

Research to define metrics for measuring progress in surface water flood risk management

Final

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**Committee on Climate Change
Adaptation Sub Committee**

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Contract

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Purpose

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Acknowledgements

Appendix A contains a full list of the organisations who contributed to this report. In addition, we would like to acknowledge the contribution from Paul Sayers and Partners, who provided new analysis for this report.

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Executive summary

This research was commissioned following the Adaption Sub Committee's (ASCs) second statutory assessment of the National Adaptation Programme in June 2017. The 2017 report highlighted that the responsibility for managing surface water flooding is fragmented, mainly between water companies, highways authorities and lead local flood authorities. The analysis also concluded that the extent to which current activity is effectively tackling this challenge is unclear. Therefore, the ASC is interested in defining improved metrics to measure progress in managing the risk of surface flooding at a local level, and based on the available data, collate these metrics to gain a national picture of the progress being made.

The management of surface water flooding has emerged and evolved as a discipline in itself over the last 10 years, following the major floods of summer 2007. The risk is significant and coupled with this are the complexity and fragmentation of arrangements for surface water management in England. Overland surface water flows are dependent on infrastructure to manage surface water drainage. The condition of the surface water drainage network is deteriorating over time¹, whilst ownership and funding for maintenance and repairs are often contested. This presents a very real challenge for surface water management and one where climate and population change are not the only driver for increased risk into the future.

This research has considered the use of both existing and new metrics to assess progress that has been made in surface water management at both a national and local level. The advantages, disadvantages and possible unintended consequences of using different metrics within the groupings of Risk, Ways of working and Delivery have informed the recommended metrics.

The analysis has found that it is not currently possible to compile a set of populated metrics that could be used to measure the progress in management of surface water flood risk because:

- The data is not currently collected;
- The lack of compatible standards results in an inconsistency in reporting between Risk Management Authorities (RMA); or
- They are not currently collated nationally.

Therefore, in the present circumstances, the national assessment of progress made in this report using metrics from respective parties should be treated with caution as it does not provide a complete picture and could contain data that is inconsistent. This report identifies a series of gaps in data and information that if addressed, could enable a complete national assessment of progress to be completed in future.

A National Assessment of Progress

Understanding risk

- 2.5 million households in England are currently in areas at risk of flooding from surface water, with expected annual damages of £300 million. However, estimates do vary as broadscale data (generated using national assumptions about flood model inputs and nationally available input data that may not account for very localised specifics e.g. drop kerbs in ground level data, property thresholds etc.) is used to assess risk at a national level.
- A key challenge is the lack of recorded information on surface water flooding incidents year on year. The main reason for this is that the information is reported to different organisations who do not necessarily record or share data consistently.

¹ CIWEM (2017) Government review of surface water management – paper presented to Defra in November 2017

Some data is available by source, for example, in 2016/17 5,690 properties were affected by internal sewer flooding and 33,481 properties by external sewer flooding². Formal flood investigations undertaken by Lead Local Flood Authorities provide local information but are not undertaken in consistent circumstances so are not possible to easily collate into national figures of properties affected. However, surface water flooding is complex and can be difficult to apportion to any one source due to complex interactions between different parts of the drainage system.

- Flood risk is expected to increase in the future due to a variety of factors, including climate change, population change, aging infrastructure, lack of capacity in existing networks and new developments. There are currently only broadscale estimates of what this might mean at a national scale. For example, by the 2080s the number of residential properties at risk of surface water flooding is expected to increase by 20%³. Because the frequency of surface water flooding is likely to increase, those properties currently at relatively low risk will become more susceptible to flooding in future and hence surface water flooding will cause greater disruption and economic damage to those affected².
- There is very little consistent data available at a local level (some areas have better coverage of this than others) that provides a detailed understanding of the interactions between drainage systems owned and maintained by different RMAs and third parties and hence there is not a shared understanding of local flood risk on which to make informed decisions in partnership. This is important because the performance of one part of the drainage network is often dependent on another e.g. water floods from highway gullies because the receiving sewer is at capacity.

Ways of working

- Many of the existing metrics measure process rather than outcomes. This makes it challenging to identify the difference that these factors have made to actual progress in managing surface water flood risk. What this data does show is that progress by Lead Local Flood Authorities (LLFAs) has been mixed and in some cases delayed, for example by January 2015, 57% (86) LLFAs had developed a register of their assets, but the content varied and 47% of the 152 LLFAs had policies available which set out when a Section 19 (Formal) Flood Investigation will be undertaken⁴. It is also possible that relevant data on flooding incidents is collected outside of the formal reporting requirements (as evidenced during the collection of information for the Brighton and North Yorkshire Test Cases).
- The picture with respect to collection of information is evolving, for example, the Government's Single Data List is changing to capture how various activities such as flood investigations and asset management have informed further work. However, this data will be largely qualitative and difficult therefore to collate and use to present a national picture on progress.
- Information on Ways of Working tends to be collected on an organisational basis, hence a picture can be established for one organisation, but it may be challenging to collect across the board. For example, the number of staff allocated to flood risk management in each LLFA has increased from an average 2 Full Time Equivalent (FTE) to 3.5 FTE. However, what is harder to establish are the total resources across all organisations committed to managing risk in any one geographical area e.g. Environment Agency Strategic Overview role and from others such as Water Companies and Internal Drainage Boards. This example

² Water UK et al. (2018) Discover Water website <https://discoverwater.co.uk/sewer-flooding> [Access date 25 May 2018]

³ Paul Sayers (2018) Additional surface water flooding statistics from the Future Flood Explorer provided specifically for this project

⁴ ASC (2017) Monitoring and evaluating the National Adaptation Programme; People and the built environment theme

illustrates that further work is needed to understand the capacity of all RMAs involved in surface water management and how this capacity is translating into enhanced effectiveness in managing risk.

Delivery of outcomes

- Current metrics mostly focus on Outcome Measures (and largely residential properties protected) from the Environment Agency’s Forward Investment Programme, as that is the information that is collected and collated at a national level. For example, the current six year Investment Programme should deliver 82,000 homes at reduced risk of surface water flooding and the average cost benefit ratio of a scheme is 7.66.
- The Investment Plan has been analysed to compare the funding and outcomes for surface water schemes between schemes managing different sources of risk.

Key findings are that:

- 25% of the schemes in the future programme are identified as primarily addressing surface water flood risk;
- This represents 6% of the total investment; and
- 9% of the total outcomes, in terms of homes at a reduced risk of flooding
- Many small scale local measures and quick wins⁵ have been carried out, funded by water companies and/ or Local Authorities, but the size of such works is normally small and the overall impact in reducing surface water flood risk is not routinely quantified.
- There is no clear understanding of how overall investment by RMAs is reducing overall surface water flood risk. This is because most information on the benefits of work is collected at a project level and where the benefits can be easily quantified e.g. through physical flood alleviation works. In addition to this, because different RMAs work to deliver different outcomes and against different regulatory timescales, there is often not a shared understanding of the overall magnitude of the impact of surface water flood risk management work in any one geographical area.

Recommended metrics

A comprehensive list of metrics has been developed for this project that seek to measure the effectiveness of surface water management in relation to the understanding of risk, ways of working and delivery of outcomes. These have been prioritised in terms of how critical they are to the understanding of progress being made in surface water management.

Table 1 shows those metrics considered to be most critical. Central to the understanding of risk are the establishment of current and future baseline positions that are agreed and used by all partners. Further to this, and to meaningfully understand the effectiveness of surface water management, are metrics that measure the shared understanding of the drainage network and the overall effectiveness of actions every party is taking to understand the risk.

⁵ Quick wins can be considered as simple, low cost and straightforward actions that can alleviate localised flooding, without making things worse elsewhere. For example, the installation of a trash screen to stop a culvert blocking.

Table 1-1 Metrics that are critical to understanding progress in surface water management

Metric type	Suggested metric	Further work needed
Current risk	<p>No. of properties at risk of flooding and/ or predicted flood damages now for any given scenario. This data could be zoned to show the varying degrees of risk.</p> <p>Ideally to provide a baseline this would be based on assuming no drainage capacity, so that the impact of interventions can then be considered. The Surface Water Zones demonstrated by the Brighton and Hove case study would be one way to achieve this.</p>	<p>Current estimates of risk are broadscale and may over or underestimate the problem. At a local level partners need to work together to agree a shared baseline for managing the overall risk in an area.</p>
Future risk	<p>No. of properties at risk of flooding now and/ or predicted flood damages for any given scenario for a given point in the future (2080 is commonly used at present for long term projections). This data could be zoned to show the varying degrees of risk.</p> <p>Ideally to provide a baseline this would be based on assuming no drainage capacity, so that the impact of interventions can then be considered. The Surface Water Zones demonstrated by the Brighton and Hove case study would be one way to achieve this.</p>	<p>There is no nationally consistent mapping of future surface water flood risk. The application of climate change allowances can vary between RMAs. At a local level partners need to work together to agree a shared future baseline for managing the overall risk in an area. This needs to be updated over time as better information becomes available on the likely impacts of climate and land use change on flooding.</p>
Current risk/ Asset Management/ Standards	<p>Identification of ownership of assets relied on for management of risk.</p> <p>This would provide an understanding of the interdependencies between assets owned and managed by different RMAs/ Riparian Owners and develop a shared local understanding of drainage capacity</p>	<p>Currently RMAs work to different regulatory cycles and standards and can manage different parts of the drainage network in silos. On the ground, what happens in one part of the drainage network will affect another and at a local level partners need to work together to develop a shared understanding of the drainage network.</p> <p>Further consideration is needed as to how this would be measured.</p>
Changes in surface water risk	<p>Provides a measure of the quantum of risk reduction that has been achieved against the current/ future baseline.</p> <p>Could be measured by number of properties and/ or flood damages avoided.</p>	<p>By developing a shared understanding of local risk and interdependencies, partners can work together to prioritise the work that will have the greatest overall effect on reducing surface water flood risk. Effectively this would be measuring shared outcomes between RMAs.</p>

Strategic Recommendations

The recommended metrics are a mixture of those currently collected and those suggested throughout the course of this project. Any new metrics need careful consideration, with regards to who collects the data, how the information is managed and communicated and being mindful that reporting does not place an undue burden on RMAs. In effect, the collection of metric data should in itself drive a change in how local flood risk is managed, rather than be collecting data for its own sake. A clear driver is also needed for RMAs to undertake additional reporting. The following strategic recommendations/ next steps are therefore made:

1. Organisations need to be clearly tasked with (and if appropriate, funded for) data collection and collating progress on a national level, beyond the mechanisms and metrics that currently exist
2. National expectations should be established with regards to consistent standards of service for flood risk management partnership working and for the systems performance of assets relied on to manage risk (allowing for the fact there are no common standards)
3. Investment in flood risk management should clearly and consistently evidence shared outcomes for all sources of flooding and among RMAs
4. Consideration is needed to the method and frequency of updating the assessment of future flood risk, given that projections of changes in climate are periodically updated and hence influences the size and nature of the risk and the subsequent level of adaptation required

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The following appendices are available on request from the ASC

Appendix D: Metrics long listing spreadsheet

Appendix E: February 2018 Workshop Handout

Appendix F: Brighton and Hove Test Case Summary Report

Appendix G: North Yorkshire Test Case Summary Report

Appendix H: Greater Manchester Test Case Summary Report

Appendix I: Investment Plan analysis results for figures and charts

Please note that the latest Environment Agency Investment Plan is available from the [government website](#). Individual scheme information is not available in this appendix.

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Abbreviations

ADA	Association of Drainage Authorities
ADEPT	Association of Directors for the Environment, Planning and Transportation
AEP	Annual Exceedance Probability
AGMA	Association of Greater Manchester Authorities
AMP	Asset Management Plan
ASC	Adaptation Sub Committee
BHCC	Brighton and Hove City Council
CCC	Committee on Climate Change
CC Water	Consumer Council for Water
CCRA	Climate Change Risk Assessment
CIRIA	Company providing research and training in the construction industry
CIWEM	The Chartered Institution of Water & Environmental Management
CM	Capital Maintenance
DEF	(Flood or Coastal Erosion) Defence
Defra	Department for the Environment, Food and Rural Affairs
DfT	Department for Transport
DTM	Digital Terrain Model
EA	Environment Agency
EU	European Union
FCERM	Flood and Coastal Erosion Risk Management
FLAG	Flood Action Group
FRM	Flood Risk Management
FTE	Full Time Equivalent
FWMA	Flood and Water Management Act
GI	Green Infrastructure
GIA	(FCERM) Grant in Aid
GMCA	Greater Manchester Combined Authority
HMEP	Highways Maintenance Efficiency Programme
IDB	Internal Drainage Board
LEP	Local Enterprise Partnership
LFRMS	Local Flood Risk Management Strategy
LGA	Local Government Association
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LRF	Local Resilience Forum
MHCLG	Ministry for Housing, Communities and Local Government
NAP	National Adaptation Programme
NFM	Natural Flood Management
NYCC	North Yorkshire County Council
OFWAT	The economic regulator of the water sector in England and Wales
OM	Outcome Measure
PLP	Property Level Protection

PLR	Property Level Resilience
PR19	Price Review 2019
RESIN	Climate Resilient Cities and Infrastructure Project
RFCC	Regional Flood and Coastal Committee
RMA	Risk Management Authority
Section 18 (FWMA)	Regarding annual reporting by LLFAs to the EA
Section 19 (FWMA)	Regarding the production of formal Flood Investigations
Section 21 (FWMA)	Regarding the production of significant asset registers
Section 104 (Water Industry Act)	Regarding the adoption of sewer by WaSCs
SFRA	Strategic Flood Risk Assessment
SPD	Supplementary Planning Document
SUDS	Sustainable Drainage Systems
SW	Surface Water
SWM	Surface Water Management
SWMP	Surface Water Management Plan
UKCIP	UK Climate Impacts Programme
WaSC	Water and Sewerage Company

1 Introduction

Summary

This study has been commissioned by the Adaptation Sub-Committee (ASC) of the Committee on Climate Change (CCC). The objective of the study is to develop a national understanding of the progress that has been made in England in managing surface water flooding. The report identifies which metrics can be used to establish a measure of progress in surface water management and assembles these to present a picture of progress that has been made, alongside discussing areas for further work.

1.1 Aims of the Research

This research was commissioned following the ASC's second statutory assessment of the National Adaptation Programme (NAP) in June 2017. The report highlighted that the responsibility for managing surface water flooding is fragmented, mainly between water companies, highways authorities and lead local flood authorities. The analysis also concluded that the extent to which current activity is effectively tackling this challenge is unclear. Therefore, the ASC is interested in defining improved metrics to measure progress in managing the risk of surface flooding at a local level, and based on the available data, collate these metrics to gain a national picture of the progress being made.

The specific research questions posed were:

1. How much national funding (FCERM Grant-In-Aid) is being spent on managing surface water flood risk as part of the six-year investment plan? How much local (partnership) funding are these projects leveraging, and what are the sources of these funds? What outcomes and benefits will these surface water projects achieve in comparison with river and coastal flood alleviation schemes?
2. How is (or could) progress in managing surface water flood risk be measured at the local level?
3. What are the advantages, disadvantages and possible unintended consequences of using different metrics?
4. How can national and local data best be combined to assess the progress being made in managing surface water flood risk in England?
5. What types of interventions are contributing the most towards this progress, and what are the costs and benefits of these?

1.2 Purpose of this study

The UK government will set out its objectives and policies for adapting to climate change, including the impacts of current and future surface water flooding, in its second National Adaptation Programme (NAP), expected to be published in summer 2018. In the following year the ASC will make its statutory report to parliament based on the second NAP, considering the actions being taken to adapt to these impacts, and how vulnerability to surface water flooding is changing over time. This research has identified metrics that will assist the ASC in assessing progress made in surface water management. This research has also identified several limitations in the management of surface water flooding that contribute to the current and future risk and lack of clarity. These are also identified to assist the ASC in developing its next statutory report and may help inform future recommendations to government.

1.3 Geographic scope

The geographic scope of the study is England. Scotland, Wales and Northern Ireland are subject to different regulatory and legislative regimes with significant differences in the management of surface water. The range of approaches continues to diversify between the nations of the UK. For example, the Welsh Government recently consulted on draft statutory instruments and national standards needed to implement Schedule 3 of the Flood and Water Management Act 2010 for the use of Sustainable Drainage Systems (SUDS) on new developments.

1.4 Target audience

The main audience for this report is the ASC of the CCC as it is intended to inform the ASC's progress report on the implementation of the NAP. However, this report will also be of interest to government organisations and departments responsible for flood and coastal erosion risk management (FCERM) planning, policy, programmes and funding. Therefore, other interested parties may include: Defra, the Environment Agency (EA), Regional Flood and Coastal Committee (RFCC) chairs and members, Lead Local Flood Authorities (LLFAs), Water and Sewerage Companies (WaSCs) and Coastal Authorities and Coastal Groups.

1.5 Structure of report

This report is structured as follows:

- Chapter 2 outlines the methodology we have applied to this research,
- Chapter 3 provides background on roles and responsibilities for the management of surface water. It also considers the likely scale of the surface water flood risk challenge, both now and in the future,
- Chapter 4 sets out a logical framework for assembling surface water metrics,
- Chapter 5 explores in detail how progress in different areas of surface water management might be measured and the advantages and disadvantages of doing so,
- Chapter 6 considers what this research means in the national context, and
- Chapter 7 provides conclusions and recommendations.

2 Methodology

Summary

Recognising the complexities of the project, a Scoping Stage was undertaken to consult with stakeholders and undertake an initial literature review. Key observations from the Scoping Stage were used to inform the approach for the remainder of the study.

Following a stakeholder workshop and the production of an organising framework, potential metrics were categorised into those for measuring 'Risk', 'Ways of Working' and 'Delivery'. These were then explored in detail with local stakeholders in the Test Case areas of Brighton and Hove, North Yorkshire and Greater Manchester, respectively.

Using the outcomes from the Stakeholder Workshop and Test Cases, we then explored in more detail how progress in managing surface water flood risk might be measured at both a local and national level. This work has been conducted in parallel with the Water UK 21st Century Drainage Programme, the Government programme on surface water management and the Ministry of Housing, Communities and Local Government (MHCLG) SUDS review.

2.1 Overview

The following approach was undertaken:

1. A Stakeholder Engagement Plan was developed to ensure a wide range of views from across the industry were considered at suitable stages in the Project. This is included as Appendix A.
2. Recognising the complexities of the project, a Scoping Stage was undertaken to consult with stakeholders, undertake an initial literature review and refine the approach and programme.
3. A long list of metrics was developed and short-listed for further consideration.
4. A Stakeholder Workshop was held to feedback on the project so far and inform the development of surface water metrics.
5. An analysis was undertaken of the Environment Agency's Forward Investment Plan to explore surface water schemes in more detail.
6. Potential Surface Water Metrics were explored through three Test Cases.
7. Recommendations for surface water metrics and an analysis of national progress were then made.

2.2 Scoping Interviews

The interviews were conducted by telephone with key national stakeholders (listed in Appendix A) and covered the following areas:

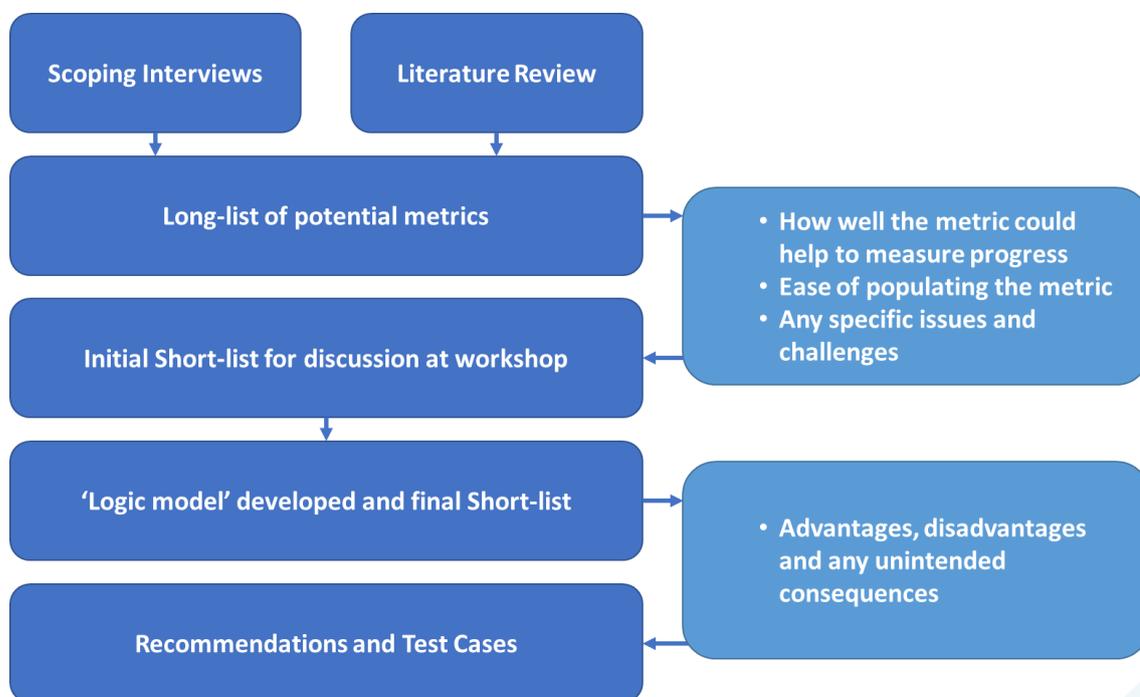
- Aspects of surface water risk management that we should be trying to measure
- Current metrics collected that people are aware of
- Challenges that might be encountered in identifying appropriate metrics
- The way forward: what metrics should be collected and what data would be needed?
- Thoughts on project methodology

Findings and insights from the consultations influenced the identification of a long-list of metrics, shortlisting approach, content of the Stakeholder Workshop and the areas explored in the Test Cases.

2.3 Metrics long and short listing

The process for developing the metrics is shown in Figure 2-1.

Figure 2-1 Process for developing metrics



A long-list of metrics was developed (provided in a standalone report addendum available on request from the ASC), based on:

- Metrics already collected
- Current initiatives that have proposed new metrics
- Potential new metrics suggested by the Scoping Stage Stakeholders

The outcomes of the Scoping Stage were used to organise these into three groups:

- Metrics that capture the risk of flooding
- Metrics that capture ways of working
- Metrics that capture delivery of outcomes

These categories and further sub-categories are shown in Table 2-1. Metrics were initially short-listed on the basis of:

- Those of most relevance to surface water management
- How well the metric could help to measure progress in surface water management
- Ease of populating the metric (although since this is an exploratory piece of research, this was not considered to be a sufficient reason, by itself, to not take a metric forward)
- Any specific issues and challenges regarding the use of that metric

Table 2-1 Organising framework for the development of metrics

Metrics that capture the risk of flooding	Metrics that capture ways of working	Metrics that capture delivery of outcomes
Actual Current Current and future Future	Asset management Community Investigations Local delivery Partnerships Planning Resources Standards Strategies	Asset management and maintenance Awareness Environmental Insurance Investment Local measures Partnerships* Planning Property Level Resilience Schemes

*Partnership working was later considered under Ways of Working

This initial list of metrics is provided in a standalone report addendum (available on request from the ASC) and was discussed at the Stakeholder workshop. Drawing on responses from the workshop we then developed a Framework to refine and develop the metrics on the basis of understanding the root causes of current and future surface water risk. The framework considers the input, outputs and outcomes of surface water management, together with the impact these have on overall flood risk. This is explained further in Chapter 4.

The short-list was then finalised, using additional metrics suggested at the workshop and some slight adjustments made to categories. The advantages, disadvantages and unintended consequences of the metrics were explored further through the Test Case areas, with further adjustments made to the recommended metrics as suitable. This is covered in Chapter 5.

