



South Eastern CFRAM Study

Final Report

Unit of Management 15

DOCUMENT CONTROL SHEET

Client	The OPW					
Project Title	South Eastern CFRAM Study					
Document Title	IBE0601Rp0076_UoM15 Final Report_F02					
Document No.	IBE0601Rp0076					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
	1	1	39	1	1	1

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
F01	First Version	Various	M Brian	G Glasgow	Belfast	July 2017
F02	2 nd Version	Various	M Brian	G Glasgow	Belfast	Oct 2017



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ABBREVIATIONS

AEP	Annual Exceedance Probability
AFA	Area for Further Assessment
BCR	Benefit Cost Ratio
CFRAM	Catchment Flood Risk Assessment and Management
FHRC	Flood Hazard and Research Centre
FRA	Flood Risk Assessment
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
HEFS	High end future scenario
ICM	Integrated Catchment Management
KMM	Kirk McClure Morton
MCM	Multi Coloured Manual
MPW	Medium Priority Watercourse
MRFS	Mid range future scenario
OPW	Office of Public Works
OSi	Ordnance Survey ireland
PFRA	Preliminary Flood Risk Assessment
POR	Preliminary Options Report
PVb	Present Value benefit
PVd	Present Value damage
RBD	River Basin District
SEA	Strategic Environmental Assessment
SI	Statutory Instrument
SoP	Standard of Protection
SSA	Spatial Scale of Assessment
SUDS	Sustainable Urban Drainage Systems
UoM	Unit of Management

1 INTRODUCTION

1.1 THE 15 UNIT OF MANAGEMENT – UoM15

The South Eastern CFRAM Study covers an area of 12,857 km² and includes six Units of Management (UoM) each comprised of a single Hydrometric Area (HA). They are UoM11 (Owenavorrhagh & Blackwater RB), UoM12 (Slaney RB), UoM13 (Ballyteigue-Bannow RB), UoM14 (Barrow RB), UoM15 (Nore RB) and UoM17 (Waterford South Coast RB). UoM16 (Suir RB) is covered by the Suir pilot CFRAM Study and covers an area of approximately 3,542 km².

There is a high level of flood risk within UoM15, with significant coastal and fluvial flooding events having occurred in the past. UoM15 covers an area of 2,595 km² and includes much of County Kilkenny, a significant portion of County Laois, as well as smaller portions of Counties Tipperary, Offaly and Carlow.

The principal river in UoM15 is the River Nore which rises in a hilly area approximately ten kilometres southwest of Roscrea in Tipperary. It flows in a north easterly direction through Borris-in-Ossory to Castletown in County Laois and then flows in a south easterly direction through Ballyragget, Kilkenny, Bennettsbridge, Thomastown and Inistioge in County Kilkenny to its confluence with the River Barrow approximately four kilometres upstream of New Ross. The total length of the River Nore from its source to the confluence with the Barrow is 141 kilometres. The lower part of the river, downstream of Inistioge, is tidal.

Other significant tributaries are the Delour, Mountrath, Owveg, Kilfane and Dinin rivers which join the River Nore on its left hand bank and the Gully, Erkina, Nuenna, King's River, Breagagh, Little Arrigle and Arrigle rivers which join the River Nore on its right hand bank.

Within UoM15 the OPW in conjunction with Kilkenny County Council has implemented and maintains the Kilkenny City Flood Relief Scheme which was constructed between 2001 and 2005, under the 1945 Arterial Drainage Act (as amended). The OPW continues to have statutory responsibility for inspection and maintenance of this Scheme, which includes the main River Nore channel through Kilkenny and part of the lower reaches of the River Breagagh.

Drainage Districts represent areas where the Local Authorities have responsibilities to maintain watercourse channels and therefore contribute to maintaining the existing regime. In relation to the ten Drainage Districts located within UoM15, only the Rathdowney and Mountrath models contain watercourses located within Drainage Districts although even within these models the activities within Drainage Districts are not considered to significantly contribute to the maintenance of the existing regime affecting the AFAs. However, the activities of Drainage Districts do contribute to the maintenance of the existing regime in other parts of UoM15.

