:

- (1) factors that drive costs but are outside management control (the green box in Figure 5.1)
- (2) chance events such as poor weather (the grey box in Figure 5.1)
- (3) cost inefficiency (the red box in Figure 5.1)

It is vital that (1) and (2) are taken into account so as to measure cost efficiency correctly. Simple comparisons of cost (for example, £25,000 for FRM system A versus £50,000 for FRM system B) or of easy-to-calculate performance ratios (for example, using metrics such as 'cost per km of embankment' or other key performance indicators) tend to overstate inefficiency, precisely because they fail to take (1) and (2) into account – either at all or completely

The statistical method applied in this project (that is, internal efficiency benchmarking using parametric cost frontiers) addresses these shortcomings. It is a state-of-the-art technique, widely used by UK regulators including Ofgem, Ofwat and the Office of Rail and Road (ORR). It complements the existing bottom-up projects that the Environment Agency is already running<sup>3</sup> and can share much of the data already collected by these initiatives.

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<sup>3</sup> These include the Creating Asset Capacity Management (CAMC) and Field Services Benchmarking projects.

# 5 Compiling and preparing a suitable dataset

FTI Consulting worked closely with the Environment Agency to tailor its recommendations to the Environment Agency's specific circumstances and project objectives. FTI Consulting determined that there were sufficient existing data to demonstrate its recommended approach as a proof of concept and asked the Environment Agency for these data.

The data requirements related to the following items, most of which were already available in the Environment Agency's existing databases:

- basic information about the FCRM assets and the FRM systems they belong to
- the costs incurred in maintaining these FRM systems in 2013 to 2014 or 2014 to 2015
- the amount of maintenance work that needs to be done (to be approximated using the number and type of assets, and the required maintenance standards)
- the prices paid for key inputs – average salaries, fuel prices, equipment hire rates and so on
- other factors which are outside management control but still affect maintenance costs including asset characteristics and environmental factors

The Environment Agency undertook to compile the relevant data and, in October 2015, provided the available data. These data were sufficient to demonstrate the techniques. The analysis consisted of the following 6-step process:

1. information and knowledge gathering
2. data request
3. data cleaning and further clarification requests
4. model development
5. model validation and refinement
6. efficiency assessment

# 6 Approach to efficiency benchmarking

The approach adopted involved:

- a significant emphasis on developing a clear understanding of the nature of the Environment Agency's data on:
  - maintenance costs
  - the factors that determine maintenance costs but are outside the control of the maintenance teams (that is, the cost drivers)
- developing a dataset suitable for efficiency benchmarking – this dataset relates to £41.0 million of costs<sup>4</sup> incurred by 1,994 FRM systems<sup>5</sup> in maintaining channels, defences and structures in 2014 to 2015
- using a state-of-the-art statistical method to estimate how differences in these maintenance cost between FRM systems can be explained by:
  - factors that drive costs but are outside management control
  - chance events and other factors for which there are no data
  - cost inefficiency
- demonstrating how the cost efficiency estimates can be presented and understood
- setting out detailed recommendations on how the analysis (and in particular, the dataset it is based on) can be improved and developed further so that its results can be used to drive efficiency savings

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<sup>4</sup> This is approximately 50% of the total amount (£84 million, 2014/15) allocated by the Environment Agency for on-the-ground maintenance activities. These are the costs that can be attributed to FRM systems, include all direct costs relating to FCRM asset maintenance of channels, defences and structures; and exclude costs that are not strictly incurred for maintenance. The remaining £42.6 million do not meet these criteria and so cannot be included in the analysis.

<sup>5</sup> All 2,710 FRM systems cannot be included because the data available are incomplete.

# 7 Key findings

There is significant variation in maintenance costs. The average cost was £20,000 per FRM system in 2014 to 2015, but it was far lower for some FRM systems than for others.

The statistical analysis was able to attribute about 35% of this variation to differences in factors that drive costs but are outside management control.<sup>6</sup> These cost drivers include:

- the number and type of FCRM assets in each FRM system
- the standard to which the Environment Agency has decided each FRM system needs to be maintained
- the actual condition of those assets
- the distance by road between FRM systems and the nearest Environment Agency depots
- the consequences of FRM system failure

The remaining 65% of variation in costs is attributed to, chance events, other factors for which no data were available, or inefficiency. Efficiency estimates can be produced from this leftover variation. These efficiency estimates can be used to:

- rank each FRM system from 1 (being the most cost efficient) to 1,631 (being the number of FRM systems for which it was possible to estimate efficiency)
- estimate the potential for efficiency savings for each FRM system<sup>7</sup>

Given the relatively low explanatory power of the model (that is, it is currently only able to explain 35% of the variation in costs), the efficiency estimates cannot be relied upon at this stage. Illustrative estimates are presented in the full technical report, but they should not be relied upon until the recommendations in the next section are implemented, and the analysis repeated and developed further.

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<sup>6</sup> The effect of all these cost drivers is consistent with economic theory, and has been cross checked and agreed with the experience of the Environment Agency's asset maintenance and engineering practitioners.

<sup>7</sup> These summary statistics can be produced by Operations Area Team, Operations Area, Area, or any other aggregation desired by the Environment Agency.

# 8 Evaluation of the project's success and recommendations for further work

This project is the first time that any formal efficiency benchmarking has been applied to the Environment Agency's FCRM asset maintenance costs. Efficiency benchmarking is now widely used by UK regulators including Ofgem, Ofwat, and ORR. However, it has taken these regulators a number of years to develop their analysis to a point where reliable efficiency benchmarking was possible. By commissioning this project, the Environment Agency has made significant progress along a similar path.

The project has demonstrated how the Environment Agency's rich datasets can be combined with state-of-the-art statistical techniques to benchmark maintenance cost efficiency between FRM systems. For this reason, the project is considered a success.

But perhaps the most important output is not the set of efficiency estimates themselves, but rather the detailed list of recommendations set out in the technical report. The strongest recommendations relate to:

- improving the quality, accuracy and completeness of the Environment Agency's existing data
- collecting the additional data that were not available
- extending the time horizon of the analysis beyond one year

Once these recommendations have been implemented, the Environment Agency should repeat the analysis performed so as to develop and improve the efficiency benchmarking models further. The aim should be to develop efficiency estimates that are sufficiently reliable to identify the most efficient FRM systems. This, in turn, will enable the Environment Agency to:

- investigate the factors that cause inefficiency
- spread the best practice across the entire FCRM maintenance programme
- make efficiency savings
- drive significant improvements in value for money without having to compromise on the level of protection from flood risk

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