2.4 Stakeholder Workshop

The workshop was held in February 2018. All the stakeholders interviewed and Test Case representatives were invited to the workshop. The objectives of the workshop were to:

- Provide a reminder of the project aims and objectives and how this links to other ongoing work by the ASC and others
- Give an update to all stakeholders on the work so far, including the long list of metrics and an initial short list
- Obtain stakeholder input to consider the advantages, disadvantages and potential unintended consequences of using different metrics

It was clear from the discussions in the workshop that in developing metrics there is a need to identify where the gaps are in terms of an industry wide response to manage and reduce surface water flood risk. Several factors, alongside climate change, were also identified that are likely to lead to an increasing risk e.g. aging assets, fragmented roles and responsibilities, loss of permeable surfaces resulting from increased development etc.

It was therefore recognised that the project could usefully identify the nature and scope of such gaps and, by highlighting these, make recommendations on how these might be addressed in the future management of surface water flooding.

It was agreed that it will be possible to identify some metrics to assess progress in managing surface water flood risk, but alongside this it would be beneficial to highlight where further work is needed to try and co-ordinate and lead an industry wide response e.g. where programmes are on different time cycles, where different RMAs work to different standards of protection and where different approaches are taken to asset management or planning responses.

2.5 Analysis of the Investment Plan

The 2017/18 version of the 2015/16 to 2020/21 Investment Programme was obtained from the Environment Agency and analysed per Regional Flood and Coastal Committee (RFCC) area to identify project costs, funding and outcomes.

2.6 Test Cases

Table 2-2 shows the Test Case areas that were used in this research. There were chosen to represent a spread across the country and different surface water management challenges. It is important to note that the Test Cases were entirely exploratory in nature. They were not intended to measure performance of organisations in managing surface water in the areas chosen, rather to highlight the challenges for surface water management and help develop potential metrics for assessing progress.

Table 2-2 Test Cases

Test Case	Reason for using	Metrics and areas that were explored in detail	Reason for focus
Greater Manchester	Large City Conurbation with substantial surface water flood risk	Focus on 'Delivery' metrics	Numerous activities on the ground include Natural Flood Management (NFM) and Properly Level Resilience (PLR). Combined Authority with statutory planning powers across 10 unitary authorities.
Brighton and Hove	Smaller urban Unitary authority with few watercourses but substantial surface water flood risk and some groundwater flooding	Focus on 'Risk Reduction' metrics	Innovative approaches being used to identify surface water flood risk zones
North Yorkshire	Large rural County with dispersed surface water flood risk	Focus on 'Ways of Working' metrics	Multiple partners involved given Two Tier Local Government structure and large geographical area

As part of the Test Cases, the following tasks were undertaken:

- Desktop review of local plans, policies and approaches
- Interviews/ meetings with Local Stakeholders to discuss:
 - Flood risk issues locally
 - Local activity on surface water flood risk management and how this could be measured
 - Thoughts on the other metric groups
 - Views on climate change adaptation
 - Key considerations regarding surface water management
- Summary Reports were produced for the Test Cases to explore the use of Metrics in more details for those areas.

The outcomes from the Test Cases have been used to explore the potential surface water metrics and areas that need further work, set out in Chapter 5.

2.7 Scaling up the effectiveness to a national scale

Chapter 6 describes how this work has been undertaken.

2.8 Links to other ongoing work

This work was undertaken at the same time as other emerging work. To ensure links between the work, representatives from these other projects were interviewed at the Scoping Stage and invited to the Stakeholder Workshop. The Project Manager for this research also attended relevant workshops hosted by Water UK and Defra/ MHCLG.

- MHCLG SUDS review to assess the effectiveness of planning policy in delivering SUDS in new developments. This research follows a commitment in the Housing and Planning Act (2016) to “*carry out a review of planning legislation, government planning policy and local planning policies concerning sustainable drainage.*”⁶ At the time of writing this Report, this Review was not yet available.
- Government programme on surface water management. Defra has identified five Action Areas and an implementation timetable is expected to be published this Spring.
 1. National position: strengthening emergency planning for extreme rainfall scenarios
 2. Effective collaborative working
 3. Skills and capacity
 4. Maps and data
 5. Forecasting
- Water UK 21st Century Drainage Programme, provides for the development of a framework for water companies’ long-term planning for drainage and wastewater. In future, Water Companies will produce Drainage and Wastewater Management Plans for their areas.
- The 21st Century Drainage Programme has brought together the water companies with regulators and stakeholders, to identify the major risks for drainage in the future and provide options for how these risks could be addressed. The programme is considering the vulnerability of wastewater catchments to sewer flooding and developing a way of assessing available capacity within foul and

⁶ HM Government (2016) Housing and Planning Act, Section 171

combined sewerage systems. Water Companies will use this information to justify their business plans for the 2019 Price Review (PR19).

- The report from a joint Defra and Water UK workshop in January 2018 was made available to inform this research and has been fed into the recommendations from this report⁷.

⁷ CAG Consultants and Atkins (2018) Collaborative approaches to surface water management, drainage and wastewater resilience. Report from stakeholder workshop, 23 January 2018

3 The Management of Surface Water

Summary

The management of surface water flooding has emerged and evolved as a discipline in itself over the last 10 years, following the major floods of summer 2007. The risk is significant, with 2.5m properties at risk today⁸ and projections suggesting the frequency and severity of surface water flooding will increase by the 2080s.

Coupled with this are the complexity and fragmentation of arrangements for surface water management in England. Overland surface water flows are dependent on infrastructure to manage surface water drainage. The condition of the surface water drainage network is deteriorating over time, whilst responsibility for ownership and funding for maintenance and repairs is often unclear. This presents a very real challenge for surface water management and one where climate change is not the only driver of increased risk into the future.

3.1 Background

Following the severe flooding during the summer of 2007, the independent Pitt Review (2008) and subsequent legislative changes, Upper Tier Local Authorities (County and Unitary Authorities) became Lead Local Flood Authorities (LLFAs), with various powers and statutory duties to manage and co-ordinate local flood risk management activities. The scale of the challenge should not be underestimated. At the time of the 2007 floods, the Environment Agency estimated that 2/3 of the 55,000 properties that were flooded were affected by surface water.

The main legislation for local flood management is the Flood and Water Management Act (2010), with sections of this enacted in stages through secondary legislation since 2010. Not all sections have been enacted in England, most notably those on SUDS adoption and reducing the limit for reservoir legislation to 10,000m³.

Local flood risk covers flooding from surface runoff, groundwater and smaller watercourses (known as Ordinary Watercourses). The legal definition for surface runoff (in the context of flooding) in the Flood and Water Management Act (2010): "*Means rainwater (including snow and other precipitation) which— (a) is on the surface of the ground (whether or not it is moving), and (b) has not entered a watercourse, drainage system or public sewer.*"⁹

However, surface water flood risk management introduces the potential for interdependencies that affect the performance and management of assets and operations across different infrastructure sectors. It can be challenging to define the boundaries of "surface water flood risk" because interactions between overland flows, watercourses and pipe networks are often complex and the cause of flooding is not clear. In addition, groundwater flooding generates surface flows that are exacerbated by local rainfall and can result in flooding.

Consequently, whilst LLFAs lead on the management of surface water flooding, there are multiple partners involved in managing the overall drainage network that can contribute to the issues. LLFAs work in partnership with other organisations including the Environment Agency, which manages flooding from generally larger rivers (known as Main Rivers) and the sea; Internal Drainage Boards (IDBs) which manage low lying areas; District Councils and infrastructure / utility providers, such as Water Companies and Highways Authorities. These are known as Risk Management Authorities (RMAs).

8 Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017: Evidence Report
9 HM Government (2010) Flood and Water Management Act

3.2 Roles and responsibilities for surface water management

Table 3-1 sets out the main organisations involved in surface water management and the key interactions with the LLFA role. The role of the LLFA is explored in further detail in the next section.

Table 3-1 Roles and Responsibilities in relation to Surface Water Management

	Main role (in relation to surface water management)	Typical interactions with LLFAs
Water Companies	Maintain the public sewer network. Emergency responder (Category 2 in the Civil Contingencies Act, 2004)	Represented on Strategic FRM Partnerships Day to day communications on specific issues
Environment Agency	Maintain the Main River network and coastal flooding defences Strategic Overview for all forms of flooding Emergency responder (Category 1 in the Civil Contingencies Act, 2004)	Represented on Strategic FRM Partnerships Day to day communications on specific issues
Internal Drainage Boards	Maintain Ordinary Watercourse in IDB Districts, where these exist	Represented on Strategic FRM Partnerships* Day to day communications on specific issues
District Councils in two tier areas, where there is also a County Council In Unitary Council areas, all of these duties are undertaken by the same Council, who is also the LLFA	Are the Local Planning Authority for residential and commercial development Emergency responder (Category 1 in the Civil Contingencies Act, 2004) Maintain some legal powers to do works on Ordinary Watercourses	Consult LLFA as a Statutory Consultees Represented on Strategic FRM Partnerships* Day to day communications on specific issues
Highways Authorities (local roads)	Maintain the highways drainage network under adopted roads	Are the same Council as the LLFA The LLFA often, but does not always, sit within the Highways function
Highways England (Trunk Roads and Motorways)	Maintain the highways drainage network	Interaction tends to be on specific issues
Utilities	Assets may be part of, or interact with the drainage network e.g. culverts under railways, cables and ducting can sometimes run through underground drainage pipes	Interaction tends to be on specific issues
Community Groups	Local knowledge and potential capacity to take action on a local level	Tends to be on specific issues and often follows flooding The Defra Pathfinder Projects (2013 to 2015) explored ways in which LLFAs could support

	Main role (in relation to surface water management)	Typical interactions with LLFAs
		communities to become more resilient to surface water flooding.
Local Resilience Forums (LRFs)	Responsibility to plan for, respond to and support recovery from surface water flooding	The Secretariat of the LRF will often sit in the same Council as the LLFA The Upper Tier Authorities that are LLFAs are all Emergency responders (Category 1 in the Civil Contingencies Act, 2004), although the LLFA function itself has no specific emergency response duties
Local Enterprise Partnerships	Can provide funding towards schemes, where these meet LEP objectives	During development of programmes and funding bids e.g. for EU funding
Regional Flood and Coastal Committee	To influence and approve National Flood and Coastal Erosion Risk Management Grant in Aid (GIA) and Regional Local Levy funding towards surface water schemes	Most (but not all) LLFAs have a direct Councillor seat on the RFCCs most relevant to them for
Catchment Partnerships	Have some influence over the delivery of environmental programmes of work and Natural Flood Management	The relationships and relevance will vary. LLFAs may liaise with internal colleagues or attend meetings directly.

*One organisation may represent a number of similar organisations on Strategic FRM Boards

3.3 The role of the Lead Local Flood Authority

There are both strategic and operational elements to the role of LLFA. Strategically, a Council needs to develop, maintain, apply and monitor a Local Flood Risk Management Strategy. Operationally, a Council has a duty to investigate flooding incidents, hold a flood risk management asset database and has powers to designate third party assets where they have an impact on flood risk (so that they cannot be removed or altered without permission from the LLFA). LLFAs also regulate land drainage activities, including consenting to works and enforcement on Ordinary Watercourses outside of Internal Drainage Board (IDB) areas. Additionally, in 2015, LLFAs became a statutory consultee for major planning applications for sustainable drainage designs.

There are now 152 LLFAs with responsibility for surface water management. Approaches will vary between them, based on skills, capacity and experience unlike other organisations with national or regional coverage, such as the Environment Agency and Water Companies. This makes the assembly of data and information on progress on surface water management challenging to collect on a consistent basis nationally.

Within areas with two-tier local government, the lower tier councils have duties and responsibilities under the Land Drainage Act (1991). In practice, some lower-tier authorities maintain a drainage capability, and may be delegated some of the responsibilities of the LLFA, whereas in other areas lower-tier authorities do not retain an effective drainage capability and their Land Drainage duties are exercised by the LLFA.

3.4 Sustainable drainage responsibilities

For many years, LLFAs had been expecting Schedule 3 of the Flood and Water Management Act (FWMA) to be enacted. This would have made them SUDS Approving Bodies (SABs) and they would have been responsible for approving, adopting and maintaining SUDS on new developments. The automatic right for developers to connect to the sewerage network would have been dependent on SUDS being installed. The purpose of SUDS is to mimic natural drainage, significantly reduce surface water runoff and the resulting pressure on sewers and improve water quality. Typical SUDS measures include rainwater harvesting, permeable paving, swales, ponds and landscaped attenuation areas that only hold water after rainfall.

After a number of delays over a five-year period, implementation of this legislation was postponed indefinitely. Instead, in April 2015, LLFAs became a statutory consultee to the planning process. When considering planning applications for major developments, Local Planning Authorities (LPAs) must consult the relevant LLFA on the management of surface water. LPAs need to ensure that, using planning conditions or planning obligations, there are clear arrangements in place for the lifetime maintenance of SUDS.

LLFAs in turn provide technical advice on the surface water drainage strategies and designs put forward for new developments. Their role is to check that these are in line with relevant SUDS standards and guidance and that the new development will not increase flood risk either off site or to future users of the development. National non-statutory SUDS standards exist and many LLFAs have chosen to develop supplementary local SUDS guidance that set out local SUDS requirements, which may be given further weight in planning terms by being written into Local Planning Policy. Where the LLFA is a County Council and not therefore the LPA for residential and commercial development, this can become complicated because Local Planning Policy is written at a District/ Borough level.

The change of approach nationally from a SUDS adopting authority to one that works via planning approvals means that the ongoing adoption and maintenance of SUDS is

still unresolved nationally. No one authority or company has responsibility and on a site by site basis developers must come up with local solutions. There is a strong possibility that some of the private maintenance arrangements being put in place will not maintain SUDS as private maintenance companies can fail. LPAs have limited resources for planning enforcement and are likely to seek support from LLFAs, who would have a duty to investigate, should such failures cause locally significant flooding. In 2016, CIWEM¹⁰ undertook an industry wide survey on SUDS uptake in new developments. The survey identified four policy and institutional barriers that need to be addressed by central government to improve the update of SUDS: weak planning policy, local authorities having insufficient resource to drive and enforce good quality SUDS, a lack of clarity around SUDS adoption and weak standards creating poor quality schemes.

3.5 Capacity and funding challenges

The implementation of local flood risk management has been affected as the new responsibilities for FRM came at a time of severe austerity for local government. Local Authorities are faced with a funding crisis, with increasing costs, most notably in adult social care, at the same time as central government funding cuts and uncertainty about long term funding. In addition to this, funding for flood management for LLFAs is not ring-fenced, meaning that Councils could choose to spend it on areas they perceive as higher priority at any particular time e.g. social care, schools, highways etc.

In the workshop discussions, there was a perception that the level of service for FRM has largely been driven by local politics and unless an area has seen recent severe flooding, that it can be hard for a Council to give flood management the priority and resources it needs to manage risk to a level that the public and policymakers might expect.

Central government funding can be a challenge, for example LLFAs do not get Flood Defence Grant in Aid revenue funding to maintain Ordinary Watercourses and only receive approximately a fifth¹¹ of what it costs them to operate as a statutory consultee for planning. Without funding and flood risk management being perceived as a high priority or at least an area to not cut funding for, capability and capacity can suffer¹².

3.6 Water Companies

Water Companies have a duty to provide, maintain and operate systems of public sewers and works for the purpose of effectually draining their area. This duty is specified in Section 94 of the Water Industry Act (1991).

Water Companies are regulated by OFWAT and develop 5 year rolling investment plans to meet targets that are agreed as priorities by their customers. They are currently in Asset Management Plan 6 (AMP6) from 2015 to 2020 but are proactively developing their Business Plans now for AMP7 from 2020 to 2025.

The targets set out for Water Companies in their Business Plans for AMP periods have largely driven how Water Companies have worked in partnership to resolve surface water flooding. A sticking point tends to be the definitions in the Water Industry Act regarding what they are technically responsible for and can legally adopt. For surface water drainage, this has been interpreted as primarily below-ground piped drainage systems and excludes systems which drain land not within the curtilage of a building. Increasingly though, Water Companies are showing flexibility and starting to adopt

10 CIWEM et al. (2017) A Place for SUDS

11 JBA (2016) Survey Results Analysis (for the ADEPT Flood and Water Group)

12 CIWEM (2017) Government review of surface water management – paper presented to Defra in November 2017

some types of SUDS and work in partnership with other RMAs to resolve complex flooding issues, where sewer flooding is a contributing factor. This is as a result of recognition by the industry, its regulators and stakeholders, of the needs to provide more resilient¹³ and sustainable solutions to manage surface water flood risk, focussed on outcomes to customers and the environment¹⁴, and of the multiple benefits of SUDS systems when compared to piped drainage systems.

Sewers for Adoption 8 is due for imminent publication and has been informed by legal advice regarding the definition of a sewer and what is adoptable¹⁵. It will set out for the first time which SUDS can be adopted and in what circumstances. OFWAT are developing an Adoption Code for clean water and wastewater systems to be published in 2019 that will be informed by Sewers for Adoption 8.

3.7 Current levels of surface water flood risk

Nationally, 2.5 million households in England are currently in areas that are at some risk of flooding from surface water, with expected annual damages of £300 million¹⁶. It can be hard, however to get an accurate understanding of the properties at risk as these estimates are based on broad scale national surface water mapping. The likelihood of properties flooding depends on property type, floor levels, the local topography e.g. does land slope away or towards a property and often complex interactions between surface water and the local drainage network.

The impact of surface water flood risk can to be different to other sources of flood risk because:

- It can happen with little or no warning
- It is often flashy (responds quickly to rainfall) and flooding does not last long, but can be relatively disruptive
- It is often shallow, so very minor differences to the local environment, such as kerb levels and fences can make a big difference to what gets flooded
- Flooding can happen relatively frequently in some areas but affect relatively few properties compared to river flooding. Hence the risk could be similar to areas at risk of river flooding that flood less frequently, but it can be challenging to find a cost-effective solution to flooding issues. This is due to there being lower numbers of properties at risk in local area compared to relatively high costs required to address this risk as solutions are not always straightforward.
- People are often not aware they are at risk of flooding until it happens. This is partially because the source of the flooding is not always visible as a river or the sea

13 OfWAT (2017) Resilience in the Round. <https://www.ofwat.gov.uk/wp-content/uploads/2017/09/Resilience-in-the-Round-report.pdf>

14 OfWAT (2017) Delivering Water 2020: Our final methodology for the 2019 price review. <https://www.ofwat.gov.uk/wp-content/uploads/2017/12/Final-methodology-1.pdf>

15 Water UK (2017) Sewers for Adoption 8: Revised Principles Paper

16 Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017: Evidence Report

3.8 Future increases in surface water flood risk

By 2080, the number of residential properties at risk of surface water flooding is expected to increase by 20%. In addition, properties that are at low risk now are likely to see more instances of surface water flooding in the future and this will cause greater economic damage. Surface water flood risk to infrastructure will increase too, with greater lengths of roads and railways and more schools and hospitals at significant and moderate risk of flooding¹⁷.

There are also other factors that are likely to increase surface water flood risk in the future. The 2017 ASC Report Progress in preparing for climate change highlighted that *"evidence suggests a significant and increasingly severe lack of capacity in the sewer network to cope with heavy rainfall events. The scale of the investment to tackle this issue has yet to be assessed and the ownership of the problem is fragmented between national and local government and the water industry"* and that *"New development is highly likely to be adding pressure to existing drainage networks. There is little confidence amongst industry professionals that current policy is delivering high quality sustainable drainage systems."*

Other key factors affecting future flood risk can be summarised as:

- Surface water drainage infrastructure is aging and this makes it vulnerable to failure or collapse
- Complex and fragmented management arrangements mean that ownership of surface water drainage assets is often disputed
- No dedicated funding stream for the overall maintenance of surface water assets, with an over reliance on riparian owners to maintain watercourse and culverts that can often exacerbate surface water flooding
- Population increases may increase the number of people living in areas of surface water flooding
- Actions taken to adapt to surface water flooding may help to mitigate against some of the increases in flood risk, but are unlikely to completely mitigate against it¹⁸

This means that at the same time that rainfall and river flows are increasing, the surface water drainage network is deteriorating, and actions are not necessarily being taken to maintain or replace assets.

Increases in surface water flood risk will not be uniform across the Country, given differences in topographic and climatic conditions as well as the vulnerability of receptors to surface water flooding.

New developments also have the potential to increase surface water inflows to the network unless strict regulation and governance are in place locally to hold water back using SUDS systems.

17 Paul Sayers (2018) Additional surface water flooding statistics from the Future Flood Explorer provided specifically for this project

18 Sayers and Partners (2015) Climate Change Risk Assessment 2017: Projections of future flood risk in the UK
The report considered actions to reduce the probability of flooding from all sources, such as improving defences, managed realignment on the coast, catchment management and urban runoff management through the use of SUDS. It found that current levels of adaptation can offset a significant proportion of the projected increase in flood but will not be sufficient to completely offset all of the projected increases under either a 2°C or 4°C climate change projection. Under more extreme climate change current levels of adaptation would do little to prevent a significant increase in risk.

4 A Framework to Assess Progress

Summary

A logic model has been developed to present the research. This considers the underlying problems causing surface water flood risk, the activities required to address these problems and the outcomes that these activities should achieve in reducing surface water flood risk. This can be considered into terms of the input, outputs and outcomes of surface water management, together with the impact these have on overall flood risk.

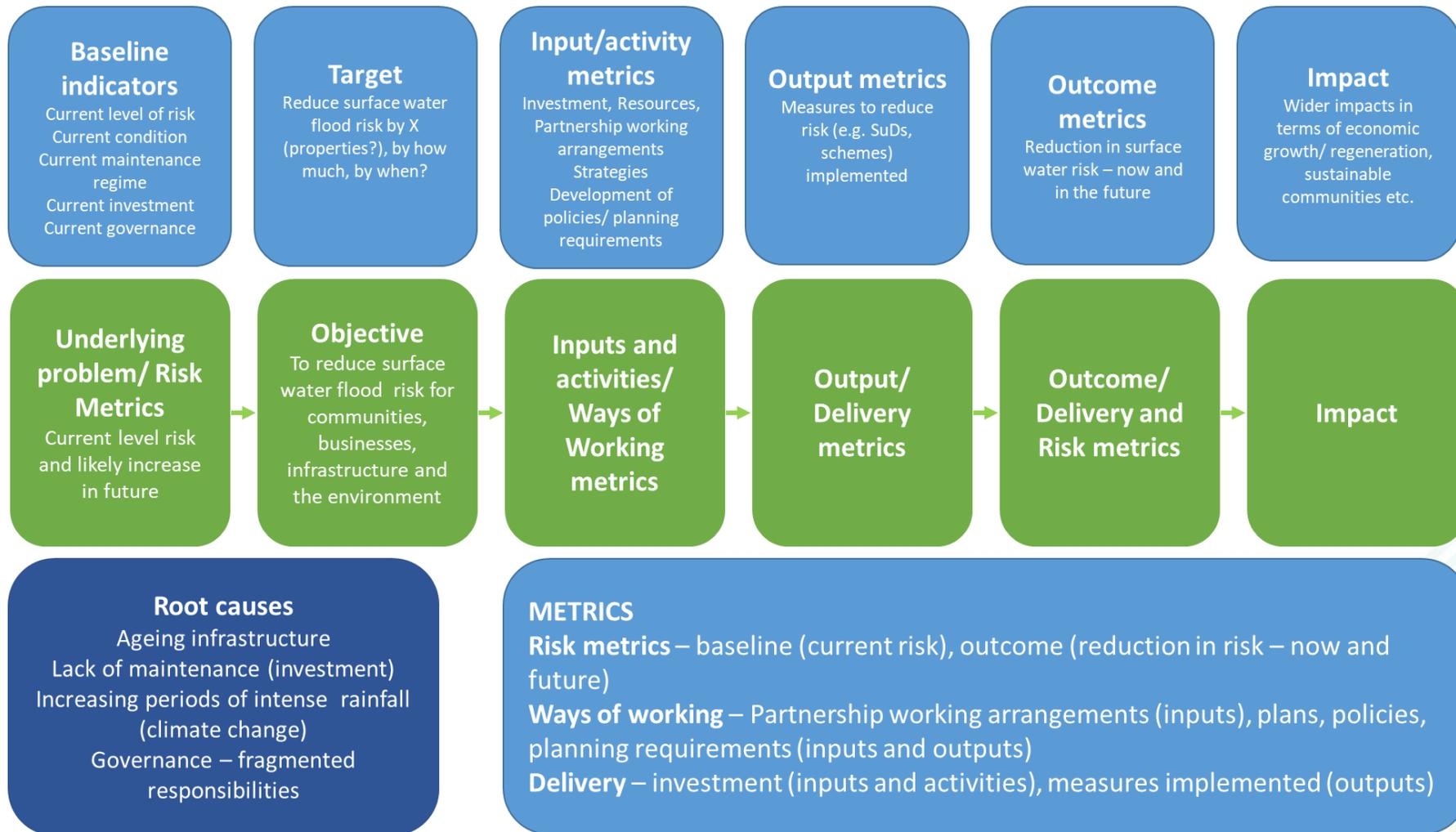
The stakeholder workshop discussions identified that several factors, in addition to climate change, that are likely to lead to an increasing risk of surface water flooding in the future. These include aging assets, fragmented roles and responsibilities and a loss of permeable surfaces. Therefore, it was agreed that the study needed to consider the root causes of current and future risk and the development of metrics that can measure the degree to which root causes are being addressed.