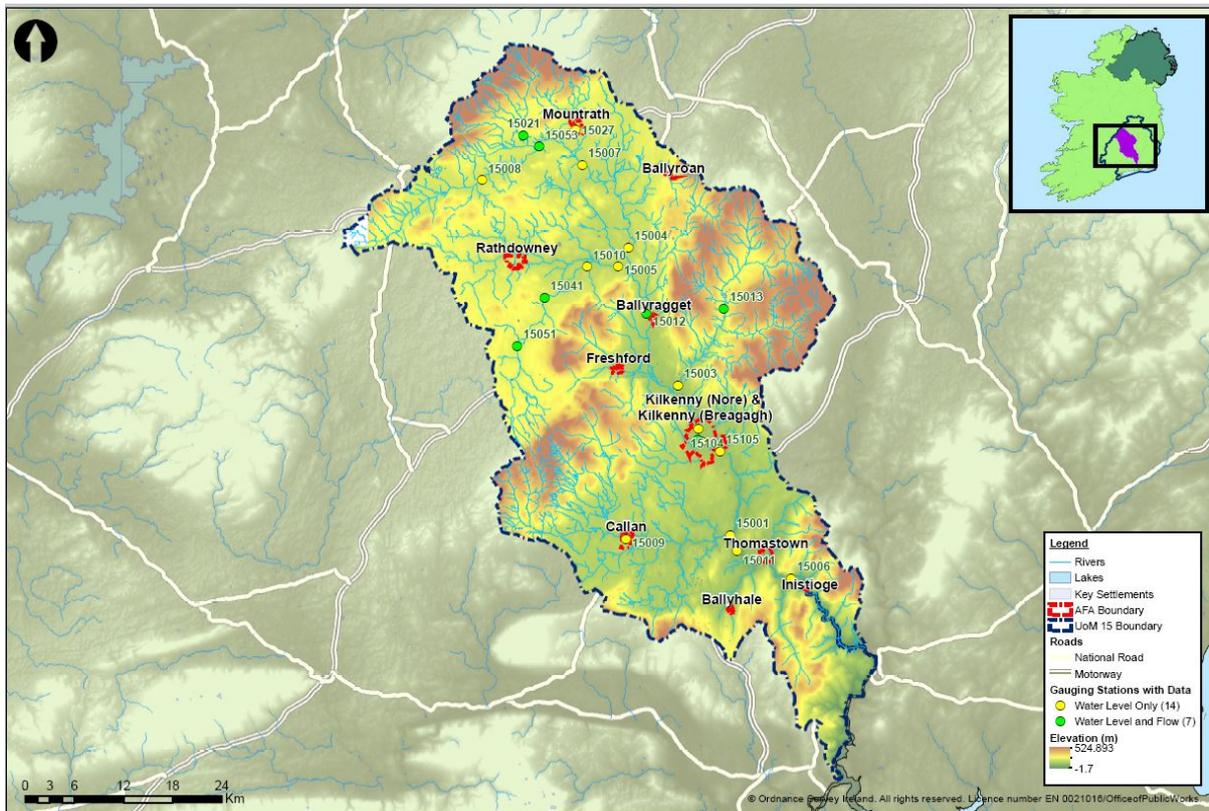


Figure 1.1: UoM15 Location Map

1.2 OBJECTIVE OF THIS REPORT

The principal objective of this report, in accordance with Section 12.2 of the CFRAM Studies Stage 1 Project Brief, is to; provide a summary of the relevant reports prepared for UoM15 as part of the South Eastern CFRAM Study, and detail the development of the draft UoM15 Flood Risk Management Plan (FRMP), consulted on during the second half of 2016 and the finalisation of the UoM15 FRMP in preparation for its adoption in 2017.

This report also aims to identify any issues that may influence the proposed methodologies or programme going forward into the second cycle of Floods Directive implementation.

1.3 ACCOMPANYING AND SUPPORTING REPORTS

This report accompanies the UoM15 Final Flood Risk Management Plan containing the following volumes:

- VOLUME I Draft Flood Risk Management Plan
- VOLUME II SEA Environmental Report and Natura Impact Statement.

This report is also supported by a suite of project deliverables, including flood maps and key UoM15 technical reports on inception, hydrology, hydraulics and preliminary options, which are summarised in

Sections 2 to 5 of this report respectively. The development of the draft and final Flood Risk Management Plan is summarised in Section 6 of this report.

The full list of project reports to date, which also include a series of relevant consultation and environmental reports and specific assessments of flood risk, survey data and rainfall within the South Eastern CFRAM Study area, are listed in Table 1.1.

Table 1.1: Reports – South Eastern CFRAM Study Overall & UoM15 Specific Reports

Ref.	Document Title
Rp0001	IBE0601Rp0001_Communications Plan, Implementation Programmes & Event Plans <ul style="list-style-type: none"> • Initial Scoping Phase • Mapping Phase • Options Phase • Draft Plan Phase
Rp0002	IBE0601Rp0002_Flood Risk Review
Rp0003	IBE0601Rp0003_Initial Scoping Phase Synthesis Report Stakeholders Workshop
Rp0004	IBE0601Rp0004_Initial Scoping Phase Public Open Evening Synthesis Report
Rp0008	IBE0601Rp0008_HA15 Inception Report
Rp0009	IBE0601Rp0009_Radar Rainfall Stage 3
Rp0010	IBE0601Rp0010_HA15 Hydrology Report
Rp0015	IBE0601Rp0015_HA15 Hydraulics Report
Rp0016	IBE0601Rp0016_RPS_CFRAM_SouthEasternCFRAMS_SurveyContractReport_D01
Rp0019	IBE0601Rp0019_Mapping Phase Summary Report
Rp0020	IBE0601Rp0020_SE_SEA Scoping Constraints Report
Rp0021	IBE0601Rp0021_SE_SEA Scoping Report
Rp0022	IBE0601Rp0022_SE_AA_Screening_Report
Rp0025	IBE0601Rp0025_HA15 Preliminary Options Report
Rp0029	IBE0601Rp0029_SE_SEA_Environmental_Report_UoM15
Rp0031	IBE0601RP0031_UoM15_NIS
Rp0039	O15_FRMP_PART01 draft Flood Risk Management Plan
Rp0043	IBE0601Rp0043_HA15 draft final report
Rp0045	IBE0601Rp0045_Option Phase Synthesis Report
Rp0048	IBE0600Rp0048_UoM15 Strategic SUDS Report
Rp0052	IBE0600Rp0052_UoM15 Strategic Planning Report
Rp0057	<i>IBE0601Rp0057_UoM15_SEA_Statement_Report - in preparation</i>
Rp0061	<i>IBE0601Rp0061_UoM15 Defence Asset Database Report – in preparation</i>
Rp0066	<i>IBE0601Rp0066_UoM15 Health & Safety Report – in preparation</i>
Rp0072	<i>O15_FRMP_PART01 Flood Risk Management Plan – in preparation</i>
Rp0076	<i>IBE0601Rp0076_UoM15_Final Report (this report)</i>
Rp0078	IBE0601Rp0055_Draft Plan Phase Synthesis Report
OPW	<i>Synthesis report – in preparation</i>