To provide a structure against which to present the research, we took a 'logic model' approach in which we considered the underlying problems causing surface water flood risk, the activities required to address these problems and the outcomes that these activities should achieve i.e. addressing the underlying problem. This approach was taken because it helped provide a logical structure for considering the interaction between the different types of metrics. The logic model is shown in Figure 4-1.

This can be used to organise metrics into:

- Inputs – this largely relates to Ways of Working metrics
- Outputs and Outcomes – this largely relates to Delivery metrics
- Impacts – in terms of establishing a baseline and over time measuring progress against this baseline, this largely relates to the Risk metrics

Figure 4-1 Logic model for considering surface water metrics



5 Developing the metrics

Summary

The existing and any proposed new metrics identified through this project or supporting research have been considered in groups of those that measure surface water flood risk, those that capture ways of working and those that measure delivery of outcomes. The advantages, disadvantages and any unintended consequences of the metrics have been taken into account alongside the testing of the metrics in the Test Cases to determine a final list of recommended metrics.

5.1 Introduction

Figure 2-1 in Chapter 2 shows the process of developing the metrics. This Chapter uses the outcome of the workshop convened in February 2018 together with the consideration given to the outputs from the test cases, to further consider the initial list of metrics and identify recommended metrics. The 'understanding the problem/ risk' metrics draw on the Brighton & Hove Test Case, the 'inputs and activities/ ways of working' metrics draw on the North Yorkshire test case and the 'delivery, output and outcome' metrics draw on the Greater Manchester test case.

Appendix B contains full lists of the existing metrics and new metrics proposed during this project for each metric grouping. It also contains a table with reasons for those that were screened out at the initial stages of the project.

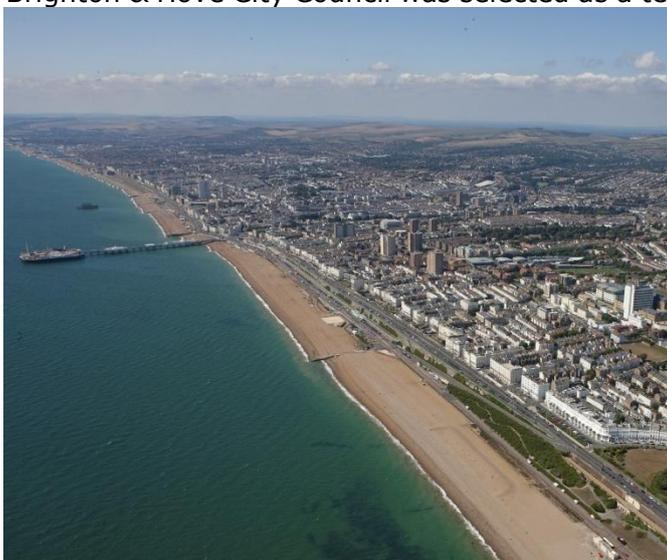
Appendix C contains full details of the assessment of the advantages, disadvantages and any potential unintended consequences of the metrics in each grouping that have been used alongside the Test Cases to propose a further short-list of metrics for additional consideration. Some metrics were modified from those initially proposed as part of this process.

The full Test Case summary reports are not published in this report but are available to the ASC.

5.2 Understanding the problem/ Risk Metrics

5.2.1 Overview of the understanding of surface water flood risk in Brighton and Hove

Brighton & Hove City Council was selected as a test case due to the surface water flood risk challenges faced by the established urban conurbation, the Unitary Authority status with statutory planning responsibilities for development planning and flood risk management, current work underway to address flood risk at a strategic level through the Brighton & Hove City Council (BHCC) Strategic Flood Risk Assessment (SFRA) and the proposed Supplementary Planning Document (SPD). In addition, there are activities on the ground to address surface water flood risk including Property Level Resilience (PLR) to address flood risk from surface



water that affects the level of future risk, together with an historic problem with flooding from groundwater. Brighton and Hove is a defined area of “significant flood risk” (“Flood Risk Area”) as defined in the Flood Risk Regulations (2009) and the lack of ‘fluvial features’ (rivers and watercourses) has to date stifled the application of a strategic management approach based on fluvial Flood Zones (there are none).

The management of risk relies heavily on drainage infrastructure owned, maintained and operated by Southern Water. The performance of these assets is critical to the standard of protection afforded to the existing and proposed community, although to date it is understood that there has only been a limited degree of partnership working at a strategic level.

Being a unitary authority BHCC has also faced challenges in securing the implementation of new development that addresses surface water flood risk strategically. Going forward BHCC has identified that a strategic approach will be essential to meet the challenges posed by climate change and that these must be delivered in partnership with providers of surface water infrastructure.

Actual risk

A database is held on the locations of all known flood events. Since there are no rivers, nearly all rainfall generated events involve surface water flooding, making the database more reliable than is normally the case. A comparison has been made between locations where events have been observed and those shown on the Risk of Flooding from Surface Water mapping. This exercise suggested that the mapping was reflecting the areas of highest risk and where it might be expected that risk would become an increasing management priority in future.

Current risk

BHCC is aware of the importance of understanding the basic characteristics of the measures in place to manage surface water flood risk and so has compiled data on areas of the city that drain to soakaways; areas that contribute to combined systems and areas that discharge to surface water sewers or culvert systems. In addition, data on the location and species of trees is used to identify locations where gullies could become blocked by leaf drop. BHCC also has a comprehensive dataset on gully drainage collection systems and the location of highway drainage. Since it is a unitary authority BHCC is responsible for preparing a Strategic Flood Risk Assessment, Local Flood Risk Management Strategy and Surface Water Management Plans. This overarching involvement provides for the assembly of risk data that can be used to assess and manage surface water flood risk.

Current and future risk

BHCC has little existing information on the actual current and future risk, as much of the capacity to prepare such data rests with Southern Water. Going forward it is the intention that BHCC and Southern Water will work together more closely, making it possible to identify priorities and put in place strategic funding that delivers flood risk management and benefits to water utility customers.

Future risk

To date there has been little information available on how risk might change under climate change conditions. The most recent update to the SFRA does include data on the change to risk due to climate change and is accompanied by a SPD that gives more refined guidance with respect to SUDS requirements. A capital programme of work to improve the resilience of properties to surface water flooding is in place and funding has been secured from numerous sources. It is accepted that the measures do not address the root cause of the flooding and were considered as a ‘last resort’ at the time they were conceived. In future it would be the intention to consider a wider range of responses to address the effects of climate change.

5.2.2 Testing the metrics for Brighton and Hove

The proposed metrics have been applied to the information available for Brighton and Hove.

<p>Actual risk</p> <p>Proportion of 'at risk' properties that flooded in the last year (internally) <i>Such information could be abstracted from the Council database and compared against the current properties at risk data.</i></p> <p>Sewer flooding – internal (Existing metric)</p> <p>Sewer flooding – external (Existing metric) <i>Such information would need be provided from Southern Water.</i></p>									
<p>Current risk</p> <p>Total number of properties at risk <i>This could be provided based on the latest available datasets used by the LLFA or derived using the Surface Water Flood Zones prepared for the SFRA (as the Zones describe the potential number of properties relying on surface water flood risk management measures to control the consequences)</i></p>									
<p>Future risk</p> <p>Changes in surface water flood risk (New metric) – evaluated in Brighton test case. <i>Again this can be derived using the Climate Change Surface Water Flood Zones prepared for the SFRA (as the Climate Change Zones describe the potential number of properties relying on surface water flood risk management measures to control the consequences)</i></p> <p>Changes in surface water flood risk <i>Analysis using the Surface Water Flood Zones provides an indication of the magnitude of the surface water flood risk that will need to be managed under climate change conditions. The following table summarises the results of a simple analysis to determine the increase in properties potentially affected by flood risk and so requiring some form of management so the consequences are acceptable.</i></p>									
<table border="1"> <thead> <tr> <th style="background-color: #4F81BD; color: white;">Scenario</th> <th style="background-color: #4F81BD; color: white;">Number of Residential Properties affected</th> </tr> </thead> <tbody> <tr> <td>Surface Water No Drainage 1% AEP +40% rainfall intensity (SW Flood Zone + climate change)</td> <td>9156</td> </tr> <tr> <td>Surface Water No Drainage 1% AEP (SW Flood Zone)</td> <td>6215</td> </tr> <tr> <td style="background-color: #4F81BD; color: white;">Difference</td> <td style="background-color: #4F81BD; color: white;">2941</td> </tr> </tbody> </table>		Scenario	Number of Residential Properties affected	Surface Water No Drainage 1% AEP +40% rainfall intensity (SW Flood Zone + climate change)	9156	Surface Water No Drainage 1% AEP (SW Flood Zone)	6215	Difference	2941
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Surface Water No Drainage 1% AEP (SW Flood Zone)	6215								
Difference	2941								
<p><i>The results show an increase of approximately 50%. Further consideration would need to be given, not just to the number of properties affected by a 1 in 100 event, but also the consequences of more frequent flooding for events with a higher chance of occurrence.</i></p>									

5.2.3 Recommended metrics

The following metrics are recommended for further consideration.

Table 5-1 Recommendations for Risk metrics

Area	Recommendation	Details
Actual risk	Proposed metrics	<p>Proportion of 'at risk' properties that flooded in the last year</p> <p>Sewer flooding – internal (Existing metric)</p> <p>Sewer flooding – external (Existing metric)</p> <p>These metrics should continue to be collected and used over time to validate metrics relying on analysis and modelling.</p>
Current risk	Proposed metrics/ Further work needed	<p>Total number of properties at risk gives an oversight of the risk but needs to be used with caution.</p> <p>Consideration could be given to the identification of surface water flood zones that are described by the 'potential risk'. This approach is adopted for river and sea flooding and has been accepted as a planning tool. This approach would also potentially address the unintended consequence of the outputs being used to evaluate risk at an individual property level.</p>
Current and future risk	Further work needed	<p>Should be considered further, but in combination with an assessment of the wider sources of surface water flooding in any one area, working across stakeholders to present a complete picture.</p>
Future risk	Proposed metrics/ Further work needed	<p>Changes in surface water flood risk (new metric) – evaluated in Brighton test case</p> <p>Consideration should be given to collection of data from all stakeholders to assemble a broader picture of the investment. Consideration should also be given to which future scenarios should be considered e.g. increased rainfall, population growth, urban creep etc.</p>

5.3 Inputs and Activities to manage Surface Water Flooding/ Ways of Working metrics

5.3.1 Overview of Ways of Working in North Yorkshire

North Yorkshire was selected as a test case as an example of a large and mainly rural area, with dispersed surface water flood risk. In addition, the Local Government structure is two tier, with the LLFA sitting at County level and other functions, such as the Local Planning Authorities sitting with the seven District/ Borough Councils. In addition to this there are the North York Moors and Yorkshire Dales National Park Authorities. With so many stakeholders, we wished in particular to explore metrics regarding 'Ways of Working' (so the inputs and activities element of the logic model). However, to build a complete picture, it was useful to gain an understanding of the local flood risk challenges in the area, objectives for managing risk, outputs and outcomes.

North Yorkshire is England's largest County by area. It is mainly rural, with a population of over half a million people scattered over 3,200 square miles. Larger towns include Harrogate, Northallerton, Ripon, Richmond, Skipton, Selby and Scarborough and there are over 5,600 miles of public highway and 730 Parish Council areas. Surface water flood risk is dispersed across a number of settlements and not concentrated in any one place.



Surface water flood events on their own tend to affect small numbers of properties in isolated pockets, but the widespread river flooding of 2012 and 2015 demonstrated how complex interactions are between different sources of flooding. Surface water flooding in these events was caused by river levels blocking outfalls from discharging and by river water overwhelming underground drainage networks. The flooding highlighted capacity issues with the surface water drainage network and where watercourses have not been maintained, showing the weaknesses in the drainage network.

The most complex, high profile and shared flooding issues where surface water is an element are in Tadcaster and Malton. This is due to there being both surface water and river flooding issues in the same area. Groundwater flooding can also be an issue in some areas, such as Malton.

Flooding near Old Malton, North Yorkshire¹⁹

Asset Management Each RMA has a different system and protocol for recording asset information and takes a different approach to maintenance of their assets, depending on funding and priorities. Some areas rely on a joint operational response to asset management e.g. Malton, where water is pumped out to the river to stop surface water flooding. It is not always feasible to hold detailed information on entire asset inventories e.g. for highways drainage pipes under thousands of km of road.

Community Involvement In high profile locations there are Flood Action Groups/ active Community Leaders that work with the RMAs e.g. Tadcaster Flood Action Group, Malton, Norton and Old Malton Flood Partnership (a multi-agency liaison group). Community Flood Grants exist in some areas (such as Ryedale), which encourage communities to take a lead and become more flood resilient, although the take up of this has been limited. North Yorkshire specific advice leaflets have been created for

¹⁹ © Pauline E, Licensed under <https://creativecommons.org/licenses/by-sa/4.0/>

riparian ownership, Natural Flood Management and Property Flood Resilience and RMAs attend the Yorkshire Show together to promote flood resilience.

Flood Investigations The LFRMS sets out the characteristics of a flood that will be considered to determine if a formal report is undertaken. There is no set threshold, but significant property flooding is likely to trigger an investigation. Nine Formal Flood Investigation Reports have been published. The LLFA also undertake informal flood investigations and there have been 168 investigations in total over the last 7 years. Other RMAs also undertake their own investigations and have different triggers for these e.g. Yorkshire Water have a standard process and system for investigating internal/ external sewer flooding.

Planning The LLFA receive around 800 major applications a year, with major developments in the A1 corridor and in the areas around Leeds, Harrogate, Selby and York. Minor applications are reviewed on a prioritised basis on request from the Local Planning Authority when resources allow.

Resources These vary across the RMAs and it is difficult to identify the exact amount of resource for surface water management in North Yorkshire as patches vary:

- The LLFA has 1 Team Leader and 3 Engineers
- Yorkshire Water have two dedicated FRM staff covering their region. Localised flooding issues are dealt with by network teams.
- The Environment Agency offer a Strategic Overview and support for local flood risk management, with 1 officer taking a lead role in this
- The capacity of IDBs varies, depending on size, funding and the direction of members to get involved in bidding for funds for capital works and planning responses.
- The capacity of District Councils varies, Scarborough have the most, due to the coastal engineering need. Some are Commissioning Councils that contract out specialist services like engineering.

North Yorkshire County Council contribute £359k per year to Local Levy. Since 2014 NYCC have received just under £5m from FDGiA and since 2016 £70k from Local Levy (note that additional funding has come into the County to other RMAs, including the District Councils. The annual budget for the LLFA is £950k, of this £359k funds the Local Levy contribution and currently £200k is internally ringfenced for FRM projects. The capital fund can be used as a contribution towards any scheme (not specifically for surface water) and can vary between years e.g. in 2016 a contribution of £750k was made to the Skipton scheme.

Yorkshire Water’s AMP6 Business Plan committed £84M over 2015-2020 to address sewer flooding, and an additional £8M for partnership schemes. This was not, however, available disaggregated to the LLFA area.

5.3.2 Testing the metrics for North Yorkshire

The proposed metrics have been applied to the information available for North Yorkshire

Partnerships

Whether Strategic Flood Partnerships meet regularly and how these are structured

(Yes) Multi-Agency meetings are held on specific issues such as Tadcaster and Malton. Other arrangements vary - there is some office sharing with the LLFA and Environment Agency, Quarterly Senior Strategic meetings between the EA and North Yorkshire County Council (NYCC), the LLFA contributes to Catchment Partnership

meetings and attend the Northumbria Integrated Drainage Partnership and there is regular day to day dialogue between all RMAs.

Who is represented on Partnerships

All RMAs get involved in Partnership working. The Partnerships are extended to relevant others where appropriate e.g. National Park Authorities, Natural England and the Rivers Trust for Natural Flood Management (NFM) and the Local Enterprise Partnership (LEP) regarding funding for schemes.

Information on the areas of work that Flood Partnerships are involved in

The Partnerships largely meet to discuss scheme work.

Planning

Reflection of LLFA Guidance in Local Planning Policy

(Partially) NYCC have produced SUDS Guidance to support their LLFA role. The District Councils, National Park Authorities and County Council (for Minerals, Waste and County Developments) are all Local Planning Authorities and there will be some inconsistency between LLFA SUDS Guidance and Local Planning Policy as updates to the Local Plans work to different timescales.

Planning Permissions for major developments granted by LPAs contrary to LLFA advice on SUDS

Percentage of as built SUDS in accordance with Planning Permissions granted

Percentage of SUDS being maintained in accordance with management plans

There is no information available to inform these as this information is not collected

Standards

Partnership schemes delivered where the management of surface water has been clearly identified as an element of the scheme

(2) Major schemes are being developed for Malton and Tadcaster where surface water is a critical consideration. A study is also currently underway for resolving multiple flooding issues at Great Ayton.

Strategies

The use of Strategies to influence, deliver or change approaches to Surface Water Management

The Local FRM Strategy for North Yorkshire (February 2015) was written in 2013/14, is high level and becoming out of date. The 2017 Preliminary Flood Risk Assessment captures some information on progress and the Humber Flood Risk Management Plan reports on progress on Local FRM Strategies.

The existence of a programme for flood alleviation schemes, created by all partners working together.

(Yes) Discussions are ongoing between the EA, NYCC and Water Companies to update the future programme and work in partnership.

5.3.3 Recommended metrics

The following metrics are recommended for further consideration.

Table 5-2 Recommendations for Ways of Working metrics

Area	Recommendation	Details
Asset Management	Further work needed	<p>Further work is needed to identify on an asset systems basis, rather than based on organisational responsibilities:</p> <ul style="list-style-type: none"> Whether a comprehensive Asset Database is in place, What it is used for and Progress in defining local asset systems <p>Incentives are needed for LLFAs to further develop and prioritise their Asset Registers consistently and so that the interdependencies between assets owned by RMAs and third parties is better understood to more effectively target enforcement, maintenance and improvement work.</p>
Community Involvement	Further work needed	<p>The presence of Community Flood Resilience initiatives is likely to be more measurable on a local scale and as the offering and take up vary, it may be more appropriate to highlight good practice in this area than attempt to measure take up nationally.</p> <p>LLFAs should be incentivised to take forward relevant Community Flood Resilience approaches locally. This could be particularly challenging for areas that have not recently experienced flooding, where communities may not wish to engage and expectations of communities on RMAs would need to be carefully managed.</p>
Flood Investigations	Further work needed	<p>Further work is needed to identify on a Partnership basis, rather than based on organisational responsibilities:</p> <ul style="list-style-type: none"> What triggers an Investigation What individual and shared systems and procedures should there be for collecting and sharing flooding information Procedures for investigating floods in Partnership <p>RMAs should be incentivised to develop clear systems and processes for sharing flooding information and jointly investigating flooding incidents.</p>
Partnerships	Proposed metrics	<ul style="list-style-type: none"> Whether Strategic Flood Partnerships meet regularly and how these are structured Who is represented on Partnerships Information on the areas of work that Flood Partnerships are involved in
Planning	Proposed metrics	Reflection of LLFA Guidance in Local Planning Policy

Area	Recommendation	Details
		<p>Planning Permissions for major developments granted by LPAs contrary to LLFA advice on SUDS</p> <p>Percentage of as built SUDS in accordance with Planning Permissions granted</p> <p>Percentage of SUDS being maintained in accordance with management plans</p>
Resources	Further work needed	<p>Resources need to be considered alongside outcomes in any local area to gain an understanding of how progress is being made, recognising that priorities and approaches will vary across the Country.</p> <p>A specific metric for this area will be challenging to define and collect consistently that gives a true understanding of the collective effort of all RMAs in SWM and funding will vary from year to year.</p> <p>Retention in Local Government FRM roles needs to be considered further e.g. by capturing the staff in place over a 5 year period and benchmarking the success of the EA led FCERM Degree programme for local government versus EA placements. Skills and resource sharing and capacity building between LLFAs should also be promoted as best practice.</p>
Standards	Proposed metrics/ Further work needed	<p>The following metric is advised: Partnership schemes delivered where the management of surface water has been clearly identified as an element of the scheme</p> <p>Careful definition is needed of what it means to develop a scheme that fully considers all sources of flooding to ensure a consistent approach is taken</p> <p>Further work is needed to identify how a local shared understanding of existing drainage capacity can be developed. Work is needed to bring together the work of the 21st Century Drainage Project and datasets of other RMAs</p>
Strategies	Proposed metrics	<p>The use of Strategies to influence, deliver or change approaches to Surface Water Management</p> <p>The existence of a programme for flood alleviation schemes, created by all partners working together. Careful criteria would need to be considered to ensure accurate information was provided regarding a truly shared partnership programme of work.</p>

5.4 Outputs and Outcomes/ Delivery metrics

5.4.1 Overview of delivery of surface water management in Greater Manchester

Greater Manchester has been selected as a test case due to the surface water flood risk challenges faced by the large conurbation, its Combined Authority status with statutory planning responsibilities and current work underway to address flood risk at a strategic level through a Greater Manchester Combined Authority (GMCA), SFRA and Flood Risk Management Strategic Framework. In addition, we are aware that there are numerous activities on the ground to address surface water flood risk including NFM and PLR.

The GMCA is comprised of 10 unitary authorities that have worked together voluntarily for many years via the Association of Greater Manchester Authorities (AGMA) on strategic issues for the area such as transport, regeneration, and inward investment.

Superimposed on the conurbation's "major" drainage system of a large network of main rivers, canals and ordinary watercourses is the drainage from the smaller local urban watercourses and the drains and sewers draining the roads and urban development. There are also a significant number of culverted watercourses in Greater Manchester and several "Hidden Rivers" or "Lost Rivers" within the sub-region, particularly Tameside, Manchester and Trafford Districts. Excess water from rainfall events, which exceed the capacities of any of these systems or the surface infiltration capacity, can also cause flooding.

The sewerage infrastructure of the urban areas of Greater Manchester is based on Victorian sewers from which there is a risk of localised flooding associated with the existing drainage capacity and sewer system. The drainage system may be under capacity and / or subject to blockages resulting in localised flooding of roads and / or property. United Utilities is responsible for the management of the adopted sewerage system. This includes surface water and foul sewerage. There may however be some private surface water sewers. Surface water sewers discharging to watercourses were not part of this transfer and would therefore not be under the ownership of United Utilities, unless adopted under a Section 104 adoption agreement. Water company assets include Wastewater Treatment Works, Combined Sewer Overflows, pumping stations, detention tanks, sewer networks and manholes.