1.4 ACCOMPANYING AND SUPPORTING GIS DELIVERABLES

Table 1.2: GIS Deliverables – South Eastern CFRAM Study Overall & UoM15 Specific

Survey Data	Type	Scale	
Survey Water Channel	Polyline	UoM	
Surveys Cross Sections	Polyline	UoM	
Surveyed Structures	Polyline	UoM	
Floodplain Photo Location	Point	UoM	
Flood Model Datasets	Type	Scale	Scenario (Probability %AEP)
Extent	Polygon	AFA	Current (All)
			Mid-Range Future Scenario (All)
			High End Future Scenario (10, 1, 0.1)
Flood Zones	Polygon	AFA	Current (1, 0.1)
			Mid-Range Future Scenario (1, 0.1)
Depth	Raster	AFA	Current (All)
			Mid-Range Future Scenario (All)
			High End Future Scenario (10,1,0.1)
Velocity	Raster	AFA	Current (All)
Risk to Life	Raster	AFA	Current (10,1 0.1)
Defence Failure Scenario- Extent	Polygon	AFA	Current (2 Scenarios)
Defence Failure Scenario- Depth	Raster	AFA	Current (2 Scenarios)
Defence Failure Scenario-	Raster	AFA	Current (2 Scenarios)
Defence Failure Scenario-Risk to	Raster	AFA	Current (2 Scenarios)
Specific Risk (No. of Inhabitants)	Raster	AFA	Current (10, 1, 0.1)
			Mid-Range Future Scenario (10, 1, 0.1)
Specific Risk (Type of Economic Activity)	Point	UoM	Current (0.1)
			Mid-Range Future Scenario (0.1)
Specific Risk (Risk Density)	Raster	AFA	Current (0.1)
			Mid-Range Future Scenario (0.1)
Other Datasets			
Modelled River Centreline	Polyline	AFA	
Flows and Water Level Nodes	Point	AFA	Current, Mid-Range & High End
Defended Area	Polygon	AFA	Current (If Applicable)
			Mid-Range (If Applicable)
Def. Failure – Breach Time Steps	Polygon	AFA	
Def. Failure – Defence Removal	Polyline	AFA	
Def. Failure – Defence Removal End point	Point	AFA	
Defence Asset Database	Type	Scale	
UoM Asset Menu	Polyline	UoM	
UoM Asset Menu_Point	Point	UoM	
UoM Structure Menu	Polyline	UoM	
UoM Defence Asset Database	Geodatabase	UoM	
Geometry Infill (if Applicable)	CAD Dwg	AFA	
Risk Management	Type	Scale	
Damage Assessment (Baseline)	Point	AFA	
Damage Assessment Benefit	Point	AFA	
Damage Assessment Defended	Point	AFA	

1.5 HEALTH & SAFETY ROLE

RPS have a role to advise the OPW on CFRAM Study related matters of Health and Safety; RPS undertook duties in the management of the Survey Contractor (ensuring compliance with best practice and Health, Safety and Welfare at Work legislation); and RPS was appointed as Project Supervisor Design Process (PSDP) under the Safety, Health and Welfare and Work (Construction Regulations) 2006 - updated 2013.

Within the remit of PSDP, RPS have undertaken a preliminary hazard management/risk assessment as part of the multi-criteria analysis of options. This has quantitatively assessed the potential hazards and risks associated with the construction and maintenance of options (for example working near water (construction) & (maintenance); Heavy plant and machinery, working at heights (construction), working at heights (maintenance) etc.). These have been collated into the South Eastern CFRAM Study preliminary Safety File, which has been reviewed by the PSDP and will be provided with the final project deliverables in 2017.

2 THE UoM15 INCEPTION REPORT

In 2012, an Inception Report was prepared for UoM15. Its principal objective was to provide detail on the relevant datasets identified for use in the River Nore catchment as part of the South Eastern CFRAM Study, and also provide an update on the collection and interpretation process to date for that data.

The Inception Report identified any issues that had been encountered in sourcing data and flagged any that were considered to potentially affect the proposed methodologies or programme going forward. The data requested, received or outstanding was detailed in the document, together with progress with data analysis.

At the time of preparing the report RPS had not identified any significant data gaps that would impact on the completion of the South Eastern CFRAM Study however, this statement was made without having received any survey information or having full data returns for the information requested from the Local Authorities.

Key findings:

RPS had to adopt an ongoing data collection and quality assurance exercise, to incorporate additional or updated data, as the South Eastern CFRAM Study evolved through its subsequent phases.

For example, when the LiDAR and cross sectional survey data were received and quality checked in comparison with the National Digital Height Model, it became evident that manual data interpolation and correction was required during the hydraulic analysis stage. This ensured linkage between topographical survey and floodplain levels obtained from National Digital Terrain Models or LiDAR survey.

Similarly, population of the defence database remained “live” throughout the study, as, in some cases it was difficult to establish which structures were acting as formal or informal defences, and in others, the effectiveness of the defences required update of their condition due to damage by events or due to recent construction activities.

Thus, the flood risk management process must be considered as “live” and it is not possible at any given point in time to categorically conclude that there are no data gaps which will impact in some way on the future stages of the South Eastern CFRAM Study.

Throughout the South Eastern CFRAM Study a register of datasets received was maintained, this is available with the project's progress reporting for reference. Metadata provided with final project GIS deliverables is also available to confirm the versions of datasets utilised in the CFRAM Study analysis.

3 THE UoM15 HYDROLOGY REPORT

In 2013, RPS commenced the preparation of the UoM15 hydrology report. Its principal objectives were to build on the Inception Report methodology and to provide detail on the outputs from the processes of hydrological analysis and design flow estimation. The Hydrology Report did not include details of the data collection process, flood history within the Areas for Further Assessment (AFAs) or methodology and results from the historic flood analysis (except where this was used to inform the design flow estimation) as this was already contained within the Inception Report for UoM15.