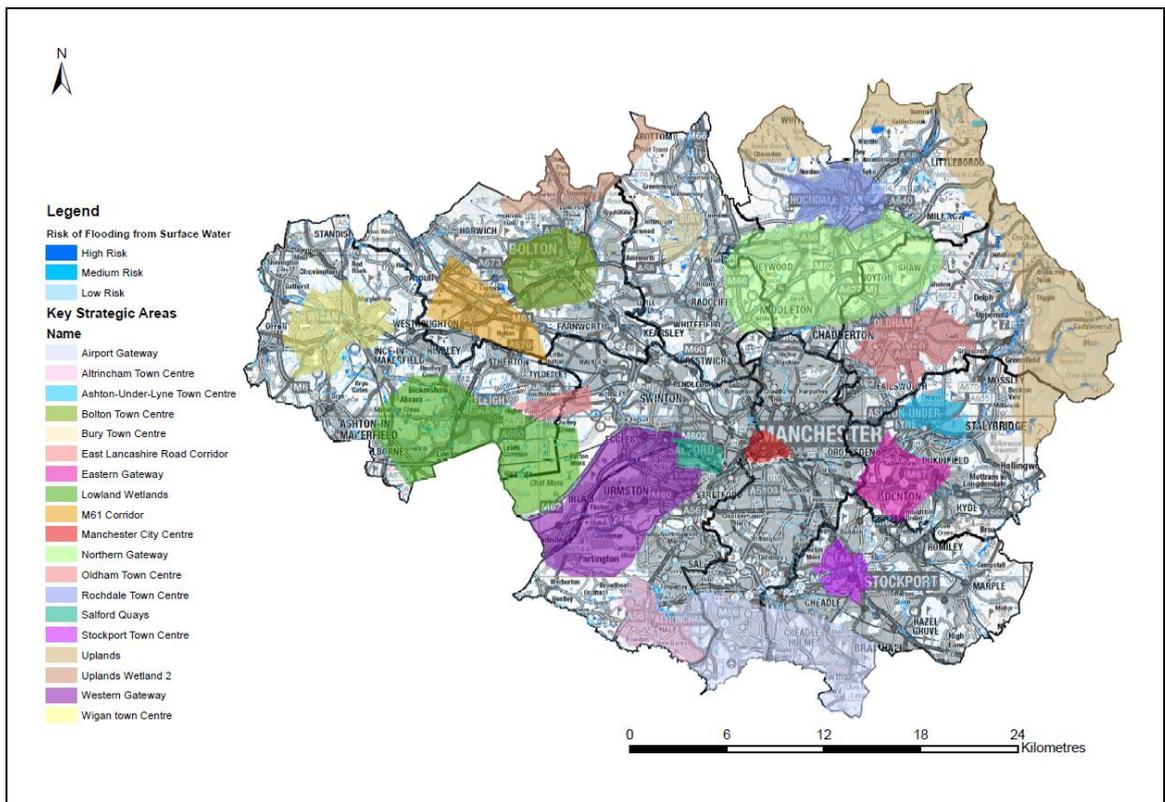


Figure 5-1: Greater Manchester strategic locations and surface water flood risk - High risk = 1 in 30 AEP, Medium = 1 in 100 AEP and Low = 1 in 1000 AEP (Source: Draft GMCA SFRA, March 2018)

Understanding of risk: whilst the Test Case focused on delivery, understanding the level of risk is essential to be able to measure the progress of delivery in managing this risk. It was felt that there is no clear understanding of surface water flood risk with assessments varying from over 250,000 properties (Preliminary Flood Risk Assessment that is not considered robust) to around 60,000 (Sayers and Partners (2015) Future Flood Projections in the UK). The Environment Agency’s surface water flood risk map vastly overestimates the scale of flood risk. Having a standard understanding and way of measuring what is at risk would help i.e. using the same return periods - currently properties identified at risk range from those that could be affected by a range of return periods (1 in 30 years, 1 in 75 years, 1 in 100 years, 1 in 1000 years). The situation is further complicated by the fact that many areas/properties are at risk of flooding from surface water and rivers. This is particularly the case in Greater Manchester and was shown by the effects of the Boxing Day flooding, 2015. Risk from surface water and groundwater flooding is also blurred with less understanding of groundwater flood risk and where this may occur. Finally, consultees highlighted the important of the receptors of risk i.e. whether this is just residential properties, focused on vulnerable communities or including wider impacts to the economy as a result of transport disruption etc.



Figure 5-2: Close Park, Bury following the Boxing Day flooding, 2015

Delivery of the SWMP: some SWMP actions have been followed up and some not. Partly due to priorities and also a better understanding of surface water risk since the plan was produced. However, assessing progress against agreed actions should be a good approach to understand how surface water flood risk is being managed.

Natural Flood Management (NFM): several NFM research/pilot projects being progressed in Greater Manchester (Defra urban pioneer, Natural Course, Water Resilient Cities, RESIN) are largely research focused rather than having any immediate impact on alleviating risk. In time, these may produce approaches to help reduce risk. Moors for the Future²⁰ is an initiative led by University of Manchester aiming to demonstrate that landscape restoration could be a low-cost way to reduce the risk of flash flooding in rural communities near steep upland streams and rivers. It is understood that the project is looking to develop metrics regarding the alleviation of flood risk that could be useful. Including metrics that include wider benefits around natural capital could also be helpful.

Environment Agency Investment Programme: this provides a good way of assessing progress in terms of measures, cost-benefit ratios etc. However, it is important to be aware of the context in that the Investment Programme reflects the current situation in relation to delivery and different priorities between different LLFAs in taking forward schemes. It also does not reflect the large amount of delivery funded by other sources e.g. LLFA run and funded schemes so is not a whole risk management programme and needs to be recognised as such. In addition, the Investment Programme demonstrates the results of appraisal i.e. what should be achieved - there is no mechanism for reporting what has been implemented and the results achieved

²⁰ <http://www.manchester.ac.uk/discover/news/flooding-risk/>

regarding a reduction in the overall level of risk. Water companies measure benefits of investments after they have been completed. The Environment Agency locally tracks the progress of schemes on the programme and provides support if challenges arise with delivery. The intention via the Flood and Water Management Board is to move towards a more collective response to managing risk across Greater Manchester.

Management and maintenance: whilst it was queried whether ongoing LLFA surface water management and maintenance should be subject to measurement as this is concerned with preventing risk occurring rather than reducing risk (although these can be considered as separate sides of the same coin), it was also highlighted that the day to day management of existing assets, especially the inspection and clearance of debris screens on culvert inlets, is by far the greatest contribution LLFAs make to avoiding flooding incidents. Whether this can be counted as a reduction in risk is for discussion. But it does result in reducing the frequency and impact of flood incidents. In very urbanised areas, the primary risk from flooding is either from sewer flooding or highway flooding so there needs to be more recognition of the role played by the sewerage and highway authorities in managing flood risk. Reduction in Highway Authorities budgets has led to a reduction in the resources available to manage their assets and this may have had a negative impact on flood risk near highways.

SUDS take-up and development impacts: as SUDS are only required with major development, the cumulative impact of minor development could be significant in highly urbanised areas. This is discussed regularly with the North West RFCC but is very difficult to capture and analyse. It was suggested that changes in urban morphology could be measured and the amount/change of green space assessed. United Utilities' SUDS Opportunity mapping should provide an opportunity to better understand where SUDS could and should be implemented. This should be available by mid 2018. The importance of context is again crucial to the uptake of SUDS as highly urbanised areas with low permeable geology can be fairly limited in their ability to implement green as opposed to grey SUDS.

Strategic delivery: at the strategic level, Greater Manchester is progressing well in developing a strategic flood risk management approach across the 10 authorities via the SFRA and Strategic Framework but managing and measuring progress in addressing local surface water flood risk is less straightforward.

Ways of working: Network Rail has funding on a five-year cycle (via Control Periods) and has looked at investing some of this in drainage to support LLFAs. This can be used to support Partnership Funding bids. The Test Case highlighted that using resources from one organisation to help another to achieve mutual benefits for the wider area should be happening more.

One scheme is funded from Grant in Aid and United Utilities' five-year plan, but there have been challenges in developing projects with joint surface water and sewer flood risk issues. It was highlighted that this is down to a lack of compatibility between the partnership funding approach used for Grant in Aid and the way that water companies justify investment.

GMCA is reviewing water governance particularly in relation to the Natural Course project.

Better access to data and wider data sharing would be a big improvement and the reliability and consistency of data also needs addressing.

Overall it was suggested that a way needs to be found to identify success criteria for an effective partnership. Work is ongoing through various research approaches to measure the effectiveness of catchment-based approaches. The focus on managing risk to individual properties can conflict with a catchment-based approach. Potentially combined plans for managing flood risk in geographical areas are needed, however fragmented ownership of assets and responsibilities make this difficult.

5.4.2 Testing the metrics for Greater Manchester

The proposed metrics have been applied to the information available for Greater Manchester

<p><u>Asset management and maintenance</u></p> <p>Asset condition <i>Registers in place detailing condition but not reported consistently across RMAs</i></p> <p>Asset performance <i>Regular inspection and sharing results of inspection would help evidence performance but is not currently carried out or reported consistently by all RMAs</i></p> <p>Capacity of drainage and combined metric <i>Recognised as an essential metric for water companies.</i></p>
<p><u>Awareness</u> <i>Supportive of developing a way of capturing awareness but currently recognised that the only evidence that could be captured relates to activities e.g. no. people given leaflets, invited to flood action group meetings etc.</i></p>
<p><u>Environmental</u> <i>Very much in favour of capturing the wider green infrastructure (GI) /natural capital type benefits that can be generated from surface water flood risk management projects. A lot of current work on this area in Greater Manchester is research focused and exploratory but work in this area is increasing with the potential to monetise benefits for ecosystems and health and wellbeing – Moors for the Future is developing relevant metrics.</i></p>
<p><u>Insurance</u> <i>Access to insurance is an important element especially for more deprived communities but this would have to come from insurance companies.</i></p>
<p><u>Investment</u> <i>Environment Agency’s Investment Programme provides data on this but represents a snapshot in time and not all schemes are realised as included at an early stage. Whilst GM is moving more towards a collective programme currently there is no overall view of all surface water delivery across the city region.</i></p>
<p><u>Local measures</u></p> <p>SUDS Uptake <i>SUDS uptake could be recorded by the LPAs.</i></p> <p>Flood and culvert hotspots <i>Flood and culvert hotspots and those mitigated against are currently recorded internally by Highways England and Network Rail, but as an operational measure through risk registers rather than reviewed on a strategic basis. Combining their recording with that undertaken by LLFAs would provide a more informed overview than hotspots detailed in the SWMP.</i></p> <p>SWMP actions <i>SWMP actions across Greater Manchester are not monitored centrally and some are no longer relevant due to work implemented or new evidence that has come to light. These are being updated to include in the emerging GMCA SFRA.</i></p> <p>Quick wins <i>Agreed that these should be included within overall assessment of schemes delivered</i></p>
<p><u>PLR</u></p>

PLR measures are concerned with increasing resilience to risk, they do not reduce risk, but would be useful to include. Currently not collected across Greater Manchester.

Planning

The suggested metrics would help to assess overall changes to urban morphology which is key to understanding increased propensity for surface water flooding. The North West RFCC have tried to keep a record of record minor developments with and without SUDS but found this challenging.

Schemes

It would be helpful to record all interventions delivered, by water companies, Network Rail and Highways England, as well as LLFAs to deliver overall progress in addressing surface water flood risk.

5.4.3 Recommended metrics

The following metrics are recommended for further consideration.

Table 5-3 Recommended Delivery metrics

Area	Recommendation	Details
Asset Management and maintenance	Proposed metrics	Asset ownership and performance in areas at risk of surface water flooding – importance of inspections to evidence effectiveness, need to capture progress by highways and sewerage authorities plus Network Rail and Highways England as well as LLFAs Capacity of drainage and combined networks – essential metric for water companies.
Awareness	Possible metric	Number of people aware of surface water flood risk in areas at risk Activities needs to be collected regularly and through an objective approach. Activities are easier to measure than outcomes but do not evidence increased awareness
Environmental	Possible metric	Green Infrastructure (GI)/ Natural Capital benefits (quantified and monetised) This demonstrates wider impact of surface water interventions but would not evidence progress in addressing risk
Insurance	Possible metric	Further investigation required to develop a suitable metric that demonstrates ability to access insurance in areas at surface water flood risk
Investment	Yes, in part	Overall investment in surface water flood risk management or on a per scheme/property basis does not evidence progress in managing risk without considering benefits. Cost benefit ratio would be better than absolute values of

Area	Recommendation	Details
		investment.
Local measures	Yes, in part	<p>SUDS uptake should be included</p> <p>Flooding hotspots and culverts (high risk and very high risk) mitigated should be included for LLFAs, Highways authorities, Network Rail and Highways England</p> <p>Community led works likely to differ in different locations due to local context and history. Quick wins could be captured within information on the number of schemes complete</p> <p>LFRMS and SWMP actions completed</p>
Partnerships	Ways of working	Not considered here – cross-reference to ways of working
Planning	Yes	<p>Area/proportion of built up areas with impermeable surfaces</p> <p>Planning permissions in areas of surface water flood risk</p> <p>No. minor planning applications with SUDS measures</p>
PLR	Possibly	PLR coverage i.e. number of properties with PLR measures
Schemes	Yes	Number of schemes completed – this should cover all schemes including Investment Programme, Quick Wins and other LLFA schemes

6 Measurement of Progress

Summary

The recommended metrics have been brought together and populated with available data to present a picture of national progress. In doing so, factors affecting how progress can be monitored have been considered.

The Investment Plan has also been analysed to compare the funding and outcomes for surface water schemes between Regional Flood and Coastal Committee areas and between schemes managing different sources of risk.

6.1 Factors affecting how progress can be monitored

There is an existing 'assembly' of metrics in relation to surface water that are already being collected. The metrics are generally collected in operational silos and could not be readily applied across a spectrum of RMAs. The following key factors that affect the specific collection of both existing and any proposed new metrics were raised throughout this project:

- There was a concern that if metrics were used to set standards that must be met then this could have a budgetary implication and that in addition a balanced picture should be presented of what is going well and areas where further action is needed.
- Actors in surface water management operate over a range of spatial scales. National organisations may also take regional approaches. This makes it challenging to scale up progress to a national level.
- Action to manage flood risk is driven by different Government departments e.g. Defra, MHCLG, Department for Transport and the Cabinet Office. This drives different work streams and related reporting mechanisms e.g. annual Section 18 Reports are submitted by LLFAs to Defra and Highways Authorities report annually on highways drainage approaches using the Self-Assessment Questionnaire for an element of their Highways Maintenance Funding.
- Actions taken in one area to reduce flood risk can be unintentionally undermined by lack of action or decisions taken into other areas and when considering where progress is being made, there is a need to consider other sectors e.g. planners, infrastructure investment, LEPs, transport etc.
- There was a recommendation that we need to build on what we already have, what's being achieved, monitored and measured against strategic plans. Currently this is largely done in organisational silos, based against organisational strategies, work plans and programme. For example, some LLFAs have started to collect Performance Information for internal reporting. Internal Key Performance Indicators such as these can be useful to capture metrics on Ways of Working, although approaches will vary between LLFAs and they are more likely to capture how and how much work is being done, rather than the outcomes in terms of reduced surface water flood risk.
- Another challenge can be a lack of consistency between plans that can cover the same geographic area but are led by different RMAs regarding how both current and future flood risk are assessed.
- Local flood risk issues lend themselves to local action, be this community emergency plans or community delivery of small works, such as ditch clearance, trash screen construction etc. Communities are increasingly being encouraged and supported to take a local leadership role e.g. through the Localism Act and initiatives to provide Community funding for small schemes. These can be thought of as 'quick win' or 'no regrets' actions i.e. the absolute outcome in terms of reducing flood risk is not known, but they will have a beneficial effect. There is

currently no organisation tasked with taking an overview of this work and work may take place at a local level that RMAs are not always aware of.

- There are interdependencies between drainage networks managed by different RMAs and third parties that need to be considered to build a full picture of progress being made. Other sectors, such as highways, rail, utilities and waste have made substantial commitments to surface water management that need to be captured to fully understand national progress in managing the risk.
- There is an opportunity to relate the collection of metrics to current and emerging industry initiatives and identify areas where these could be joined up: for example, joining up mapping outputs from sewer flooding with those from other flooding sources.

6.2 Bringing together potential metrics

Table 6-1 sets out the full list of potential metrics across the three categories and highlights those that are already collected and can be populated. It populates these metrics at a national level where this information exists. The table also brings together metric groupings considered in Chapter 5 under different headings where there are similarities between the data needed e.g. on asset management.

It is not possible to compile a complete set of populated metrics that could be used to measure the progress in management of surface water flood risk because:

- The data either is not currently collected,
- The lack of compatible standards results in an inconsistency in reporting between RMAs; or
- It is not currently collated nationally.

Therefore, in the present circumstances, the national assessment of progress made using metrics from respective parties should be treated with caution as it does not provide a complete picture and could contain data that is inconsistent.

Table 6-1: Full set of potential metrics

Area	Metrics	Can it be populated now?	Data source	Results	Issues
Risk metrics					
Actual risk	Proportion of 'at risk' properties that flooded in the last year	No	N/A	N/A	Not currently collected
	Sewer flooding - internal	Yes	CC Water and Water UK	5,690 properties (2016/17)	
	Sewer flooding - external	Yes	CC Water and Water UK	33,481 properties (2016/17)	
Current risk	No. properties at risk Assets at risk	Yes	Surface water flood map	2.5m properties	Broad-scale mapping over-estimates the problem. Consideration should be given to surface water flood risk zones
Current and future risk	Variance in risk now and with different climate scenarios	Further work required but some data available	Projections of future flood risk (2015) - Sayers and Partners for the UK CCRA, 2017	2.5 million households in England are currently in areas at risk of flooding from surface water, with expected annual damages of £300 million. Climate change is expected to increase this risk by at least 40% by the 2050s.	Data not regularly collected, should be considered further considering all sources of surface water flooding and all stakeholders
Future risk	Changes in surface water risk	Further work required	N/A	N/A	Data from all stakeholders is needed to populate a complete picture of where investment has reduced

Area	Metrics	Can it be populated now?	Data source	Results	Issues
					risk to properties
Ways of working					
Asset management	Status of LLFA Register	Yes	Single Data List and ASC Indicator	By January 2015, 57% (86) LLFAs had developed a register of their assets, but the content varies: only 35% of those analysed (60) include asset condition, 37% did not include information on asset ownership, and 12% did not include privately owned assets.	
	What is register used for?	No – further work required	N/A	N/A	Would require additional reporting by LLFAs either via Single Data List or another route
	Progress in defining local asset systems. Would capture interdependencies between asset conditions and effectiveness owned and managed by different RMAs	No – further work is required	N/A	N/A	Require joint RMA project to set this up
	Asset ownership and performance in areas at risk of surface water flooding	No – further work is required	N/A	N/A	Would be good to bring together existing asset condition/performance data from RMAs including Network Rail and Highways England
	Capacity of water company foul and	Under development	Water UK 21 st Century	Some parts of the public sewer network are at risk	Water company focused metric

Area	Metrics	Can it be populated now?	Data source	Results	Issues
	combined networks		Drainage Programme	of having capacity constraints unless action is taken	
Community involvement	Community flood resilience initiatives	No – further work is required	N/A	N/A	Probably best assessed at local level – joint working between LLFAs and National Flood Forum
	Community awareness of surface water flood risk in areas that are at risk	No – further work is required	N/A	N/A	Awareness of surface water flood risk would be useful to assess progress but needs to be collected regularly and through an objective approach. Activities (outputs) easier to measure than outcome but don't evidence increased awareness
Flood investigations	What triggers an investigation?	No – further work is required	N/A	By January 2015, 47% of 152 LLFAs had policies available which set out when a section 19 flood investigation will be undertaken, and 30% had published investigations. However, further analysis is needed to understand the differences in where these are undertaken.	Would require joint RMA reporting
	Individual and shared systems for collecting and sharing flooding information?	No – further work is required	N/A	N/A	

Area	Metrics	Can it be populated now?	Data source	Results	Issues
	Procedures for investigating floods in partnership	No – further work is required	N/A	N/A	
Partnerships	Strategic flood partnership meetings and structure	No – further work is required	N/A	N/A	Would require joint RMA reporting
	Representation on partnerships	No – further work is required	N/A	N/A	Would require additional reporting by LLFAs either via Single Data List or another route
	Areas of work that partnerships are involved in	No – further work is required	N/A	N/A	
Planning	Reflection of LLFA guidance in local planning policy	No – further work is required	N/A	N/A	Would require LPA and LLFA reporting
	Planning permissions for major developments contrary to LLFA advice on SUDS	No – further work is required	N/A	N/A	
	Percentage as built SUDs in accordance with planning permissions granted	No – further work is required	N/A	N/A	
	Percentage of SUDS being maintained in accordance with management plans	No – further work is required	N/A	N/A	
	Area/proportion of built up areas with impermeable surfaces	Yes	ASC Indicator	The overall impermeable fraction of built-up areas has not increased since 2011, remaining stable at an estimated 44% in 2016.	Updated every 2 years
	Planning permissions	No	N/A	N/A	Would require additional

Area	Metrics	Can it be populated now?	Data source	Results	Issues
	in areas of surface water flood risk				reporting by LPAs
	No. minor planning applications with SUDS measures	No	N/A	N/A	
Resources	Investment in all RMA efforts to manage surface water	No – further work is required	N/A	The number of staff allocated to flood risk management in each LLFA has increased from an average 2 FTE to 3.5 FTE, however further work is needed to understand the capacity of all RMAs involved	Would require joint RMA reporting
Standards	Partnership schemes delivered where the management of surface water has been clearly identified as an element of the scheme	No – further work is required	N/A	N/A	Careful definitions needed and joint RMA reporting
	Develop local understanding of drainage capacity	No – further work is required	N/A	N/A	
Strategies	The use of Strategies to influence, deliver or change approaches to Surface Water Management	No – further work is required	N/A	N/A	The content of Strategies varies and so this may be challenging to collect consistently.
	The existence of a programme for flood alleviation schemes, created by all partners working	No – further work is required	N/A	N/A	Careful criteria would need to be considered to ensure accurate information was provided regarding a truly shared

Area	Metrics	Can it be populated now?	Data source	Results	Issues
	together.				partnership programme of work.
	Local FRM Strategy and SWMP actions delivered	No	N/A	N/A	Would need consistent criteria and data is not currently collected consistently
Delivery					
Environmental	Wider benefits such as GI/natural capital of surface water flood risk management schemes	No – further work is required. Online tools such as the CIRIA BEST tool ²¹ could be useful for capturing such benefits.	N/A	N/A	Metric helps demonstrate wider impact of surface water interventions but would not evidence progress in addressing risk
Insurance	Access to insurance in areas of surface water flood risk	No – further work is required	N/A	N/A	Need to be clear about how surface water flood risk is defined – The Risk of Flooding from Surface Water map overestimates scale of the problem
Investment	Value for money	Yes	Environment Agency Investment Programme	Average cost: benefit of a surface water scheme in 6 year programme is 7.66	Overall investment in surface water flood risk management or on a per scheme/property basis does not evidence progress in managing risk without considering benefits. Cost benefit ratio would be better than absolute values of investment.
Local	SUDS uptake	Yes	ASC	Many actions have been	

21 CIRIA (2018) New Tool Assesses the Benefits of SUDS, available from https://www.ciria.org/Resources/Free_publications/New-tool-assesses-the-benefits-of-SuDS.aspx [Access date 30/05/2018]

Area	Metrics	Can it be populated now?	Data source	Results	Issues
measures			Indicator	carried out, mainly funded by water companies, but the scale is limited and the overall impact in reducing surface water flood risk is unknown.	
	Flooding hotspots and culverts (high risk and very high risk) mitigated	No	Highways England Network Rail LLFAs Highways Authorities	N/A	Would need consistent criteria and data is not currently collected consistently
PLR	PLR coverage	Has been but not collected regularly	Defra's Flood Resilience Community Pathfinder Evaluation - Final Evaluation Report (Oct 2015)	N/A - not available consistently on a national basis	Would need to identify a way to assess regularly. Demonstrates resilience to risk rather than risk reduction
Schemes	No. of properties protected	Yes, in part	Environment Agency Investment Programme	82,000 from 2015-2021	Snapshot of progress, some schemes at an early stage so may not come to fruition. Does not capture schemes without GiA or Local Levy funding.
	Quick wins	No	LLFAs Highways Authorities Water Companies IDBs	No. of properties protected	Would need consistent criteria and data is not currently collected consistently

6.3 Analysis of the six year investment plan

We have obtained the 2017/18 Investment Programme from the Environment Agency.

The following should be considered when using the outcomes from this analysis:

- Over the six year period, the confidence in scheme costs, contributions and Outcomes will change as a scheme progresses through the initial concept and bid, Project Appraisal and Detailed Design stages. Therefore, the analysis shows a snap shot in time based on the time of the analysis (December 2017).
- There are known delivery challenges for LLFAs in particular, meaning that some of the schemes in the programme may not be delivered within the six-year timeframe. This was recognised in RFCC meetings during 2017²². Given that delivery of projects is phased over years it has not been possible to undertake a straightforward assessment of schemes complete against the initial programme prepared in 2014/15 as the split of funding over years will have changed.
- The investment programme categorises all schemes against flood risk source. As many schemes address multiple sources of flood risk, only the primary source is identified. Therefore, the Programme may underestimate investment in surface water flood risk management as schemes to address other sources may also help to tackle surface water issues. It is also difficult to separate out Ordinary Watercourse schemes from surface water schemes as often drainage is so complicated that the two happen together in the same place. In practice, there is often an interchangeable use of terminology when describing schemes e.g. local flood risk schemes, surface water schemes.

Key findings are that:

- 25% of the schemes in the future programme are identified as primarily addressing surface water flood risk;
- This represents 6% of the total investment; and
- 9% of the total outcomes, in terms of homes at a reduced risk of flooding
- Over the six year programme, over 82,000 residential properties should see their standard of protection against surface water flooding improve. Figure 6-1 shows how these schemes will be funded. The majority of funding (97%) will come from public funds (Flood and Coastal Risk Management Grant in Aid, Local Levy and Public Contributions).

²² Colin Berghouse (2017) Paper on “Building capacity and skills in Risk Management Authorities” presented in July 2017 RFCC papers

Figure 6-1 Funding for surface water schemes (millions)

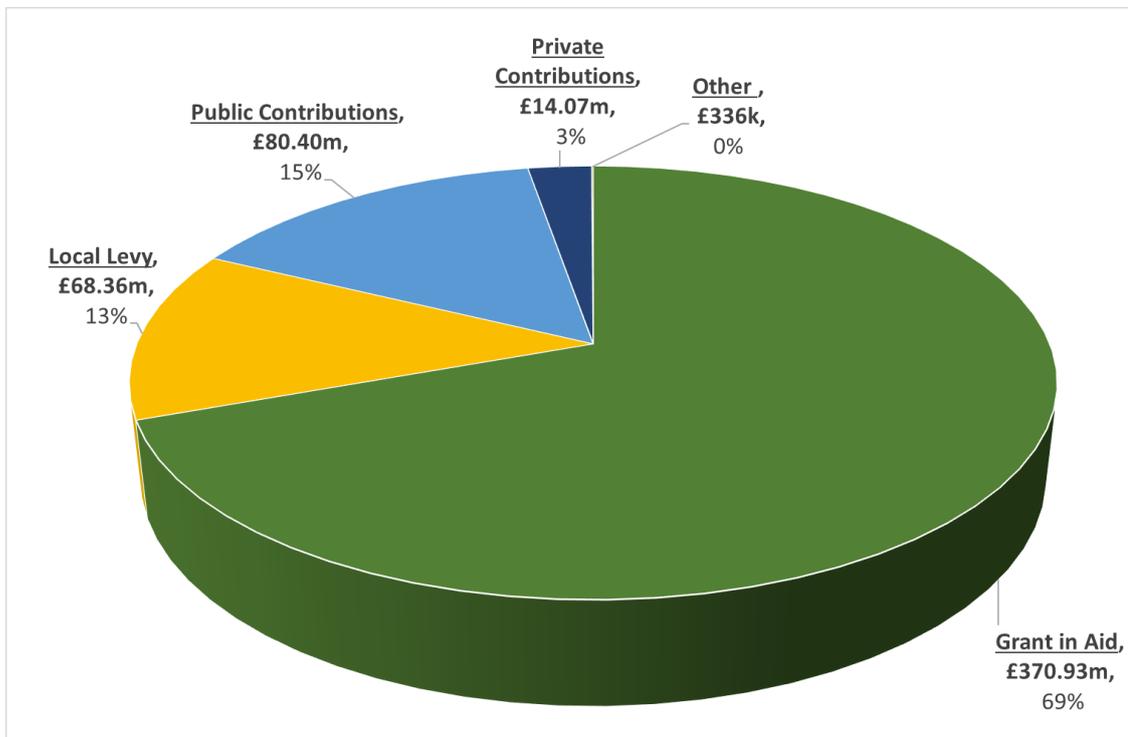
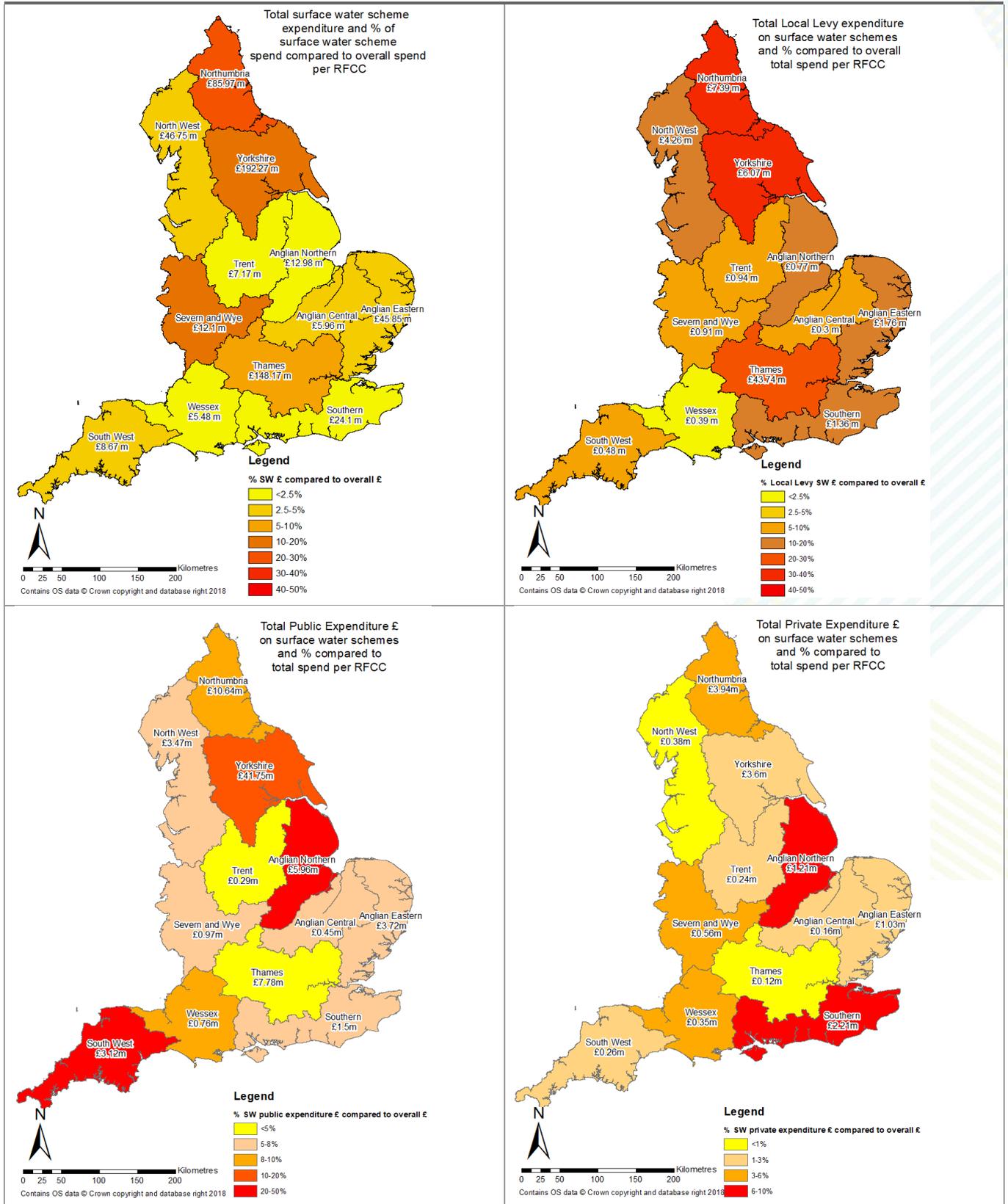


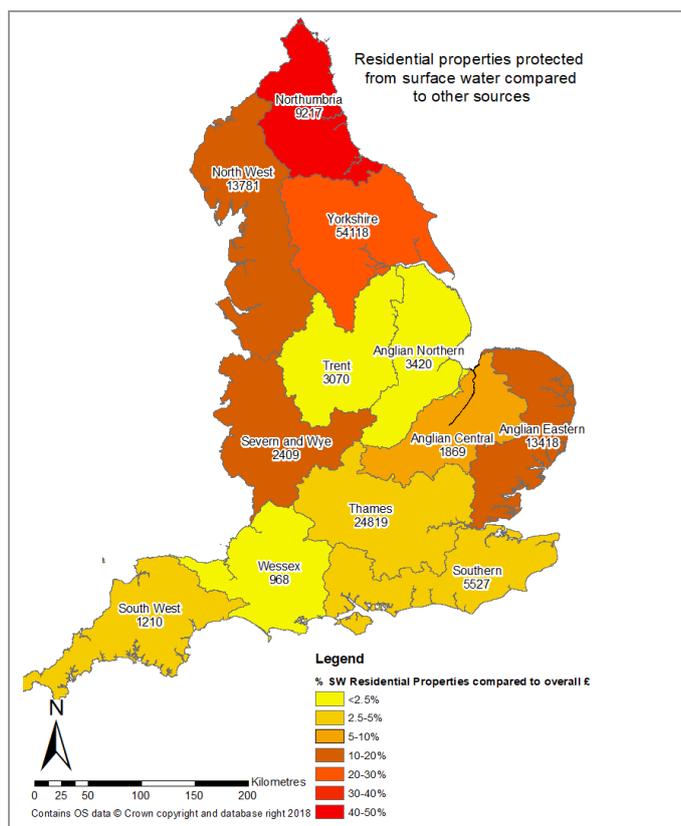
Figure 6-2 compares investment in surface water flood risk management between RFCC areas showing:

- Total expenditure on surface water schemes compared to all schemes.
- Total Local Levy expenditure on surface water schemes compared to all schemes.
- Total private and public contributions towards surface water schemes
- Total number of residential properties protected by surface schemes (known as Outcome Measure 2 (OM2)) compared to all schemes.

These maps show that expenditure and outcomes vary around the country, with the highest proportionate expenditure and outcomes being delivered in Northumbria and the lowest in Wessex. Comparisons should be made with caution as the different geographies around the County will influence the type of schemes needed and for the reasons set out above.

Figure 6-2 Investment Plan analysis per RFCC





6.4 What types of interventions are contributing the most towards progress, and what are the costs and benefits of these?

6.4.1 Analysis of the Investment Plan

When projects are submitted by an RMA for Grant in Aid funding, they are categorised into DEF – flood defences, CM – Capital Maintenance or PLP – Property Level Protection (now known as Property Level Resilience). Therefore, at a National level an analysis can be taken against these categories. As these are relatively high-level groupings, caution should be taken interpreting the results as there can be grey areas between categories – for example, the fitting of a trash screen onto a culvert could be classed as a new defence or capital maintenance.

Figure 6-3 compares the total whole life costs and benefits of surface water schemes for the different types of intervention and presents an average cost: benefit per scheme. Note that since the analysis includes schemes of different sizes an average is purely indicative. This shows that the average cost: benefit for defence schemes is around double that of capital maintenance or Property Level Protection schemes.

Figure 6-3 Comparison between different types of intervention for surface water schemes

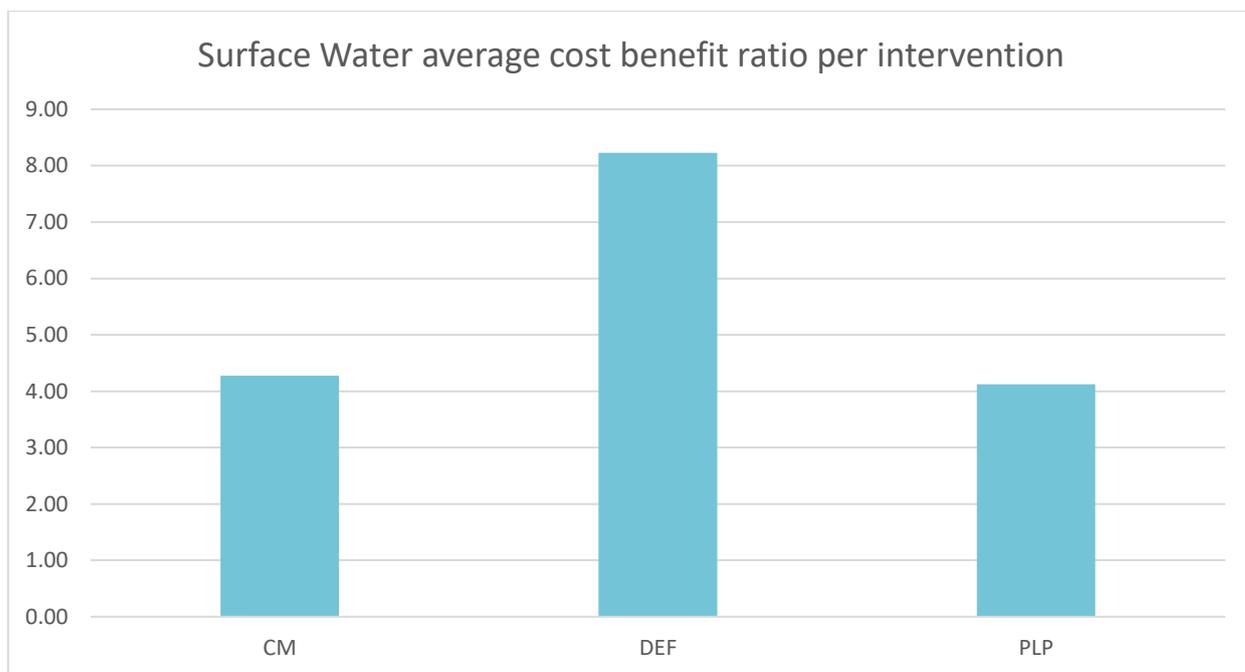


Figure 6-4 shows the 'raw' Partnership Funding score for a surface water scheme (based on GiA funding available for a scheme based on the outcomes it delivers), compared to the 'adjusted' Partnership Funding score, that takes into account other sources of funding. This shows limited variation in the proportion of additional funding for a scheme between intervention types. However it does show that on average, defence schemes are more likely to receive full funding from GiA than other types of intervention i.e. the average raw Partnership Funding score for defence schemes is over 100%.

Figure 6-4 Comparison between Partnership Funding scores for different types of interventions

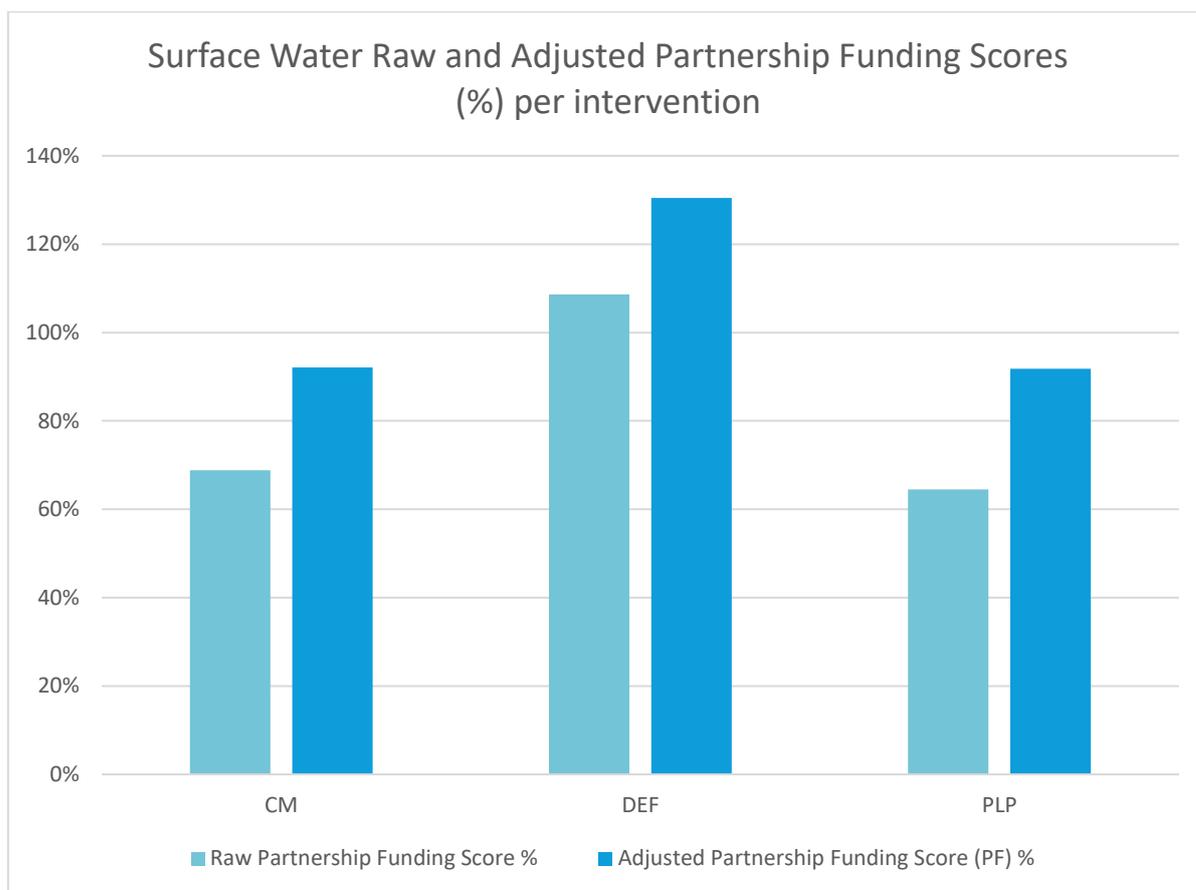


Figure 6-5 compares the whole life costs of different types of intervention for the different sources of flooding and coastal erosion, based on Total Project Expenditure. This shows that most investment at a national level is directed into coastal erosion, reservoir, tidal river flooding and sea flooding schemes. Most investment goes into defence schemes.

Figure 6-5 Comparison of total expenditure between different sources of flooding

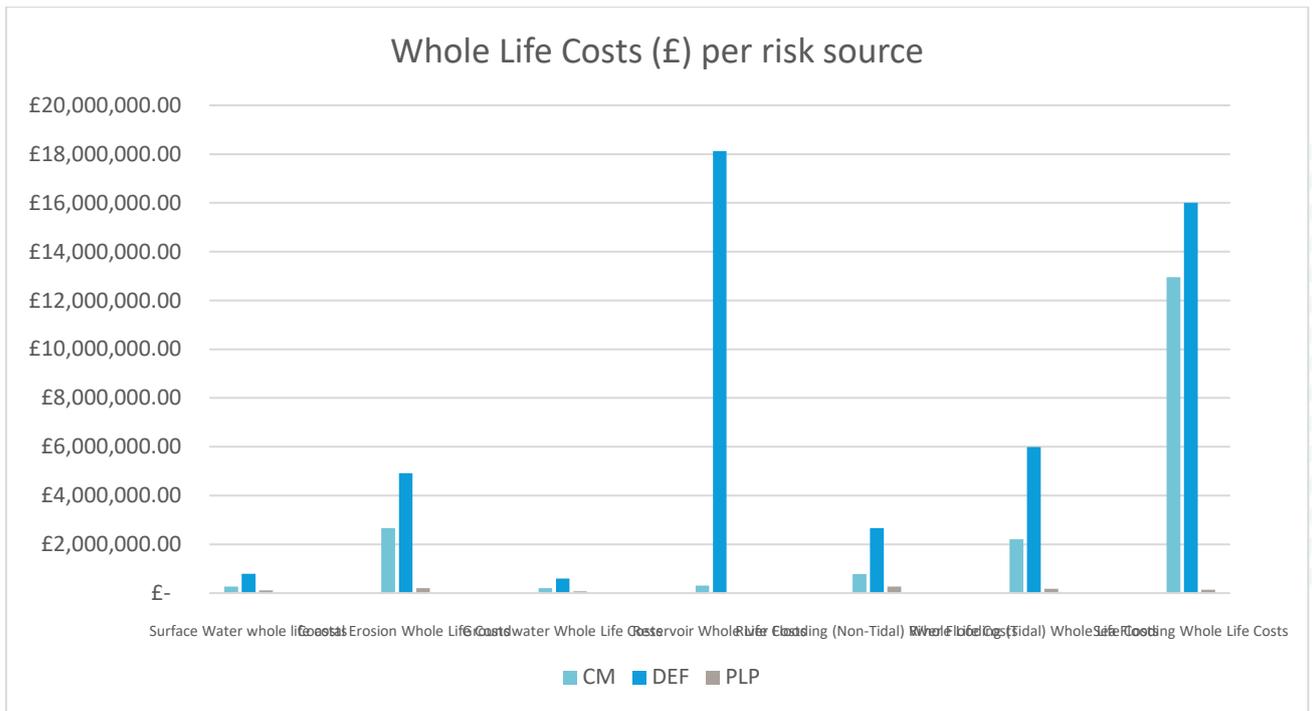


Figure 6-6 compares 'raw' Partnership funding scores for schemes managing different sources of risk. The results of this are interesting as it suggests that defence schemes may be more likely to be fully funded by GiA for surface water, groundwater and sea flooding schemes than for other sources of flooding. For capital maintenance however, schemes managing coastal erosion, tidal river and sea flooding are more likely to be fully funded. For PLP schemes, the analysis suggests that further sources of funding are needed for all sources of risk to ensure a scheme is fully funded.