The Hydrology Report provided a review and summary of the methodologies used as well as details of any amendments to the methodologies since completion of the Inception Report. The report detailed the results of the hydrological analysis and design flow estimation and summarised the outputs from the analysis which were taken forward as inputs to subsequent hydraulic modelling. Discussion was provided on the outputs in terms of the degree of confidence which could be attached to the outputs and the opportunities for providing greater certainty for future studies, including opportunities for improving the observed data used to inform the study.

The Hydrology Report was finalised in 2016 after completion of the hydraulic modelling and in particular the rating reviews. Hydrological analysis and hydraulic modelling activities were interactive and required input from the mapping consultation programme in order that they could be concluded.

The UoM15 catchment can be characterised hydrologically as follows:

- The catchment has a wide range of climatic and physiographic characteristics. The drier, lowland areas to the centre moving towards the coast have SAAR values as low as 817mm while the upper catchment in the Slieve Bloom Mountains has SAAR values of up to 1620mm.
- Hydrometric data is generally good but is of variable quality and availability, mainly focused on the River Nore main channel and significant tributaries. 50% of hydraulic models have hydrometric data of varying quality to work with.
- Meteorological data is of good quality and availability in the catchment, although the processing of rainfall data from the Dublin and Shannon Airport radar is of no benefit in two AFAs due to beam blockages and areas of non-coverage.
- Flood behaviour when defined in terms of the growth curve, i.e. in orders of magnitude greater than the median event, is on average slightly higher than would have been thought based on older methodologies (Flood Studies Report).
- The 1% AEP flood event ranges from approximately 1.9 (River Nore main channel) to 3.4 times larger than the median flood flow depending on catchment size. This compares to approximately 2 under FSR.

Key Findings:

The primary output of the hydrological analysis was design flow estimation which was based on previous observed data and estimation/modelling techniques. Hydrological analysis required further validation through the calibration of the hydraulic models which is reflective of best practice in hydrology/hydraulic modelling for flood risk assessment. RPS believe that through complementing statistical analysis techniques with rainfall run-off modelling that the design flow estimation has as high a degree of certainty as is possible prior to calibration/validation and that this yielded efficiency and increased accuracy in the hydraulic modelling phase of the CFRAM Study process. However, it should be noted that the interaction between the hydrology and hydraulic analysis and mapping meant that hydrology could not be finalised until mapping consultation was concluded.

Risks - The main potential source of uncertainty in the analysis is due to a lack of hydrometric gauge data in the smaller ungauged catchments which are the main source of fluvial flood risk in many of the AFAs. This has been mitigated as much as possible by the use of a comprehensive range of analysis and estimation techniques from statistical, catchment descriptor based estimates in line with the most recent FSU guidance to the use of rainfall run-off modelling.

After this cycle of the South Eastern CFRAM Study the main potential adverse impact on the hydrological performance of the catchment is the effect of future changes including climate change and urbanisation.

Opportunities - the following potential opportunities to improve the hydrological analysis further in the next cycle of the South Eastern CFRAM Study were identified:

- 1. Four hydrometric gauging stations were identified for rating review in UoM15 yet survey information and hydraulic models is available for up to a further 17 following completion of the study. All of the other stations on the modelled watercourses would benefit to some degree by carrying out a rating review using the hydraulic models / survey, if only to bring confidence to future extreme flood flow measurement. At best it may be possible to estimate historic flows at gauging stations which are currently water level only.*
- 2. Recommending that new gauging stations are installed on all of the ungauged models (or branches of models) is a long term goal but probably unrealistic within the timeframe of this or even the next CFRAM Study cycle. A more focussed exercise to identify the most acutely needed gauging stations more effectively was undertaken following hydraulic modelling and consultation such that the AFAs which are at greatest risk, are most affected by uncertainty in the design flow estimates and which would significantly benefit from additional calibration data were identified as priorities. Following detailed hydraulic*

modelling and flood risk assessment, AFAs and High Priority Watercourses which are presently ungauged but are considered to have significant flood risk, and as such would significantly benefit from the installation of new gauge stations are identified as follows:

- ***Ballyhale (Ballyhale River)***
- ***Freshford (Nuenna, Freshford North and Upperwood Rivers)***
- ***Mountrath (Shannon Stream)***
- ***Rathdowney (Glasha River).***

Interim improvements to the existing hydrometric gauge network should focus on improving the ratings through the collection of additional spot flow gaugings during flood flows at existing stations.

3. ***The rainfall run-off modelling carried out as part of this study has, due to programme and data constraints, been carried out following hydrological analysis of the gauge station data. The run-off modelling has effectively created a layer of additional simulated historic gauge station years for all of the gauge stations. This data has been utilised in the design flow estimation but could potentially be used to provide further statistical confidence to estimates of historic flood frequency or may even be used to inform hydrograph shape generation in future studies.***

4 THE UoM15 HYDRAULICS REPORT

Following delivery of UoM15 survey data in 2012-2013, RPS undertook the development of hydraulic models and hazard mapping throughout 2013. Drafting of the Hydraulic Report in 2014, led to consultation on the draft final deliverables, including core hazard and risk mapping, during 2015. The final hydraulics deliverables were completed during 2016, with reporting finalised in 2017.

UoM15 includes eleven AFAs which has resulted in the development of ten separate models for flood risk analysis. A single model was developed for the Kilkenny Nore and Kilkenny Breagagh AFAs, due to their proximity and hydraulic interaction.

The hydraulic analysis utilised computational modelling software informed by detailed topographical survey information (channel cross-sections, in-channel/flood defence structures, bathymetric and floodplain data), combined with hydrological inputs (riverine inflows and sea levels) and water-level control parameters (such as channel-roughness), to determine flood hazard.

The principal modelling software package used was the MIKE FLOOD software shell which was developed by the Danish Hydraulics Institute (DHI). This provided the integrated and detailed modelling required at a river basin scale and provided a 1-dimensional /2-dimensional interface for all detailed hydraulic model development thus enabling seamless integration of fluvial and coastal models in the AFAs for which this was required.