Figure 6-6 Comparison of raw Partnership funding scores between different sources of flooding

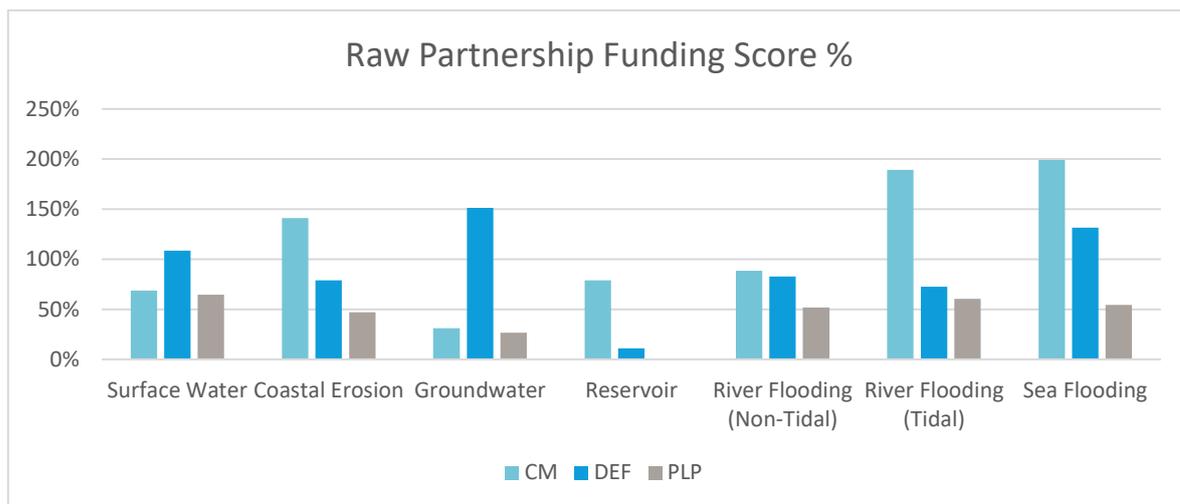
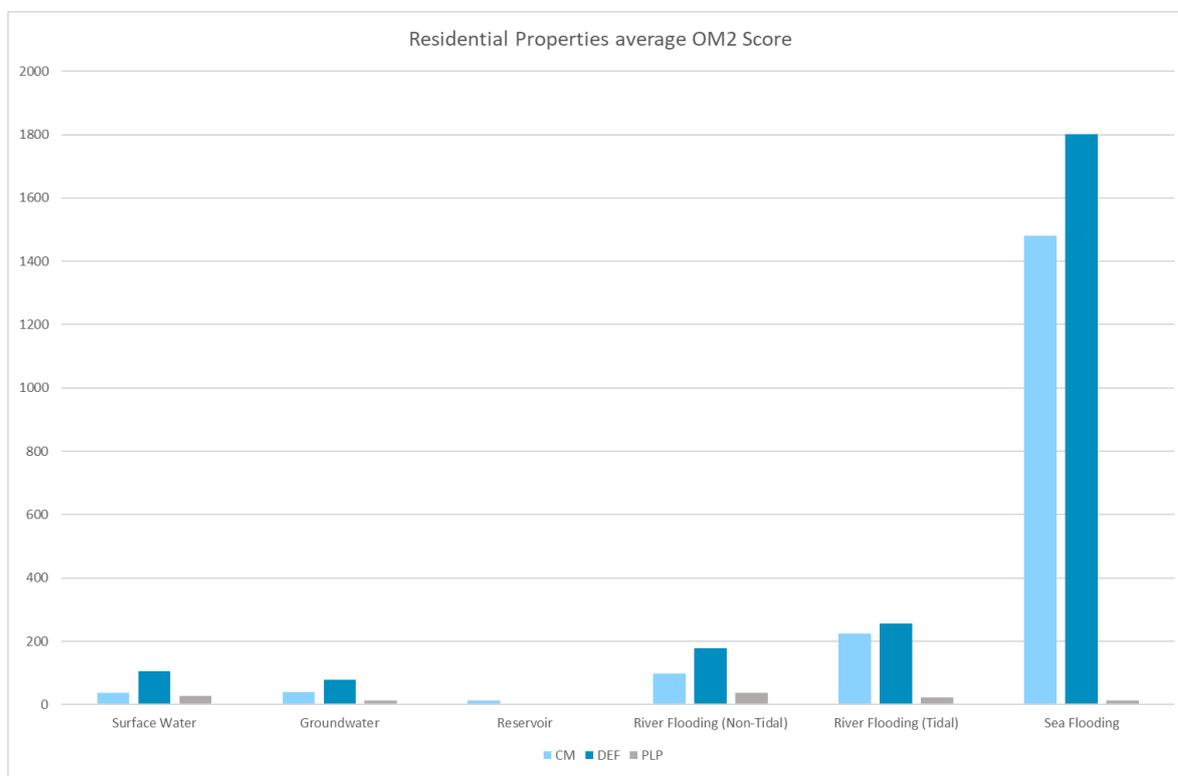


Figure 6-7 compares the average number of residential properties protected (Outcome Measure 2) for schemes managing different sources of risk. The results of this show that in general schemes protecting against coastal flooding protect the highest number of properties, followed by tidal and then fluvial flooding. By comparison, surface water schemes have lower average benefits for defence and capital maintenance schemes. For Property Level Protection schemes, there is less difference between the average benefits for different sources of flooding.

Figure 6-7 Comparison of average benefits per scheme between different sources of flooding



6.4.2 Qualitative assessment of different forms of intervention

Ways of Working influence delivery of outcomes on the ground. The way that local FRM is funded can make it difficult to split out revenue costs into different types of intervention. There can also be significant variation between LLFAs on how much Revenue Support Grant is retained for FRM. Whether a Council chooses to 'top' this up for either capital or revenue work also varies. In addition to this are the Partnership working relationships with other RMAs, that vary from place to place and the driver to work in partnership, given that local priorities between RMAs, such as the Environment Agency, Water Companies, IDBs and utility and infrastructure providers can vary.

The following points were raised through the project, either through supporting research, the Scoping Interviews, Workshop and/ or Test Cases that provide some further qualitative context:

Schemes: Small schemes that aim to reduce surface water flood risk across a large area can find it challenging to obtain Grant in Aid within the Partnership Funding approach. This is due to the overarching focus on the number of properties at risk of flooding. In practice, LLFAs can easily spend more money justifying the scheme (and calculating detailed cost: benefit information) than delivering one for small and straightforward quick win schemes. Small quick win schemes, such as trash screens and major watercourse clearance work, are locally funded (and sometimes delivered by local communities). It can be hard to determine the split between capital and revenue work and the realised benefits and the outcomes from this work are not always known or captured.

Many schemes have a surface water element, but the current system captures the main source of flooding and then whether a strategic approach has been taken to managing risk in an area. With evidence informing many schemes still heavily based on modelling the principal cause of flooding, there have been unintentional

consequences where schemes have been built to protect a town from river or coastal flooding and subsequently surface water flooding occurs. This then raises the questions of whether there is currently the baseline against which to measure outcomes (benefits) and standards where there are multiple sources of risk and where a combination of measures are needed to tackle different sources of flooding, who should fund these.

Schemes can deliver wider benefits than those captured by the Partnership funding process. In some locations, the cost: benefit of a scheme may not stack up on its own but could be delivered as part of wider regeneration plans and undertaken alongside wider redevelopment. This opens up other sources of funding, such as that available through LEPs.

A further issue that came to light were the challenges in fitting a catchment-based approach into the current funding system, since Treasury rules do not permit a trading of costs and benefits across a catchment. In addition, for Natural Flood Management schemes, detailed evidence regarding the benefits of the work is not always available, which can then get challenged at later scheme approval stage.

Planning: The Environment Agency has estimated that for every £1 spent influencing planning applications, there are £10 of flood damages avoided²³. Research undertaken for ADEPT²⁴ shows that it costs an LLFA £745 on average to review a planning application. Whilst some smaller LLFAs do receive adequate government funding, as an average the research found that LLFAs receive approximately a fifth of what it costs them to operate as a statutory consultee for planning.

The consultation changes to the National Planning Policy Framework²⁵ promote the consideration of the cumulative impacts of developments and the multi-functional benefits of SUDS. Considering the cumulative impact of new developments on wider flood risk may help to facilitate developer contributions towards schemes where there are existing issues in sensitive catchments. Considering the multi-functional benefits of SUDS systems may also help to increase their uptake. Organisations, such as CIRIA, have developed and are developing further tools to assist developers to consider the wider benefits of SUDS systems²⁶

Asset management and maintenance: A risk based approach is generally undertaken by most RMAs i.e. the most money is spent in the areas where it will have the most benefit. However, each RMA takes a different approach to inspection and maintenance, with considerable differences in how work is funded and prioritised at a local level, both between RMAs and between the same types of RMAs nationally. This means that assets are maintained in organisations' silos in many places and not as systems.

There is no collective understanding of asset systems in all areas, for example, flooding may materialise at one location, with the cause of this being an asset up or downstream. Hence action taken by one RMA within their remit e.g. clearing a problematic highway gully may not resolve an issue if it is the receiving watercourse or sewer downstream that is at capacity and causing highways drainage systems to back up. This means that collectively the benefits of doing work in one part of an asset system are not always well understood and also that where resources are being reduced in some areas, this could have a knock-on effect elsewhere in the system.

23 Staffordshire County Council (2017) County council increases work to reduce flood risk in Staffordshire <http://www.staffordshirenewsroom.co.uk/county-council-increases-work-reduce-flood-risk-staffordshire/> [Accessed 11 April 2018]

24 JBA (2016) Survey Results Analysis (for the ADEPT Flood and Water Group)

25 MHCLG (2018) National Planning Policy Framework, Draft text for consultation

26 CIRIA (2018) B&EST (Benefits of SUDS Tool) <https://www.susdrain.org/resources/best.html>

7 Conclusions and Recommendations

Summary

The study has concluded with a summary of the research questions, consideration of the criticality of the recommended metrics and strategic recommendations to help take forward actions needed to collect data.

7.1 Summary of research

This research was commissioned following the ASC's second statutory assessment of the National Adaptation Programme in June 2017. The 2017 report highlighted that the responsibility for managing surface water flooding is fragmented, mainly between water companies, highways authorities and lead local flood authorities. The analysis also concluded that the extent to which current activity is effectively tackling this challenge is unclear. Therefore, the ASC was interested in defining improved metrics to measure progress in managing the risk of surface flooding at a local level, and based on the available data, collate these metrics to gain a national picture of the progress being made. The specific research questions posed are addressed in the sections below and are followed by a summary of strategic recommendations for the way forward.

7.2 Measuring progress

Relevant Research Questions

What are the advantages, disadvantages and possible unintended consequences of using different metrics?

How can national and local data best be combined to assess the progress being made in managing surface water flood risk in England?

This research has considered the use of both existing and new metrics to assess progress that has been made in surface water management at both a national and local level. The advantages, disadvantages and possible unintended consequences of using different metrics within the groupings of Risk, Ways of Working and Delivery have informed the recommended metrics.

It is not possible to compile a complete set of populated metrics that could be used to measure the progress in management of surface water flood risk because:

- The data is not currently collected ;
- The lack of compatible standards results in an inconsistency in reporting between RMAs; or
- It is not currently collated nationally.

Therefore, in the present circumstances, the national assessment of progress made using metrics from respective parties should be treated with caution as it does not provide a complete picture and could contain information that is inconsistent. This report identifies a series of gaps in data and information that if addressed, could enable a complete national assessment of progress to be completed in future.

Understanding risk

- 2.5 million households in England are currently in areas at risk of flooding from surface water, with expected annual damages of £300 million. However, estimates do vary as broadscale data (generated using national assumptions about flood model inputs and nationally available input data that may not account for very

localised specifics e.g. drop kerbs in ground level data, property thresholds etc.) is used to assess risk at a national level.

- A key challenge is the lack of recorded information on surface water flooding incidents year on year. The main reason for this is that the information is reported to different organisations who do not necessarily record or share data consistently. Some data is available by source, for example, in 2016/17 5,690 properties were affected by internal sewer flooding and 33,481 properties by external sewer flooding²⁷. Formal flood investigations undertaken by Lead Local Flood Authorities provide local information but are not undertaken in consistent circumstances so are not possible to easily collate into national figures of properties affected. However, surface water flooding is complex and can be difficult to apportion to any one source due to complex interactions between different parts of the drainage system.
- Flood risk is expected to increase in the future due to a variety of factors, including climate change, population change, aging infrastructure, lack of capacity in existing networks and new developments. There are currently only broadscale estimates of what this might mean at a national scale. For example, by the 2080s the number of residential properties at risk of surface water flooding is expected to increase by 20%²⁸. Because the frequency of surface water flooding is likely to increase, those properties currently at relatively low risk will become more susceptible to flooding in future and hence surface water flooding will cause greater disruption and economic damage to those affected².
- There is very little consistent data available at a local level (some areas have better coverage of this than others) that provides a detailed understanding of the interactions between drainage systems owned and maintained by different RMAs and third parties and hence there is not a shared understanding of local flood risk on which to make informed decisions in partnership. This is important because the performance of one part of the drainage network is often dependent on another e.g. water floods from highway gullies because the receiving sewer is at capacity.

Ways of working

- Many of the existing metrics measure process rather than outcomes. This makes it challenging to identify the difference that these factors have made to actual progress in managing surface water flood risk. What this data does show is that progress by LLFAs has been mixed and in some cases delayed, for example by January 2015, 57% (86) LLFAs had developed a register of their assets, but the content varied and 47% of the 152 LLFAs had policies available which set out when a Section 19 (Formal) Flood Investigation will be undertaken. It is also possible that relevant data on flooding incidents is collected outside of the formal reporting requirements (as evidenced during the collection of information for the Brighton and North Yorkshire Test Cases).
- The picture with respect to collection of information is evolving, for example, the Government's Single Data List is changing to capture how various activities such as flood investigations and asset management have informed further work. However, this data will be largely qualitative and difficult therefore to collate and use to present a national picture on progress.
- Information on Ways of Working tends to be collected on an organisational basis, hence a picture can be established for one organisation, but it may be challenging to collect across the board. For example, the number of staff allocated to flood risk management in each LLFA has increased from an average 2 Full Time

²⁷ Water UK et al. (2018) Discover Water website <https://discoverwater.co.uk/sewer-flooding> [Access date 25 May 2018]
²⁸ Paul Sayers (2018) Additional surface water flooding statistics from the Future Flood Explorer provided specifically for this project

Equivalent (FTE) to 3.5 FTE. However, what is harder to establish are the total resources across all organisations committed to managing risk in any one geographical area e.g. Environment Agency Strategic Overview role and from others such as Water Companies and Internal Drainage Boards. This example illustrates that further work is needed to understand the capacity of all RMAs involved in surface water management and how this capacity is translating into enhanced effectiveness in managing risk.

Delivery of outcomes

- Current metrics mostly focus on Outcome Measures (and largely residential properties protected) from the Environment Agency's Forward Investment Programme, as that is the information that is collected and collated at a national level. For example, the current six year Investment Programme should deliver 82,000 homes at reduced risk of surface water flooding and the average cost benefit ratio of a scheme is 7.66.
- Many small scale local measures and quick wins have been carried out, funded by water companies and/ or Local Authorities, but the size of such works is normally small and the overall impact in reducing surface water flood risk is not routinely quantified.
- There is no clear understanding of how overall investment by RMAs is reducing overall surface water flood risk. This is because most information on the benefits of work is collected at a project level and where the benefits can be easily quantified e.g. through physical flood alleviation works. In addition to this, because different RMAs work to deliver different outcomes and against different regulatory timescales, there is often not a shared understanding of the overall magnitude of the impact of surface water flood risk management work in any one geographical area.

7.3 Investment in surface water schemes

Relevant Research Questions

How much national funding (FCERM Grant-In-Aid) is being spent on managing surface water flood risk as part of the six-year investment plan? How much local (partnership) funding are these projects leveraging, and what are the sources of these funds? What outcomes and benefits will these surface water projects achieve in comparison with river and coastal flood alleviation schemes?

What types of interventions are contributing the most towards this progress, and what are the costs and benefits of these?

The Investment Plan has been analysed to compare the funding and outcomes for surface water schemes between Regional Flood and Coastal Committee areas and between schemes managing different sources of risk.

Key findings are that:

- 25% of the schemes in the future programme are identified as primarily addressing surface water flood risk;
- This represents 6% of the total investment; and
- 9% of the total outcomes, in terms of homes at a reduced risk of flooding

Over the six year programme, £371m of GiA will be invested and over 82,000 residential properties should see their standard of protection against surface water flooding improve. The majority of funding (97%) will come from public funds (Flood

and Coastal Risk Management Grant in Aid, Local Levy and Public Contributions). The other 3% will come from private or other sources, a detailed breakdown of which is not available at a national level.

When considering the types of surface water intervention that are most beneficial, the average cost: benefit for defence schemes is around double that of capital maintenance or Property Level Resilience (PLR) schemes. However, it will always be easier to quantify the benefits/ outcomes for scheme work. Non-structural FRM measures, such as flood investigations, asset management, schemes, community flood resilience and planning responses will also have a beneficial effect. Evidence from the Test Cases demonstrated that a risk-based approach to these is commonly adopted at a local level, for example LLFAs target Flood Investigations to where they can make the most difference, typically based on the number of properties internally flooded rather than external flooding. This is challenging to the provision of a national overview as specific approaches and responses vary between LLFAs and other RMAs.

7.4 Recommended metrics

Relevant Research Questions

How is (or could) progress in managing surface water flood risk be measured at the local level?

The metrics recommended in Table 7-1 have been merged where appropriate between different categories and where possible made more specific as to what would need to be measured. They have then been prioritised in terms of how critical they are considered to be in measuring progress in surface water management in accordance with the following:

- Critical to understanding of progress in addressing surface water flood risk – High/Red
- Useful in understanding progress in addressing surface water flood risk – Medium/Amber
- Helpful context in understanding progress in addressing surface water flood risk – Low/Green

Table 7-1 presents the criticality of the metrics.

Table 7-1 Prioritised metrics

Metric group	Metric type	Suggested metric	Can it be populated now?	Data source	Results	Who could collect it?	Suggested frequency
Critical to understanding of progress in addressing surface water flood risk							
Risk	Current risk	<p>No. of properties at risk of flooding and/ or predicted flood damages now for any given scenario. This data could be zoned to show the varying degrees of risk.</p> <p>Ideally to provide a baseline this would be based on assuming no drainage capacity, so that the impact of interventions can then be considered. The Surface Water Zones demonstrated by the Brighton and Hove case study would be one way to achieve this.</p>	<p>Yes – noting that current estimates of risk are broadscale and may over or underestimate the problem. At a local level partners need to work together to agree a shared baseline for managing the overall risk in an area.</p>	Surface water flood map	2.5m properties	LLFAs	Checked for new data every 2 years
Risk	Future risk	<p>No. of properties at risk of flooding now and/ or predicted flood damages for any given scenario for a given point in the future (2080 is commonly used at present for long term projections). This data could be zoned to show the varying degrees of risk.</p> <p>Ideally to provide a baseline this would be based on assuming no drainage capacity, so that the impact of interventions can then be considered. The Surface Water Zones demonstrated by the Brighton and Hove case study would be one way to achieve this.</p>	<p>Yes, partially based on high level assessment.</p> <p>There is no nationally consistent future surface water mapping. The application of climate change allowances can vary between RMAs. At a local level partners need to work together to agree a shared future baseline for managing the overall risk in an area. This needs to be updated over time as better information becomes available.</p>	Projections of future flood risk (2015) – Sayers and Partners for the UK CCRA, 2017	2.5 million households in England are currently in areas at risk of flooding from surface water, with expected annual damages of £300 million. Climate change is expected to increase this risk by at least 40% by the 2050s.	LLFAs	Checked for new data every 2 years
Risk/ Ways of Working	Current risk/ Asset Management/ Standards	<p>Identification of ownership of assets relied on for management of risk and definition of local asset systems.</p> <p>This would provide an understanding of the interdependencies between assets owned and managed by different RMAs/ Riparian Owners and develop a shared local understanding of drainage capacity</p>	<p>No – further work is needed to determine how this would be measured</p> <p>Currently RMAs work to different regulatory cycles and standards and can manage different parts of the drainage network in silos. On the ground, what happens in one part of the drainage network will affect another and at a local level partners need to work together to develop a shared understanding if the drainage network.</p>	N/A	N/A	LLFAs	Checked for new data every 2 years

Metric group	Metric type	Suggested metric	Can it be populated now?	Data source	Results	Who could collect it?	Suggested frequency
Risk	Changes in surface water risk	Provides a measure of the quantum of risk reduction that has been achieved against the current/ future baseline Could be measured by number of properties and/ or flood damages avoided	No – further work is needed to determine how this would be measured By developing a shared understanding of local risk and interdependencies, partners can work together to prioritise the work that will have the greatest overall effect on reducing surface water flood risk. Effectively this would be measuring shared outcomes between RMAs.	N/A	N/A	LLFAs	Annual
Useful in understanding progress in addressing surface water flood risk							
Risk	Actual risk	No. properties flooded each year by surface water (as a proportion of those at risk)	No, no currently collated from all sources	N/A	N/A	LLFAs	Annual
	Sewer flooding – internal	Sewer flooding – internal	Yes	CC Water and Water UK	5,690 properties (2016/17)	Water Companies	Annual
	Sewer flooding – external	Sewer flooding – external	Yes	CC Water and Water UK	33,481 properties (2016/17)	Water Companies	Annual
Ways of Working	Asset management	Status and uses of LLFA Asset Register	Yes, new Single Data List will capture these metrics	Single Data List and ASC Indicator	By January 2015, 57% (86) LLFAs had developed a register of their assets, but the content varies: only 35% of those analysed (60) include asset condition, 37% did not include information on asset ownership, and 12% did not include privately owned assets.	Defra	Annual
Ways of Working	Asset management	Capacity of drainage and combined networks	Yes, under development by Water UK	Water UK 21 st Century Drainage Programme	Some parts of the public sewer network are already working at or beyond their full capacity.	Water Companies	Checked for new data every 2 years
Ways of Working	Planning	Area/proportion of built up areas with impermeable surfaces	Yes – updated every 2 years	ASC Indicator	The overall impermeable fraction of built-up areas has not increased since 2011, remaining stable at an estimated 44% in 2016.	ASC	Checked for new data every 2 years
Ways of Working/ Delivery	Planning/ Local Measures	Planning permissions for major developments contrary to LLFA advice on SUDS	Yes - partially	N/A	N/A	MHCLG	Annual
Ways of Working	Planning	Percentage as built SUDs in accordance with planning permissions granted/ Uptake of SUDS	Yes – partly as existing ASC indicator, but could be developed further linked to	ASC Indicator	Many actions have been carried out, mainly funded by water companies, but the scale is limited and the overall	ASC/ LPAs	Checked for new data

Metric group	Metric type	Suggested metric	Can it be populated now?	Data source	Results	Who could collect it?	Suggested frequency
			planning permissions and working with LPAs		impact in reducing surface water flood risk is unknown.		every 2 years
Ways of Working	Planning	Percentage of SUDS being maintained in accordance with management plans	No – further work is required	N/A	N/A	LPAs	Annual
Ways of Working	Standards	Partnership schemes delivered where the management of surface water has been clearly identified as an element of the scheme	No – further work is required	N/A	N/A	EA	Annual
Delivery	Schemes/ Investment	Average cost benefit assessment of surface water schemes	Yes	Environment Agency Investment Programme	Average cost: benefit of a surface water scheme in 6 year programme is 7.66	EA	Annual
Delivery	Schemes	Flooding hotspots and culverts (high risk and very high risk) mitigated	No	N/A	N/A	Highways Authorities Network Rail LLFAs	Annual
Delivery	Schemes	No. of properties protected	Yes, in part as only considers schemes with GiA and Local Levy funding and some schemes are funding locally or are small quick win schemes. It would also be beneficial to capture those schemes that have been delivered on site as some schemes proposed do not come to fruition or are delayed.	Environment Agency Investment Programme	82,000 from 2015-2021	All RMAs	Annual
Ways of Working	Community resilience	Measure of community awareness of local flood risk – residents, businesses, public sector bodies etc Further consideration is needed as to how this would be measured	No – further work is required	N/A	N/A	LLFAs/ LRFs	Every two years
Ways of Working	Flood investigations	Development of a national picture of how the trigger for flood investigations varies	Yes, partially but further analysis is needed to understand the differences in where flood investigations re undertaken nationally.	N/A	By January 2015, 47% of 152 LLFAs had policies available which set out when a section 19 flood investigation will be undertaken, and 30% had published investigations. However, further analysis is needed to understand the differences in where these are undertaken.	Defra/ ASC	Every two years
Ways of Working	Flood investigations	Progress in developing procedures for investigating floods in partnership and shared systems for collecting and sharing flooding information	No – further work is needed to consider how this would be measured	N/A	N/A	Defra	Annual

Metric group	Metric type	Suggested metric	Can it be populated now?	Data source	Results	Who could collect it?	Suggested frequency
Ways of Working	Planning	Reflection of LLFA guidance in local planning policy	No – further work is required	N/A	N/A	LLFAs/ LPAs	Annual
Ways of Working	Planning	Planning permissions in areas of surface water flood risk	No – further work is required	N/A	N/A	LPAs	Annual
Ways of Working	Planning	No. minor planning applications with SUDS measures	No – further work is required	N/A	N/A	LPAs	Annual
Ways of Working	Strategies	The presence at a local level of a programme for flood alleviation schemes, created by all partners working together (having prioritised risk together).	No – further work is required	N/A	N/A	RFCCs	Annual
Ways of Working/ Delivery	Strategies/ Schemes	Local FRM Strategy and SWMP actions delivered	No – further work is required	N/A	N/A	LLFAs	Annual
Delivery	Insurance	No. households in areas identified as being at risk of surface water flooding that can access insurance	No – further work is required	N/A	N/A	EA	Annual
Delivery	Schemes	Quick wins - no. of properties protected	No – further work is required and ideally this would be captured within the assessment of the total number of properties at reduced flood risk, rather than a standalone metric.	N/A	N/A	Highways Authorities Network Rail LLFAs	Annual
Helpful context in understanding progress in addressing surface water flood risk							
Ways of Working	Community resilience	Scale of initiatives – where, how many and achieving what scale of risk reduction? Further consideration is needed as to how this would be measured	No – further work is required	N/A	N/A	LLFAs/ LRFs	Every two years
Ways of Working	Partnerships	Strategic flood partnership meetings and structure	No – further work is required	N/A	N/A	LLFAs	Annual
Ways of Working	Partnerships	Representation on partnerships	No – further work is required	N/A	N/A	LLFAs	Annual
Ways of Working	Partnerships	Areas of work that partnerships are involved in	No – but will be collected from now on as part of new Single Data List questions	Single Data List	N/A	Government	Annual
Ways of Working	Resources	Combined staffing levels in all RMAs for surface water flood risk management in any one area	Yes partially, but data only exists for LLFAs and further work is needed to understand the capacity of all RMAs involved	N/A	The number of staff allocated to flood risk management in each LLFA has increased from an average 2 FTE to 3.5 FTE	ASC	Every 2 years
Ways of Working	Strategies	Assess the use of Strategies to influence, deliver or change approaches to Surface Water Management	No – but will be collected from now on as part of new Single Data List questions	Single Data List	N/A	Government	Annual

Metric group	Metric type	Suggested metric	Can it be populated now?	Data source	Results	Who could collect it?	Suggested frequency
		Consideration is needed as to how this would be measured as the content of Strategies varies					
Delivery	Natural Capital	Monetisation of natural capital benefits achieved through surface water flood risk schemes	No – further work is required	N/A	N/A	LLFAs	Annual
Delivery	Schemes	PLR coverage	Has been but not collected regularly	Defra's Flood Resilience Community Pathfinder Evaluation Report (Oct 2015)	N/A – not available consistently on a national basis	LLFAs	Annual

7.5 Strategic Recommendations

The recommended metrics are a mixture of those currently collected and those suggested throughout the course of this project. Any new metrics need careful consideration, with regards to who collects the data, how the information is managed and communicated and being mindful that reporting does not place an undue burden on RMAs. In effect, the collection of metric data should in itself drive a change in how local flood risk is managed, rather than be collecting data for its own sake. A clear driver is also needed for RMAs to undertake additional reporting. The following strategic recommendations are therefore made:

1. Organisations need to be clearly tasked with (and if appropriate, funded for) data collection and collating progress on a national level, beyond the mechanisms and metrics that currently exist

This applies to all metrics

At a regional level, metrics could be used by RFCCs to target Local Levy funding and support in line with regional FCERM priorities.