Key flood events, where available, were used in the calibration of each model whereby the model was reviewed in order to make sure historic flooding was accurately represented. The principal model parameters that were reviewed and amended during the model calibration process were:

- Bed and floodplain roughness coefficients;
- Structure roughness and head loss coefficients;
- Timing of hydrographs;
- Magnitude of hydrographs;
- Incorporation of additional survey information (e.g. additional cross-sections or missed structures).

The calibrated models (incorporating relevant updates following the consultation process) were used to simulate present day and future flood hazard conditions for events with a range of AEPs. There are inherent assumptions, limitations and uncertainty associated with hydraulic modelling, which are detailed for each hydraulic model within the hydraulics report. Defence failure scenarios (where relevant) and sensitivity tests have been conducted for each model. The parameters selected for the sensitivity analysis were dependent on the specific model but generally included:

- Roughness coefficients;
- 2D domain grid cell size;
- Critical structure coefficients;
- Flow inputs;
- Operation of dynamic structures.

Key Findings:

A series of flood extent, depth, velocity, zone and risk-to-life maps known collectively as flood hazard maps were generated based on the model results.

The outputs from the hydraulic analysis informed the subsequent stages of the CFRAM Study - the models were used to simulate potential options, facilitating the appraisal of possible flood risk management actions and measures and model outputs also helped to determine and map the degree of flood risk.

The specific findings in relation to the hydraulic modelling of each of the AFAs within UoM15 are summarised as follows:

Ballyhale - There were limited details of historic flood events to calibrate the model to within the AFA; however, the available data appeared to calibrate well with the modelled extents. There was no gauge data, and so there was no flow or level data available for quantitative calibration. Whilst the model was considered fit for purpose, overall calibration of the model was limited, consequently there was a strong focus on comments received from the Public Consultation Days, Local Authority Workshops and the sensitivity test results. There is moderate confidence in both the hydrology and hydraulics of the Ballyhale AFA. Ballyhale is at risk of flooding during a 1% AEP fluvial event. Out of bank flooding would occur on the Ballyhale watercourse upstream of the Ballyhale AFA. This would be due to a combination of low bank levels and restrictive structures such as bridges and weirs. For this reason, flood waters would flow overland into the AFA where the regional road joins the N9, south of Ballyhale church. Out of bank flooding also occurs as a result of insufficient culvert capacity at a culvert and a bridge. The result is the subsequent inundation of the floodplain. A number of properties, both residential and non-residential, are at risk of flooding in the Ballyhale AFA. There is one High Vulnerability Site, one regional road and three local roads at risk of flooding. There are reasonable event damages and risks associated with Ballyhale AFA in both present day and future scenarios.

Ballyragget - Minimal historic flooding has occurred in Ballyragget town. The model results correlated well with this, however, there is limited data availability for calibration. Flow information towards the downstream end of the model was slightly higher than predicted, due

to hydrograph peak timings occurring around a similar time. On review, this was considered to be overly conservative and so the timings were adjusted to ensure accurate flow representation. Overall, there was good confidence in both the hydrology and hydraulics of Ballyragget AFA due to the presence of several gauging stations and flood extent verification events. Ballyragget is at low risk of flooding during a 1% AEP fluvial event, with no properties or key receptors at risk of flooding during such an event.

Ballyroan - There is moderate confidence in both the hydrology and hydraulics of the Ballyroan AFA due to the lack of flood extent verification events and gauging station. Ballyroan is at low risk of flooding during a 1% AEP fluvial event. Two national roads along with four social infrastructural assets would be at risk of flooding during such an event.

Callan - There were a number of historic flood events available to calibrate the model to within the AFA. Extents, levels and flows largely matched well with the lower return periods (10% AEP). However, these flood events occurred before the Callan Flood Relief Scheme was completed and so the modelled flood extents, flows and levels are now different. There is moderate confidence in both the hydrology and hydraulics of the Callan AFA. Due to the lack of flood event data available for the post scheme period, it was only possible to conduct a limited verification exercise on this model, however, the model was shown to be a reasonable representation of the flood mechanisms described from the available flood event records and was considered to be performing satisfactorily for design event simulation. Callan is at risk of flooding during a 1% AEP fluvial event. Out of bank flooding would occur on the King's River due to insufficient channel capacity. As a result, the floodplain becomes inundated.

There are a number of residential and non-residential properties at risk of flooding within the Callan AFA along with eight Social Infrastructure Assets and one road. There are reasonable event damages and risks associated with the Callan AFA in both present day and future scenarios.

Freshford - There were a small number of historic flood events recorded in Freshford Town. However, since there was no flow data available at the gauging station, it was not possible to calibrate these events against recorded gauge data. For this reason, there is moderate confidence in both the hydrology and hydraulics of the Freshford AFA. Freshford AFA is at risk of flooding during a 1% AEP fluvial event. The main risk originates from the Nuenna River and the Freshford North River with further risk from the Upperwood River. Various flood cells are affected by the flood mechanisms from these rivers with a complex system of interaction between them. There are a number of residential and non-residential properties at risk of flooding within the Freshford AFA. There are no High Vulnerability Sites located within the floodplains; however there are six Social Infrastructure Assets or Social Amenity Sites, one utility and several regional and local roads affected by flooding. There are reasonable event

damages and risks associated with the Freshford AFA in both present day and future scenarios.