Reporting needs to be as accessible and straightforward as possible to ensure an undue burden is not placed on RMAs e.g. through the provision of online tools that can be used by the respective parties.

2. National expectations should be established with regards to consistent standards of service for FRM partnership working and for the systems performance of assets relied on to manage risk (allowing for the fact there are no common standards).

This applies mostly to Ways of Working metrics

These would need to be agreed by all relevant government departments and regulators to ensure that all RMAs were incentivised to take a partnership approach.

These need sufficient but not onerous guidance as there does need to be some degree of local flexibility to suit different circumstances. This would help ensure national consistency. Practitioner guidance should be the main outcome of any additional research that is needed. Key research priorities are the development of a shared understanding between RMAs of combined local risk and the interdependencies between assets and facilitating a partnership approach to flood reporting and investigation.

This would drive reporting, especially if the availability of funding could be linked to how these are being met locally. The model the Department for Transport (DfT) uses to award additional highways maintenance funding to incentivise an asset management approach is a good model.

3. Investment in flood risk management should clearly and consistently evidence shared outcomes for all sources of flooding and among RMAs

This applies mostly to Risk and Delivery metrics

The award of capital funding should be based on assurances that a scheme will deliver outcomes for all sources of flooding beyond the current requirements. One way to achieve this could be sign off from all relevant RMAs within an area that they support the objectives of a scheme.

To support this investment timescales and outcomes for all RMAs should be aligned. It would be beneficial to have a system that recognises multiple sources of flooding and multiple benefits and that is flexible enough to take account of softer approaches such as NFM.

The allocation of revenue funding should be based on evidence of the performance requirements and maintenance needs of the entire drainage network in a local area, rather than being prioritised by source between different areas.

This would drive joint programme development between RMAs and the co-creation of flood risk and asset system information from all sources in a locality. If a full

national programme of Surface Water Management Plans (SWMPs) had been commissioned and delivered then these would have provided the basis for a national picture of surface water flood risk, the management priorities and investment required. Unfortunately there is no formal requirement to prepare or complete SWMPs and the documents that have been prepared to date provide an incomplete picture at a national level. This would be worthwhile considering further, taking a risk based approach and recognising that the time and cost to 'fill the gaps' would be substantial and further funding for these would need to be made available.

High level consideration should also be given to the merits of a simpler system of awarding funding for small surface water schemes. This would help small schemes to access national funding, without becoming disproportionate in terms of evidence and process requirements.

4. Consideration is needed to the method and frequency of updating the assessment of future flood risk, given that projections of changes in climate are periodically updated and hence influences the size and nature of the risk and the subsequent level of adaptation required.

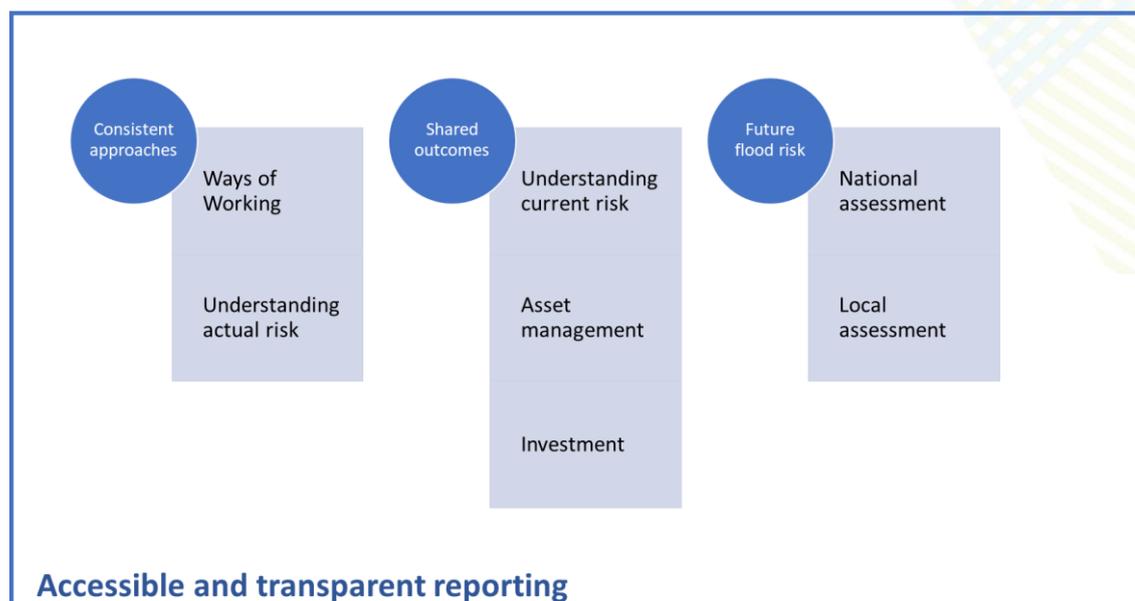
This applies mostly to Risk metrics

Assessment is needed:

- At a national level, which for consistency reasons is likely to be broadscale in nature
- At a local level, with clear guidance needed to ensure consistency for the assessment of all sources of flood risk between different geographical areas

Figure 7-1 shows how addressing these strategic recommendations could act as a driver for collecting the different groups of metrics.

Figure 7-1 Strategic recommendations



Appendices

A Stakeholder Engagement Plan

Organisation	Role in surface water management	Method of engagement
Association of Directors for the Environment, Planning and Transportation (ADEPT) Flood and Water Group	National Group of LLFAs that regularly engage with government departments on topical issues	Scoping interview Attendance at Dec 2017 Flood and Water Group meeting to present on project Invited to workshop
Department for the Environment, Food and Rural Affairs (Defra)	Set national policy for FRM	Scoping interview Invited to workshop
Ministry for Housing, Communities and Local Government (MHCLG)	Set national policy for planning	Scoping interview due in early January Invited to workshop
National Infrastructure Commission	Provide independent advice to government on infrastructure needs	Scoping interview Invited to workshop
National Flood Forum	Charity representing those who flood	Scoping interview Invited to workshop
Association of Drainage Authorities (ADA)	Represents interests of water level management organisations	Scoping interview Workshop attendee (unable to attend, so send findings for any further input)
Water UK	Represents interests of Water and Sewerage Companies	Scoping interview Invited to workshop
Local Government Association (LGA)	Represents interests of Local Government	Contacted, but happy for ADEPT to represent Local Government interests
Environment Agency	Strategic overview for all sources of flooding	Scoping interview Invited to workshop
Coastal partnerships	Bring together relevant partners for sustainable coastal management	Potential Scoping interview in January
Highways England	Highways drainage on trunk road network	Scoping interview Invited to workshop
Network Rail	Drainage of the rail network	Invited to workshop
Flood Re	National reinsurance for flooded properties	Contact will be made to inform the next stage of the project
Case study 1 partners Greater Manchester Combined authority	Local partners for surface water management delivery	Invite to workshop Face to face meeting with LLFA and invite delivery partners

Organisation	Role in surface water management	Method of engagement
Case study 2 partners Brighton and Hove	Local partners for surface water management delivery	Invited to workshop Face to face meeting with LLFA and invite delivery partners
Case study 3 partners North Yorkshire	Local partners for surface water management delivery	Invite to workshop Face to face meeting with LLFA and invite delivery partners

B Tables of metrics

Risk Metrics

B.1.1 Existing metrics

The following metrics are already in the public domain – these are either collected on a regular basis, have been collected previously through one-off studies or are proposed by current/recent initiatives.

Table B 1: Existing risk metrics

Metric	Category	Existing/ proposed	Collected/proposed by	Purpose
Proportion of 'at risk' properties that flooded in the last year	Risk actual -	Proposed	National Infrastructure Commission: Performance Measures. May 2017	Recent flooding
Sewer flooding – internal (no. properties flooded)	Risk actual -	Existing	CC Water and Water UK via http://discoverwater.co.uk/sewer-flooding	Recent flooding
Sewer flooding – external (no. properties flooded)	Risk actual -	Existing	CC Water and Water UK via http://discoverwater.co.uk/sewer-flooding	Recent flooding
Total number of properties at risk from flooding	Risk current -	Proposed but can be obtained from the Risk of Flooding from Surface Water map	National Infrastructure Commission: Performance Measures. May 2017	Evidence of current risk
Number of people exposed to frequent flooding	Risk current -	Existing i.e. been collected previously but not regularly collected	Present and future flood vulnerability, risk and disadvantage (Sayers and Partners, 2017)	Understand scale of population at risk of frequent flooding
Percentage of population equivalent associated with flooding nodes in a 1	Risk current -	Existing	Ofwat Wastewater resilience metrics:	As above

Metric	Category	Existing/ proposed	Collected/proposed by	Purpose
in 50 year rainfall event				
Percentage of assets (nodes) predicted to flood in a 1 in 50 year rainfall event	Risk - current and future	Existing	Ofwat	Understand scale of assets at risk of frequent flooding
Variance in number of properties at risk now and under different climate scenarios	Risk - current and future	Proposed	National Infrastructure Commission: Performance Measures. May 2017	Understand change in risk over time
Estimated annual damages associated with surface water risk now and in future	Risk - current and future	Existing i.e. been collected previously but not regularly collected	Projections of future flood risk: Sayers and Partners (2015) for the UK CCRA 2017	Understand change in risk over time

B.1.2 New metrics

The following new metrics were proposed either through stakeholder interviews, at the stakeholder workshop or by the Test Case.

Table B 2: Suggested new risk metrics

Metric	Category	Purpose	Suggested by
Proportion of population protected to a given Standard of Protection	Risk - current	Provide a more standardised understanding of what is meant by being at risk or protected from surface water flooding	Scoping
Provision of local intelligence on surface water flood risk	Risk - current	Encourage LLFAs and others at local level to provide data and intelligence to inform national mapping and overall improve understanding of levels of risk	Scoping

B.1.3 Screened out metrics

The following metrics were screened out in the initial stage for various reasons as detailed below.

Table B 3: Screened out risk metrics

Metric	Category	Existing/proposed/new	Reason for screening out
No. Section 19 Flood Investigations	Risk actual -	Existing – Single Data List, Government	Not nationally consistent as LLFAs can select different thresholds. Historic flood risk captured in other metrics
Scale of the potential exposure within a neighbourhood in the absence of defences	Risk current -	Existing i.e. been collected previously but not regularly collected - Present and future flood vulnerability, risk and disadvantage (Sayers and Partners, 2017)	Hard to separate out surface water flood risk and surface water tends to be more of a persistent frequent issue. Doesn't take into account defences.
Expected Annual Probability of flooding: individual	Risk current -	As above	Could usefully compare how actions to reduce risk have made a difference but difficult to separate out surface water
Neighbourhood Flood Vulnerability Index	Risk current -	As above	As above
Expected Annual Damages - residential only	Risk current -	As above	As above
Expected Annual Damage: individual	Risk current -	As above	As above
Relative economic pain - expressed as the ratio between uninsured economic damages and household income	Risk current -	As above	As above

B.2 Ways of Working metrics

B.2.1 Existing metrics

The following metrics are already in the public domain – these are either collected on a regular basis, have been collected previously through one-off studies or are proposed by current/recent initiatives.

Table B 4: Existing Ways of Working metrics

Metric	Category	Existing/ proposed	Collected/proposed by	Purpose
Status of LLFA asset registers	Ways of working – asset management	Proposed	Single Data List, Government	LLFA asset management (surface water flood risk driver)
Local outcomes from the use of the Section 21 register	Ways of working – asset management	Proposed	Single Data List, Government	LLFA asset management (surface water flood risk driver)
Drainage asset – inventory and condition data coverage	Ways of working – asset management	Existing	Highways England	Highways England asset management
Implementation status for the 2012 HMEP Guidance on the Management of Highway Drainage Assets	Ways of working – asset management	Existing	Department for Transport	Progress in taking a risk based approach to asset management
Drainage asset information: route by route information on the extent of drainage asset knowledge	Ways of working – asset management	Existing	Network Rail	Network Rail asset management
What areas of work has the strategic flood partnership group been involved in over the past year?	Ways of working – partnerships	Proposed	Single Data List, Government	Effectiveness of partnership working
Number of local plans with effective SUDS policies	Ways of working – planning	Existing	ASC indicator	Understanding degree to which local plan policies promote/require SUDS
LLFA Statutory Consultee	Ways of working –	Existing	DCLG	Understand scale of the

Metric	Category	Existing/ proposed	Collected/proposed by	Purpose
performance	planning			work and statutory consultee performance
How many full time equivalent staff are currently engaged by the LLFA on Local Flood Risk Management?	Ways of working - resources	Proposed	Single Data List, Government	Understand scale of available resources
Funding for local flood risk management (total spend)	Ways of working - resources	Existing	ASC indicator	Understand scale of investment in FCERM
Commitment of assets being resilient to 1 in 50 storm event	Ways of working - standards	Existing	Ofwat	Commitment not a measure
What have you used your strategy and associated action plan to influence, deliver, change in the past year?	Ways of working - strategies	Proposed	Single Data List, Government	Understand how strategies are helping to address surface water flood risk
Number of LLFAs with published Local Flood Risk Management (LFRM) strategies	Ways of working - strategies	Existing	ASC indicator	Demonstrate how many LLFAs have plans to address surface water flood risk
Progress of Local FRM Strategies	Ways of working - strategies	Existing	Single Data List, Government	As above
Content of the local flood strategies	Ways of working - strategies	Proposed	ASC indicator	Understand how strategies are helping to address surface water flood risk

B.2.2 Suggested new metrics

The following new metrics were proposed either through stakeholder interviews, at the stakeholder workshop or by the Test Case.

Table B 5: Suggested Ways of Working metrics

Metric	Category	Purpose	Suggested by
Impact of community action groups, flood action groups (FLAGs)	Ways of working - community	Understand how community activities are progressing and addressing risk	Scoping
Number of LLFAs with scrutiny of FRM within last 12 months	Ways of working - partnerships	Obtain understanding of the role of internal and external Scrutiny to get RMAs to get things done	Scoping
Number of LLFAs with Strategic FRM Partnership meetings within the last 12 months	Ways of working - partnerships	Strength of local flood risk management partnerships and alignment of objectives	Scoping
Number of LLFAs with regular internal partnership meetings	Ways of working - partnerships	Working relationships between different parts of an upper tier Local Authority e.g. FRM and Highways	Scoping
Number of minor developments permitted in surface water flood risk areas and/ or with measures in to reduce surface water flood risk	Ways of working - planning	Understand how the planning process is helping to manage surface water flood risk	Scoping
Planning guidance for SUDS and local FRM	Ways of working - planning	Understand degree to which LPAs are supporting and promoting SUDS	Scoping
Planning Permissions for major developments granted by LPAs contrary to LLFA advice on SUDS	Ways of working - planning	Understand degree to which LPAs are granting permission against LLFA advice	Scoping
Funding for local flood risk management	Ways of working - resources	Understand resources invested in surface water flood risk management and whether these are topped up locally	Scoping
No. schemes that have considered residual risk/ designing for exceedance	Ways of working - standards	Evidence that flood risk managers are considering residual risk	Scoping
Average Standard of Protection provided by surface water schemes	Ways of working - standards	Evidence of the level of protection by surface water management schemes	Scoping
Existence of strategy/ programme of work taking into account surface water flood risk information from the LLFA	Ways of working - strategies	Evidence that surface water risk is being taken into account	Scoping
How management strategies have addressed current and future risk	Ways of working - strategies	Evidence that surface water risk is being taken into account	Scoping

B.2.3 Screened out metrics

The following metrics were screened out in the initial stage for various reasons as detailed below.

Table B 6: Screened out Ways of Working metrics

Metric	Category	Existing/proposed/new	Reason for screening out
Progress of Local FRM Strategies	Ways of working - strategies	Existing – Single Data List, Government	Says whether a Strategy is in place but not if any actions are being taken. Covered under another metric
Content of local flood risk management strategies	Ways of working - strategies	Existing – ASC indicators	Covered under other metrics and almost impossible to collect on a consistent basis

B.3 Delivery metrics

B.3.1 Existing metrics

The following metrics are already in the public domain – these are either collected on a regular basis, have been collected previously through one-off studies or are proposed by current/recent initiatives.

Table B 7: Existing Delivery metrics

Metric	Category	Existing/proposed	Collected/proposed by	Purpose
Capacity of water company foul and combined networks	Delivery – asset management and performance	Proposed	Water UK 21 st Century Drainage Programme	Understand capacity of network
Local (public) awareness of surface water flood risk	Delivery - awareness	Existing i.e. been collected previously but not regularly collected	Defra's Flood Resilience Community Pathfinder Evaluation - Final Evaluation Report (Oct 2015)	Understanding of levels of awareness
Net area of habitat created	Delivery - environmental	Existing	Environment Agency Investment Programme – Outcome Measure	Understand scale of habitat created as a result of FCERM schemes
% of areas covered by flood insurance	Delivery - insurance	Existing i.e. been collected previously but not regularly collected	Defra's Flood Resilience Community Pathfinder Evaluation - Final Evaluation Report (Oct 2015)	Understand levels of insurance re: surface water flood risk
£ per property protected	Delivery - investment	Proposed but can be obtained from existing Investment	National Infrastructure Commission: Performance Measures. May 2017	Demonstrate value for money

Metric	Category	Existing/ proposed	Collected/proposed by	Purpose
		Programme Outcome Measures		
Retrofitting of SUDS and upgrading networks	Delivery local measures	- Existing	ASC Indicator	Understand progress in addressing surface water risk
No. flooding hotspots and culverts	Delivery local measures	- Existing	Highways England	Understanding of current flood hotspots across highway network
Area/proportion of built up areas with impermeable surfaces	Delivery planning	- Existing	ASC indicator	Understanding of surface water flood risk driver
PLR coverage	Delivery local measures	- Existing i.e. been collected previously but not regularly collected	Defra's Flood Resilience Community Pathfinder Evaluation - Final Evaluation Report (Oct 2015)	Understanding of no. properties resilient to surface water flood risk

B.3.2 Suggested new metrics

The following new metrics were proposed either through stakeholder interviews, at the stakeholder workshop or by the Test Case.

Table B 8: Suggested new Delivery metrics

Metric	Category	Purpose	Suggested by
Access to affordable insurance (everywhere)	Delivery - insurance	Assess progress in measuring surface water risk by increase in households able to access insurance	Scoping
Insurance claims outside of river and sea floodplains	Delivery - insurance	Assess progress in measuring surface water risk by increase in households able to access insurance	Scoping
Insurance claims in areas at risk of flooding	Delivery - insurance	Understand level of risk	Scoping
Community led works to reduce flooding	Delivery - local measures	Understand degree to which community led activities are helping to reduce risk	Scoping
Quick-win schemes	Delivery - local measures	Understand degree to which LLFAs are taking advantage of the funding to accelerate surface water schemes	Scoping
Planning permissions in areas of surface water flood risk	Delivery - planning	Understand degree to which development is proceeding in areas at risk of surface water flooding	Scoping
No. flood investigations LLFAs have undertaken on properties built since 2008	Delivery - planning	Understand the effectiveness of development management in reducing flood risk to new development	Scoping
Incorporation of SUDs measures in new development	Delivery - planning	Understand degree to which new development is avoiding increased or mitigating against surface water risk	Scoping
Green Infrastructure and natural capital benefits achieved by surface water schemes	Delivery - local measures	Understand degree to which multiple benefits are achieved from surface water schemes	Test Case
SWMP actions completed	Delivery - local measures	Demonstrate how progress is being made on actions that have been identified to address flood risk	Test Case

B.3.3 Screened out metrics

The following metrics were screened out in the initial stage for various reasons as detailed below.

Table B 9: Screened out Delivery metrics

Metric	Category	Existing/proposed/new	Reason for screening out
LLFA spend on surface water as proportion of total spend	Delivery - investment	New - scoping	Doesn't take variation in surface water flood risk into account
Number of LLFAs investigating local flood incidents	Delivery - planning	Existing – ASC indicator	Covered by another metric
Measure of design quality for FRM assets	Delivery – local measures	Proposed - National Infrastructure Commission: Performance Measures. May 2017	Not specific to surface water management and needs considerable research to develop measure
% population signed up to Environment Agency flood warnings	Delivery - awareness	Existing i.e. been collected previously but not regularly collected - Defra's Flood Resilience Community Pathfinder Evaluation - Final Evaluation Report (Oct 2015)	Not relevant - Flood warnings only cover fluvial and tidal flooding
Number of flood wardens in area of influence	Delivery – local measures	Existing i.e. been collected previously but not regularly collected - Defra's Flood Resilience Community Pathfinder Evaluation - Final Evaluation Report (Oct 2015)	Useful, but may be hard to measure and identify wardens for purely surface water risk. This relates to the metric on the work of community groups - so can be picked up there instead.