Inistioge - There were a number of historic flood events to calibrate the model to within the AFA. The model results were well validated at the 10% AEP return period. However, there was limited gauge data with relevant information (extents and depths) for the higher return periods. For this reason, calibration was limited to lower flow events and confidence in both the hydrology and hydraulics is moderate. Inistioge is at risk of flooding during a 1% AEP fluvial event and a 0.5% AEP coastal event. The tidal limit on the River Nore extends approximately 2km upstream of Inistioge AFA. Tidal inundation and out of bank fluvial flooding are very interactive. During a 1%AEP fluvial event there is insufficient capacity in the channel to convey the flood water, and this is impeded further during high tide levels. Consequently out of bank flooding occurs in the low lying ground immediately upstream and downstream of the Inistioge urban area. There are a number of residential and non-residential properties at risk of flooding within the Inistioge AFA during a 1% fluvial event. There is also one regional road, several local roads, four Social Infrastructural Asset and Amenity Sites affected by 1% flooding within the AFA During a 0.5% coastal event, there are four residential properties at risk along with some local roads and nine Social Infrastructure Assets and Amenity Sites. There are reasonable event damages and risks associated with the Inistioge AFA in both present day and future scenarios.

Kilkenny (Nore) – Kilkenny Flood Alleviation Scheme was completed in 2005 and is currently maintained by OPW. It should also be noted, that historical flood events prior to this date have not been used to calibrate the model. Of the three events which have occurred since the works were completed, the known flood extents validated well with the modelled flood extents. For this reason, there is good confidence in both the hydrology and hydraulics of the Kilkenny (Nore) AFA. CFRAM hydrological and hydraulic analysis has indicated that even with the Kilkenny City Flood Alleviation Scheme in place, Green’s Bridge causes water levels to rise upstream of the structure during high flows resulting in flooding. Flooding also occurs downstream of Blackfriar’s Bridge and in other locations where insufficient channel capacity to convey flows results in out of bank flooding. There is also a gap in the flood defences along the lower stretch of the Breaghagh River, near the confluence with the Nore. There are fourteen residential and six non-residential properties at risk of flooding from the River Nore within Kilkenny (Nore) AFA along with several Social Infrastructural Assets / Social Amenity Sites, one regional road and several local roads.

This residual flood risk has not been considered as part of the CFRAM process as Kilkenny (Nore) was listed in Table 8 of the Stage 2 project brief as not requiring the development and assessment of potential flood risk management option due to the presence of an existing scheme. Consequently the only management measures recommended in the Plan are the

catchment wide flood risk prevention measures and maintenance of the existing Flood Risk Management measures.

Kilkenny (Breagagh) – There are a large number of historic events to calibrate the model to within the Kilkenny (Breagagh) AFA. However, the majority of these occurred before the Kilkenny Flood Alleviation Scheme was completed. Therefore, the modelled flood extents, flows and levels may not be fully comparable. Of the three events which have occurred since the works were completed, the known flood extents validate well with the modelled flood extents. For this reason, there is good confidence in both the hydrology and hydraulics of Kilkenny (Breagagh) AFA. The main flood risk originates from two locations. The R909 by the Callan Road Roundabout is restrictive and causes water levels to rise upstream of the structure during high flows. Flooding also occurs downstream of adjacent to and downstream of the Callan Roundabout along Circular Road where insufficient channel capacity to convey flows results in out of bank flooding. There are a number of residential and non-residential properties at risk of flooding within Kilkenny (Breagagh) AFA along with several Social Infrastructural Assets / Amenity Sites, one regional and several local roads. There are reasonable event damages and risks associated with the Kilkenny (Breagagh) AFA in both present day and future scenarios.

Mountrath - There were a limited number of historic flood events to calibrate the model. These events occurred prior to the flood mitigation works which were carried out on the Mountrath River. The Mountrath gauging station was not found to be suitable for model calibration as the last flood event for which recorded information was available occurred in August 2008 which is prior to the earliest gauging for the Mountrath station in 2010. No other flow/level data was available on the model reach at the time the modelling and mapping was being progressed. Limited information is now available from an event in early 2016 which may be of assistance in future revision of the Mountrath models. For this reason, there is only moderate confidence in both the hydrology and hydraulics of the Mountrath AFA. Mountrath is at risk of flooding during a 1% AEP fluvial event. Out of bank flooding occurs on the Cole's River during a 1% AEP flood event due to insufficient channel capacity, while out of bank flooding occurs from the Mountrath River due to the insufficient capacity of bridge 15MRAT00421D. This causes flooding from both banks upstream of the bridge. Flooding also occurs on the Shannon Stream due to a combination of insufficient capacity in the culvert downstream of Shannon Street, and high water levels in the Mountrath River restricting discharge. The flooding identified for the Mountrath AFA has been deemed to be complex. There are a number of residential and non-residential properties at risk of flooding within the Mountrath AFA. There are also nine Social Amenity Sites situated within the floodplain, three regional roads and ten local roads. There are reasonable event damages and risks associated with the Mountrath AFA in both present day and future scenarios.

Rathdowney - Minimal historic flooding has occurred in Rathdowney town but the model results calibrated well with the available information. The model results are representative of the estimated fluvial return periods for each of the historical flood events (10%, 1% and 0.1% AEP). The validity of the model results was further supported by feedback from Laois County Council, which advised that Rathdowney Town floods regularly. There is good confidence in both the hydrology and hydraulics of the Rathdowney AFA due to the presence of a gauging station and flood extent verification events. Rathdowney is at risk of flooding during a 1% AEP fluvial event. In Rathdowney, out of bank flooding occurs due to a combination of insufficient bridge, culvert and channel capacity. There are a number of residential and non-residential properties at risk of flooding within Rathdowney AFA along with two Social Infrastructural Assets, three regional roads and four local roads. There are reasonable event damages and risks associated with the Rathdowney AFA in both present day and future scenarios.

Thomastown - There were a large number of historic flood events to calibrate the model to in this AFA. Unfortunately, only one of the gauged events had a recorded peak flow of below the reliable limit for the Brownsbarn and Mount Juliet gauging stations. Therefore, while the gauged flow data calibrated well with the model results at a low return period, there was limited gauge data with relevant flood information (extents, depths) for the higher return periods. The modelled flood extents match the recorded flood extents well for all recorded events. The model was therefore considered well calibrated to the low return periods. For this reason, there is good confidence in both the hydrology and hydraulics of the Thomastown AFA. Thomastown is at risk of flooding during a 1% AEP fluvial event due to insufficient channel capacity on the River Nore, causing inundation of the floodplain on both sides of the channel. There are a number of residential and non-residential properties at risk of flooding within the Thomastown AFA. Of these, one High Vulnerability Site, numerous Social Infrastructural Assets and Social Amenity Sites are located within the floodplain. There are also seven regional road and six local roads at risk of flooding. There are reasonable event damages and risks associated with the Thomastown AFA in both present day and future scenarios.

5 THE UoM15 PRELIMINARY OPTIONS REPORT

After completion of project level consultation on the draft core flood hazard and risk mapping deliverables in early 2015, RPS commenced detailed risk assessment and optioneering. In April 2015, the OPW FRAM project managers attended a two-day workshop in RPS offices in order to review the outcome of the mapping phase public consultation, discuss the detail of the next stages of analysis, confirm the scope of optioneering (in certain areas with previous schemes) and resolve any associated queries.

Risk assessment (including economic analysis) and preliminary optioneering was completed in draft for all AFAs within UoM15 by December 2015, and a series of Progress Group workshops were held (in November, December 2015 and March 2016) to review the outputs and get Local Authority feedback. A further OPW/RPS workshop was held in December 2015 dealing with reporting feedback and final technical inputs (for example climate change analysis). The initial feedback from the workshops was addressed and a series of project level public consultation days held on the preliminary options in early 2016 and the Preliminary Options Report (POR) was completed in mid-2016, in parallel with the draft Flood Risk Management Plan which drew heavily on the POR's findings. It is worth noting that at Preliminary Options Report stage the options are developed to line and level with a significant amount of work required before they can be progressed to construction stage.

The Preliminary Options Report (POR) was accompanied by AFA specific appendices containing supporting technical details on all potential options (whole life costing, multi-criteria analysis and option drawings) and also supporting information such as method screening calculations, GIS layers supporting the risk and options analysis and health and safety information. Some elements of analysis were de-coupled and reported separately, in 2016/2017, namely a strategic Sustainable Urban Drainage Systems (SUDS) analysis and a review of Spatial Planning and Impacts of Development.

All AFAs within UoM15 were included at POR stage. Identification of a low risk resulted in recommendations within the draft Flood Risk Management Plan (FRMP) to maintain the existing regime in the Ballyragget and Ballyroan AFAs and also for the Kilkenny (Nore AFA) due to the implementation of a flood relief scheme.

Whilst the project level consultation on the mapping was undertaken in the first quarter of 2015, the formal SI consultation was delayed by an update of the relevant legislation and was not completed until the fourth quarter of 2015. This meant that the optioneering was progressed without having closed out the observations and objections on the mapping, introducing the possibility that model updates may have been required after optioneering has been undertaken. This risk was constrained by the relatively low number of AFAs for which valid formal consultation input was received.

The OPW awarded a specialist contract to develop an analysis tool to support the whole-life costing of the CFRAM Study options, so that these were consistently applied at national level, in order that the resulting options would be comparable for use to develop a nationally prioritised programme of

implementation. Local Authority and the OPW regional team feedback raised concerns regarding the outcome costs of some options developed using this tool, particularly with regard to smaller schemes, and a wider perception that coastal works costing may be generally conservative, whilst culverting works may be less so. Although the database was informed by costs for completed projects, it was considered prudent to respond to these concerns by lowering the benefit cost ratio threshold for potential schemes. A cut-off benefit cost ratio of 0.5 (rather than 1.0) was used so that more potentially viable schemes were retained in the optioneering process. This was further identified within the final plan which required further investigation of potential measures within relevant AFAs.

The risk assessment, and particularly the economics aspects, drew together and analysed a range of datasets in relation to receptors and damages. For consistency, standard base year and versions of data (including Middlesex Flood Hazard Research Centre damage statistics) were utilised across the CFRAM studies. During the analysis it was noted that there were gaps and inconsistencies between the An Post geodatabase and the OSi buildings layers which required significant truthing and update. In addition, datasets on basements were difficult to obtain, and these could not always be seen from external inspection, with many of these identified only at Local Authority feedback stage, resulting in reworking of damages and options in some cases.

Recognising the benefit of the draft mapping Progress Group workshops, RPS again found the addition of workshops with the OPW, on methodology/process, and the progress group, to gain local knowledge, to be useful, and a subsequent workshop on the draft FRMP was held. This engagement process, at least in part, meant that there was less change between the potential options presented in the POR and those in the draft FRMP than might have been expected. The consultation on the options mainly informed stakeholders and the wider public and there was little feedback received in terms of alternatives or modifications that resulted in alteration of the options in the draft FRMP.

Key Findings:

The main deliverables for this report were the AFA specific risk analysis and the assessment of a series of potential flood risk management measures relevant at differing spatial scales of assessment (UoM, Sub-Catchment and AFA). These are presented in the following Tables 5.1 and 5.2 for the risk assessment and potential options for UoM15 respectively.