C Considering the advantages, disadvantages and unintended consequences of the metrics



Table C 1: Metrics to assess risk reduction

Metric Group	Metric	Advantages	Disadvantages	Unintended consequences	Recommendation
Actual (actual flooding events)	Proportion of 'at risk' properties that flooded in the last year	<p>The metrics measure events and thus provide good evidence of properties affected.</p> <p>The metrics provide evidence that can be used to validate the analytical results and model and mapping predictions.</p>	<p>The frequency and numbers of properties affected might reflect the consequences of the prevailing meteorological conditions in any one year or sequence of years, rather than provide evidence on the progress (or not) in managing the risk</p> <p>There is anecdotal evidence of householders withholding flood events so that property price and ease of sale is not affected.</p>	<p>This is a very basic measurement and thus would not be expected to have unintended consequences, unless it was not used appropriately.</p>	<p>Proportion of 'at risk' properties that flooded in the last year</p> <p>Sewer flooding – internal (Existing metric)</p> <p>Sewer flooding – external (Existing metric)</p> <p>These metrics should continue to be collected and used over time to validate metrics relying on analysis and modelling.</p>
	Sewer flooding – internal (Existing metric)				
	Sewer flooding – external (Existing metric)				
Current (existing assessments of surface water flood risk)	Total number of properties at risk from flooding (Existing metric)	<p>The existing metrics provide a cost-effective means of evaluating the national level of risk and so enable quantification of risk at locations where historic events have not been witnessed.</p> <p>The New metrics would provide better information more closely related to outcomes.</p> <p>The metrics are now based on Digital Terrain Model (DTM) data and higher resolution broad-scale modelling techniques that can reasonably represent flood flow paths and storage areas.</p> <p>Metrics on the ownership of assets would enable the evaluation of responsibility for management and more importantly locations where the management was jointly owned.</p>	<p>The methods used to generate the properties at flood risk for the Existing metrics simplify assumptions on the operation and performance of local drainage systems. To refine the results more detailed modelling could be performed using models held by utility companies, but this would be at significant cost if performed as a national exercise.</p> <p>The new metrics identified would provide improved data but would not be easily collected and thus could also involve significant cost.</p> <p>The challenge with respect to identifying assets is to be aware that this would not necessarily map out the zone of their influence. Also the data might not be easily assembled as it would have to be sourced from numerous parties.</p>	<p>The nationally generated metrics are not intended to provide 'property level' information, but by default count individual properties affected to evaluate the risk giving rise to the impression that the data can be used at a property level. This can introduce issues for property owners with respect to insurance and property value during land searches.</p> <p>Metrics that defined ownership of assets could improve partnership working and investment in interventions to provide multiple benefits.</p>	<p>Total number of properties at risk gives an oversight of the risk but needs to be used with caution.</p> <p>Consideration could be given to the identification of surface water flood zones that are described by the 'potential risk'. This approach is adopted for river and sea flooding and has been accepted as a planning tool. This approach would also potentially address the unintended consequence of the outputs being used to evaluate risk at an individual property level.</p> <p>Further evaluation of the merits of identifying asset ownership should be performed as this could improve long term management.</p>
	Number of People Exposed to Frequent Flooding (New Metric)				
	Percentage of population equivalent associated with flooding nodes in a 1 in 50 year rainfall event (New metric)				
	Standard of Protection against surface water flooding (New metric)				
	Provision of local intelligence on surface water flood risk (New metric)				
Ownership and spatial influence of assets affecting surface water risk (New metric)					
Current and future	Percentage of assets (nodes) predicted to flood in a 1 in 50-year rainfall event (New Metric)	<p>The metric relies on data sets and modelling that should be relatively easy to interrogate to abstract the required measurement.</p>	<p>The timescale for the introduction of the metric is unknown.</p> <p>The focus is a single event with an annual probability of 1 in 50. It would be prudent to consider risk for other probabilities when considering management</p>	<p>Might result in a focus on the performance of specific assets rather than the consequences of them failing. So could result in Water Industry priorities that are not aligned with those of other stakeholders.</p>	<p>Should be considered further, but in combination with an assessment of the wider sources of surface water flooding in any one area, working across stakeholders to present a complete picture.</p>

Metric Group	Metric	Advantages	Disadvantages	Unintended consequences	Recommendation
Future	<p>Changes in surface water flood risk (New metric) – evaluated in Brighton test case</p> <p>Changes in surface water flood risk (Existing metric)</p>	<p>This would measure how risk might change in the future as a consequence of climate change. Without this understanding it is not possible to measure how the progress made in management of surface water flood risk is affecting the status quo (as the baseline risk is increasing).</p> <p>The measurement of risk using investment is a logical means of understanding the commitment being made.</p>	<p>The modelling and mapping of future risk is associated with the disadvantages identified for metrics used to measure 'current' risk.</p> <p>The data on investment (Grant in Aid) funding and schemes only captures a portion of the investment and so does not paint the full picture from a national perspective.</p>	<p>The predicted future risk might not capture the intended investment and thus over-state the actual risk. It is likely that the investment and commitment is understated.</p>	<ul style="list-style-type: none"> Changes in surface water flood risk (New metric) – evaluated in Brighton test case Changes in surface water flood risk <p>Both are of value – consideration should be given to collection of data from all stakeholders to assemble a broader picture of the investment.</p>

Table C 2: Metrics to assess how ways of working are helping or hindering surface water flood risk management

Metric Group	Metric	Advantages	Disadvantages	Unintended consequences	Recommendation
Asset management	Status of LLFA asset registers	Recording the status of Asset Databases shows progress made by individual RMAs	Metrics are fairly specific to individual organisations and not easily transferable.	Each RMA has a different system and protocol for recording asset information. Each RMA then will take a different approach to inspection and maintenance, with considerable differences in how work is funded and prioritised at a local level, both between RMAs and between the same types of RMAs nationally. This means that assets are maintained in organisations' silos in many places and not as systems. Collecting information on an individual RMA basis may amplify these silos. The implications for asset systems owned by multiple RMAs are not always clear, for example, flooding may materialise at one location, with the cause of this being an asset up or downstream. There is not a collective understanding of asset systems in all areas.	Further work is needed to identify on an asset systems basis, rather than based on organisational responsibilities: Whether a comprehensive Asset Database is in place, What it is used for and Progress in defining local asset systems Incentives are needed for LLFAs to further develop and prioritise their Asset Registers consistently and so that the interdependencies between assets owned by RMAs and third parties is better understood to more effectively target enforcement, maintenance and improvement work.
	Local outcomes from the use of the Section 21 Asset Register	The use of Asset Registers can demonstrate how they are being used to make progress with SWM	Measuring whether a system is in place and how much data is held would not give a picture of progress, unless there are local targets and a baseline to measure this against		
	Drainage asset – inventory and condition data coverage	A shared understanding of asset systems between RMAs facilitates more effective SWM	A risk-based approach to data collection is needed. It is hard to measure how much of the drainage system is unknown and unrecorded and for assets that are recorded how much data is incomplete		
	Implementation status for the 2012 HMEP Guidance on the Management of Highway Drainage Assets				
	Drainage asset information: route by route information on the extent of drainage asset knowledge				
	Shared data and understanding of asset systems				
Community	Impact of community action groups, flood action groups (FLAGs)	The Defra Community Flood Resilience Pathfinders demonstrated and evaluated a range of different approaches. It is important to highlight the role that communities themselves can have in SWM. A measure of the effectiveness of community engagement is needed, alongside the resilience of Community Flood Groups. For example, do they have rolling action plans? Are they engaged with RMAs? Do they meet regularly and are they sustainable in the long term?	Nationally approaches vary, based to some degree on the capacity, expertise and resources of RMAs and also the willingness of communities to engage. Community expectation of LLFA work is high, but the capacity and approach can vary between LLFAs. There is not a consistent approach to Community Flood Resilience across the Country nor a consistent level of take up from Communities where this is on offer	It can be challenging to identify the impact that Community Groups have, for example the number of community meetings and/ or Flood Action Groups could be measured, although it is hard to know what these numbers would mean e.g. what does good look like? There is likely to be greater involvement in the aftermath of flooding and the need for RMA involvement could change over time. The number of times advice is given or webpages are viewed could be measured and has been used to successfully demonstrate the success of community resilience websites, such as the Northamptonshire Flood Toolkit. However, what is not known is how these have increased resilience e.g. what action has been taken?	The presence of Community Flood Resilience initiatives is likely to be more measurable on a local scale and as the offering and take up vary, it may be more appropriate to highlighting good practice in this area than attempt to measure take up nationally. LLFAs should be incentivised to take forward relevant Community Flood Resilience approaches locally. This could be particularly challenging for areas that have not recently experienced flooding, where communities may not wish to engage and expectations of communities on RMAs would need to be carefully managed.
	Impact of advice and support given to Communities about SWM				
Investigations	Number of LLFAs investigating local flood incidents	The number of informal and formal flood investigations gives a useful measure of the work of the LLFA	The amount of LLFA Flood Investigations will vary over time in response to flood events and vary geographically depending on the policy in place regarding when an Investigation is undertaken and the format of that Investigation.	The geographical coverage and threshold for undertaking a Formal Flood Investigation can vary from one LLFA to another. Coupled with natural climate variation, this means that any national upscaling of the number of flood investigations may be misleading.	Further work is needed to identify on a Partnership basis, rather than based on organisational responsibilities: What triggers an Investigation What individual and shared systems and procedures should be for collecting and sharing flooding information
	Procedures to investigate a flood in partnership	The use of Flood Investigations can demonstrate how they are being used to make progress with SWM			

Metric Group	Metric	Advantages	Disadvantages	Unintended consequences	Recommendation
	How the outcomes from flood investigations are being used	RMA's have different systems and protocols for collecting and sharing information. It was highlighted through the initial interviews and Test Cases that coupled with confusion from the public, this means things can get reported to the wrong people and are not quickly resolved. Having procedures in place to Investigate flooding in Partnership across RMA's helps to reduce the chance of this happening.	Different RMA's have different triggers and procedures for investigating flood events.		Procures for investigating floods in Partnership RMA's should be incentivised to develop clear systems and processes for sharing flooding information and jointly investigating flooding incidents.
Local delivery	Number of packaged schemes	Consider under Delivery metrics with schemes			
Partnerships	What areas of work has the strategic flood partnership group been involved in over the past year?	Understanding whether Partnerships have met and the breadth of representation and work the Partnership have undertaken gives a measure of progress in tackling complex flooding issues	Partnership working arrangements vary considerably around the Country and reflect local governance structures, capacity, resources and drivers to work in Partnership e.g. joint schemes, recent flooding. Nationally, many Strategic Flood Partnerships were set up following the introduction of the LLFA role, but these can be resource intensive to maintain and not all meet regularly.	Partnership working arrangements vary Nationally and trying to measure these consistently could give a misleading picture. Whilst the number of Partnerships LLFA's contribute to would be useful to demonstrate the scale of Partnership working, outputs and outcomes from these partnerships are not always straightforward to measure.	It would be beneficial to gather information on: Whether Strategic Flood Partnerships meet regularly and how these are structured Who is represented on Partnerships Information on the areas of work that Flood Partnerships are involved in
	Number of LLFA's with scrutiny of FRM within last 12 months				
	Number of LLFA's with Strategic FRM Partnership meetings within the last 12 months				
	Number of LLFA's with regular internal partnership meetings				
	Breadth of representation on Partnerships				
Planning	Number of local plans with effective SUDS policies	These metrics would capture the effectiveness of LLFA's and the current Planning Policy approach to SUDS in influencing how new development affects surface water flood risk	Because Water Companies and IDB's are not Statutory Consultees these metrics do not capture wider industry input to Planning Decisions. There is no organisation with a Statutory function to comment on local flood risk issues or to comment on SUDS features for non-major developments and the planning system cannot force new developments to implement measures to mitigate existing surface water flooding issues downstream. Statutory functions and resources are not currently available for auditing of SUDS construction and ongoing maintenance and performance on the ground.	The approach to the LLFA Statutory Consultee role varies across the Country, for example on the balance between Standing Advice/ Bespoke Comments to LPAs and the development and use of Local SUDS Standards and Guidance. Metrics based on performance assume a consistent standard of service so could be misleading. One of the potential unintended consequences here is that it can be perceived as easier to construct and get adopted underground SUDS, which does not meet wider sustainability criteria and may result in more water ultimately being discharged to the sewer network.	The following metrics are advised: Reflection of LLFA Guidance in Local Planning Policy Planning Permissions for major developments granted by LPAs contrary to LLFA advice on SUDS Percentage of as built SUDS in accordance with Planning Permissions granted Percentage of SUDS being maintained in accordance with management plans
	Number of minor developments permitted in surface water flood risk areas and/ or with measures in to reduce surface water flood risk				
	Planning guidance for SUDS and local FRM and reflection in Local Planning Policy				
	LLFA Statutory Consultee performance				
	Planning Permissions for major developments granted by LPAs contrary to LLFA advice on SUDS				

Metric Group	Metric	Advantages	Disadvantages	Unintended consequences	Recommendation
	Percentage of as built SUDS in accordance with Planning Permissions granted				
	Percentage of SUDS being maintained in accordance with management plans				
Resources	How many full time equivalent staff are currently engaged by the LLFA on Local Flood Risk Management?	Monitoring over time the resources and budget available for SWM can help to show where progress is being made	The challenge for SWM varies between LLFAs and hence it is more appropriate for some LLFAs to have more staff and funding than other LLFAs.	Resources vary both across the RMAs and around the Country. As geographical boundaries and organisational priorities of RMAs vary it is not possible to identify an exact level of resource specifically for surface water management in any given area across all partners. LLFA resources are only part of the picture. Likewise for related functions like Local Government spatial planning, time spent on surface water management will vary over time.	Resources need to be considered alongside outcomes in any local area to gain an understanding of how progress is being made, recognising that priorities and approaches will vary across the Country.
	Funding for local flood risk management (total spend)	Highlighting how much has been spent versus the available funding can highlight where there are competing priorities for local government funding and SWM is perceived as less of a priority than for other areas.	In terms of budget, then again this varies between RMAs, around the Country and between financial years, given both other organisational priorities and political influence. The split between revenue and capital funding will vary depending on the programme for local scheme delivery.	The amount of resource in a LLFA can be measured and this will give some reflection of differences in the service provided between LLFAs. However, different LLFAs will have different priorities which could mean a similar amount of staff will produce different outcomes. In addition, some LLFAs outsource work and this could complicate the picture.	A specific metric for this area will be challenging to define and collect consistently that gives a true understanding of the collective effort of all RMAs in SWM and funding will vary from year to year.
	Funding for local flood risk management v. spend	Funding for local flood risk management - both from external grants and the Revenue Support Grant could be measured.	Although like resources, the priorities for spending this will vary from one LLFA to another. However, what could be most effective is a measure of spend versus allocation, as slippage for RMA schemes on the 6 Year Investment Programme is known to be a challenge, due to delays in project progression.		Retention in Local Government FRM roles needs to be considered further e.g. by capturing the staff in place over a 5 year period and benchmarking the success of the EA led FCERM Degree programme for local government versus EA placements. Skills and resource sharing and capacity building between LLFAs should also be promoted as best practice.
	Spend on schemes versus capital funding made available	It would be beneficial to measure the success of initiatives to try and future proof capacity for surface water management.			In addition to this, alongside schemes in delivery metrics, slippage should be considered.
	Retention in Local Government FRM roles				
Standards	Commitment of assets being resilient to a 1 in 50 storm event	Understanding the standard of protection from surface water flooding can help provide a consistent understanding of outcomes	Different RMAs have different Standards of Protection they work to for their assets, due to differences in regulation, drivers and funding. Whether or not climate change adaptation is considered varies.	Having a universal target standard of protection could have the unintended consequence of making some areas uneconomical to protect, whilst at the same time raising expectations.	The following metric is advised: Partnership schemes delivered where the management of surface water has been clearly identified as an element of the scheme
	Capacity of drainage and combined networks	It would be useful at a Strategic level to understand more about how drainage capacity can vary over an area, which would inform a partnership approach to scheme development.	The feasibility of protecting to a certain standard will vary from location to location, depending on the partners involved and outcomes and funding available		Careful definition is needed of what it means to develop a scheme that fully considers all sources of flooding to ensure a consistent approach is taken
	Schemes that have considered residual risk/ designing for exceedance	Collecting information on whether			Further work is needed to identify how a local shared understanding of existing
	Average Standard of Protection afforded by surface water schemes				

Metric Group	Metric	Advantages	Disadvantages	Unintended consequences	Recommendation
	Partnership schemes delivered where surface water is an element	schemes have considered residual risk could also be a helpful driver to ensure future schemes consider all sources of flooding and that there is an element of adaptability to climate change. This could be considered as managing exceedance flows and therefore whether surface water flooding has been considered.			drainage capacity can be developed Work is needed to bring together the work of the 21 st Century Drainage Project and datasets of other RMAs to develop a complete local understanding of drainage capacity
	Development of a local shared understanding of existing drainage capacity				
Strategies	How LLFAs have used the Local FRM Strategy to influence and deliver FRM	The new Single Data List for LLFAs aims to capture information on what Strategies are used for and this may be a more useful measure of effectiveness. It may also be useful to measure progress in programming schemes with Partners - so it is beneficial to consider this in the context of Partnership working.	Whilst some reporting is undertaken for Councillor and Senior Management updates, LLFAs do not have consistent data that measure progress in implementing Strategies and many are now out of date. The existence of a Strategy alone does not necessarily reflect action that has been taken on the ground.	Whilst the existence of a Strategy does suggest a LLFA is making progress, given the varying content, format and date of Local FRM Strategies is not possible to easily assess the impact they have had on reducing surface water flood risk.	The use of Strategies to influence, deliver or change approaches to Surface Water Management The existence of a programme for flood alleviation schemes, created by all partners working together. Careful criteria would need to be considered to ensure accurate information was provided regarding a truly shared partnership programme of work.
	Number of LLFAs with published Local Flood Risk Management strategies				
	Existence of strategy/ programme of work taking into account surface water flood risk information from the LLFA				
	How management strategies have addressed current and future risk				

Table C 3: Metrics to assess the levels of delivery of interventions to manage surface water risk

Metric Group	Metric	Advantages	Disadvantages	Unintended consequences	Recommendation
Asset management and maintenance	Asset ownership and performance in areas at risk of surface water flooding	Regular asset management and maintenance programmes with regular inspection regimes are essential to report on and improve effectiveness. Need to capture progress by highways and sewerage authorities as well as LLFAs	Potential for lack of consistency due to different approaches adopted by different RMAs and incomparable outputs as comparing different things.	Could exacerbate silo management and fail to encourage collective approaches to ownership and management (see ways of working commentary)	Yes – would be useful to investigate a metric around interdependences
	Capacity of drainage and combined networks	Measuring capacity is important for water companies – need to be able to measure the volume of water that is being prevented from flooding properties and use this metric to inform scheme prioritisation and decision-making. Should include length of sewers. This is an area where interdependencies could potentially be assessed e.g. highway gullies collect runoff – highway drains convey discharges – utility company combined sewers receive highway discharges – LLFA watercourses and culverts discharge to rivers or the sea.	Essential that inspection is included alongside requirement to have registers otherwise there is no assessment of quality. Data availability and sharing will be a major challenge to taking this forward.		Asset management is also considered under Ways of Working
Awareness	Awareness of surface water flooding	Important to include a metric on awareness, but probably needs to be focused on activities rather than actual levels of awareness due to difficulties in measuring this.	Likely to be a fairly subjective measure and would require surveys etc – can't use flood warning take up as these are not provided for imminent surface water flooding. Could measure outputs such as no. properties leafleted etc. regarding local risk but this does not provide evidence of levels of awareness	Very difficult to achieve an objective approach other than through surveys. As professionals have no agreement on what level of risk constitutes surface water flood risk, difficult to expect the public to have an appropriate level of awareness.	Possible metric – would be useful to investigate further potential metrics to assess awareness
Environmental	Net area of habitat improved or created	Could show wider benefits of surface water management schemes	Unlikely for much habitat to be created by SUDS schemes and does not evidence managing risk	N/A	Not considered relevant
	Green Infrastructure and Natural Capital benefits achieved by surface water schemes	Increasingly GI and natural capital benefits, including health and wellbeing, are being quantified and monetised. This could show the added benefit of surface water flood risk schemes particularly whether these are working with natural processes	As above, does not evidence managing risk and many NFM type schemes will not achieve results for a long time and are therefore more appropriate as a wider strategic approach to manage risk over a longer time period including the impacts of climate change.	Schemes could be promoted that have more additional benefits but less flood risk alleviation benefits rather than focusing on reducing flood risk.	Possible metric – would be useful to further investigate relevant GI/ natural capital measures especially if these could be quantified/ monetised
Insurance	Flood coverage (insurance)	Access to affordable insurance is considered important as provides evidence of how well risk is being managed	Current surface water flood risk map significantly overestimates scale of properties at risk of flooding from surface water meaning that access to insurance can be difficult in areas shown as being at risk of flooding on the map that are not in reality. Many properties at risk of flooding from surface water and rivers/sea so difficult to identify which source is creating difficulties in accessing insurance.	Potential to blight areas if publicise where insurance can and can't be accessed	Possible metric – further investigation required
	Access to affordable insurance				
	Insurance claims outside of river and sea floodplains				
	Insurance industry data on number of claims				
Investment	£ per property protected	Easy to obtain (from EA Investment Programme)	Does not measure progress in addressing risk	Could lead to less effective schemes being promoted if focus is on cost	Information on the value for money surface water

Metric Group	Metric	Advantages	Disadvantages	Unintended consequences	Recommendation
				rather than overall value for money	schemes can provide would be more appropriate
Local measures	Retrofitting of SUDS and upgrading networks	<p>SUDS implementation would be welcome</p> <p>Flooding hotspots and their mitigation highlighted for Network Rail and Highways Agency – these are recorded on a register but not analysed or regularly reviewed in terms of approaches to address, geographic areas with particular concentrations, increases in risk etc. Could include no. culvert flooding hotspots that have not been mitigated to understand risk.</p> <p>LFRMS and SWMP actions have been identified to address surface water flood risk so evidence of their satisfactory completion should provide evidence of progress in managing surface water flood risk.</p>	<p>Need to monitor quality and recognise that green SUDS are not appropriate or deliverable everywhere.</p> <p>Community works more likely in some areas than others – need to be aware of the context and not compare areas using metrics as for some issues, different geographical areas are apples and pears.</p> <p>Quick wins are subject to differences in resources and interpretation across the Country and may be better captured within an assessment of the total number of properties at reduced flood risk, rather than a standalone metric</p> <p>LFRMS and SWMP actions may become less relevant over time and may be superseded by other plans or new information.</p> <p>Actions may be completed but not necessarily effectively so need to include an element of monitoring of performance not just of output delivery</p>	<p>By their nature, there can be significant geographical variation in the application of local measures. Hence any nationally collated metric may not paint a representative picture of what happens in reality at a local level.</p> <p>Not all areas produce SWMPs so not a nationally consistent approach.</p>	Yes
	The number of flooding hotspots and culverts (high risk and very high risk) mitigated				
	Community led works to reduce flooding				
	Quick win schemes				
	SWMP actions completed				
Partnerships	Management measures where multiple sources of flooding exist				Not considered here - considered under Ways of Working
Planning	Area/Proportion of built up areas covered with impermeable surfaces	<p>Changes in urban morphology suggested that would capture both increased development and green space coverage. This would demonstrate impact of development on greenspace if captured and compared over periods of time.</p> <p>Would be useful to monitor incorporation of SUDS in new minor development as well as major as cumulative impacts may be significant</p>	Not all areas are appropriate for SUDS – need to ensure measures used to study progress overall and not compare areas with each other		Yes – also considered under Ways of Working
	How many flood investigations LLFAs have undertaken on properties built since 2008				
	Incorporation of SUDS measures in new development				
Property Level Resilience	Coverage of Property Level Resilience	PLR metrics could be included as evidence of work being done to protect individuals and properties from the long-term effects of surface water flooding	The topic is focused on reducing risk. PLR does not reduce risk but helps people to be resilient to risk.	Uptake varies considerably for many reasons and PLR is more appropriate and cost effective for some properties than others – needs to be used carefully	Not considered relevant as a risk reduction metric but could be included in terms of action to increase resilience.
	Number of properties needing property resilience measures				
Schemes	Cost benefit ratio of FRM measures	<p>All Environment Agency Investment Programme metrics (investment, outcome measures, cost benefit ratios) provide a readily available evidence base regarding interventions to manage all sources of flood risk.</p> <p>Recording surface water schemes</p>	Provides a snapshot of investment and outcomes at any one time but does not provide an ongoing picture of how risk is changing. Also, this only identifies projects funded by Grant in Aid and Local Levy meaning those funded solely by LLFAs, Network Rail, Highways England, Water Companies etc are not	The Investment Programme sows the results of appraisals i.e. expected benefits in the form of outcome measures not actual that have been monitored and reviewed post-delivery. Understanding of effectiveness of interventions would better evidence reductions in risk	Yes, providing suitably caveated – some cross-over with metrics considered under Risk
	Households moved out of the very significant & significant flood risk categories to moderate or low				
	Households in the 20%				

Metric Group	Metric	Advantages	Disadvantages	Unintended consequences	Recommendation
	most deprived areas moved out of the very significant & significant flood risk categories Surface water schemes completed	completed for all RMAs and including those outside of the Investment Programme within a given area would help provide a better understanding of collective action to address risk.	captured – it is not an overarching risk programme.	achieved.	

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