Table 5.1 Flood Risk Analysis UoM15

Type of Risk	Flood Risk for Design AEP (1% Fluvial & 0.5% Coastal) Event										
	Ballyhale AFA	Ballyragget AFA	Ballyroan AFA	Callan AFA	Freshford AFA	Inistioge AFA	Kilkenny (Nore) AFA	Kilkenny (Breagagh) AFA	Mountrath AFA	Rathdowney AFA	Thomastown AFA
Current Scenario (Present Day)											
Event Damage (€)	4,707,129	0	0	5,078,626	13,549,914	3,239,665 Fluvial 270,894 Coastal 1	1,355,989	396,770	2,253,144	12,873,671	15,317,088
No. Residential Properties at Risk	19	0	0	18	55	22 Fluvial 4 Coastal 1	14	36	33	17	48
No. Business Properties at Risk	6	0	0	20	38	8 Fluvial 0 Coastal1	6	1	7	27	87
No. Utilities at Risk	0	0	0	0	1	0 Fluvial 0 Coastal 1	1	1	0	0	1
No. Major Transport Assets at Risk	4	0	2	1	16	6 Fluvial 4 Coastal 1	17	11	13	7	13
No. Highly Vulnerable	1	0	0	0	0	0 Fluvial 0 Coastal 1	0	0	1	0	1

Type of Risk	Flood Risk for Design AEP (1% Fluvial & 0.5% Coastal) Event										
Properties at Risk											
No. of Social Infrastructure Assets at Risk	0	0	4	8	6	4 Fluvial 9 Coastal 1	56	8	9	2	24
No. Environmental Assets at Risk	2	4	2	4	2	3 Fluvial 3 Coastal 1	7	3	4	1	6
No. Potential Pollution Sources at Risk	0	0	0	0	0	0 Fluvial 0 Coastal 1	0	0	0	1	0
Mid-Range Future Scenario											
Event Damage (€)	6,417,449	1,024,070	9,538	13,258,375	21,735,484	6,106,592 Fluvial 415,856 Coastal 1	38,873,693	2,078,002	5,322,534	16,198,724	25,347,157
No. Residential Properties at Risk	21	1	2	42	115	32 Fluvial 7 Coastal 1	121	59	53	31	58
No. Business Properties at Risk	7	3	0	47	43	14 Fluvial 0 Coastal 1	125	4	15	28	102
No. Utilities at Risk	0	0	0	0	1	0 Fluvial 0 Coastal 1	3	2	0	0	1
No. Major	6	0	2	8	19	11 Fluvial	24	15	13	9	13

Type of Risk	Flood Risk for Design AEP (1% Fluvial & 0.5% Coastal) Event										
Transport Assets at Risk						4 Coastal 1					
No. Highly Vulnerable Properties at Risk	1	0	1	0	0	1 Fluvial 0 Coastal 1	0	0	1	0	1
No. of Social Infrastructure Assets at Risk	1	0	4	11	6	4 Fluvial 9 Coastal 1	125	8	9	3	25
No. Environmental Assets at Risk	2	4	2	4	2	3 Fluvial 3 Coastal 1	7	3	4	1	6
No. Potential Pollution Sources at Risk	0	0	0	0	0	0 Fluvial 0 Coastal 1	1	0	0	1	0
High-End Future Scenario											
Event Damage (€)	6,744,679	1,603,996	17,679	15,969,842	26,506,244	10,411,195 Fluvial 812,971 Coastal 1	94,229,585	3,256,960	9,073,443	19,227,357	32,034,003
No. Residential Properties at Risk	22	2	2	48	130	39 Fluvial 8 Coastal 1	222	78	57	34	68
No. Business Properties at Risk	8	3	0	61	48	15 Fluvial 1 Coastal 1	227	6	20	31	114

Type of Risk	Flood Risk for Design AEP (1% Fluvial & 0.5% Coastal) Event										
No. Utilities at Risk	0	0	0	0	1	0 Fluvial 0 Coastal 1	3	2	0	0	1
No. Major Transport Assets at Risk	6	0	2	10	22	11 Fluvial 5 Coastal 1	30	22	13	9	14
No. Highly Vulnerable Properties at Risk	1	0	2	0	0	1 Fluvial 0 Coastal 1	3	0	1	0	1
No. of Social Infrastructure Assets at Risk	1	0	4	12	6	6 Fluvial 9 Coastal 1	201	9	9	3	26
No. Environmental Assets at Risk	2	4	2	4	2	3 Fluvial 3 Coastal 1	7	3	4	1	6
No. Potential Pollution Sources at Risk	0	0	0	0	0	0 Fluvial 0 Coastal 1	1	0	0	1	0

Table 5.2 Potential Options UoM15

AFA	Design flood event (AEP)	Number of properties at risk in design flood event	Options	Area NPVd	Option NPVb (capped)	Option Cost (€m)	Benefit – Cost Ratio	Total MCA-Benefit Score	MCA-Benefit Score / Cost Ratio	Sensitivity to MRFS	Sensitivity to HEFS
UoM15	-	-	<ul style="list-style-type: none"> Sustainable Planning and Development Management Public Awareness Campaign 	-	-	-	-	-	-	-	-
Ballyhale	1% Fluvial	25	<ul style="list-style-type: none"> Option 1 – Storage & Hard Defences 	€12,418,483	€4,116,935	€1,483,045	2.78	1481	998.34	Moderate	Moderate
			<ul style="list-style-type: none"> Option 2 – Hard Defences 	€12,418,483	€4,116,935	€1,712,078	2.40	1575	919.69		
			<ul style="list-style-type: none"> Option 3 – Diversion of Flow & Hard Defences 	€12,418,483	€4,116,935	€433,818	9.49	1415	3260.78		

AFA	Design flood event (AEP)	Number of properties at risk in design flood event	Options	Area NPVd	Option NPVb (capped)	Option Cost (€m)	Benefit – Cost Ratio	Total MCA-Benefit Score	MCA-Benefit Score / Cost Ratio	Sensitivity to MRFS	Sensitivity to HEFS
Ballyragget	1% Fluvial	0	<ul style="list-style-type: none"> Maintain Existing Regime 	€7,208	€0	-	-	-	-	Low	Low
Ballyroan	1% Fluvial	0	<ul style="list-style-type: none"> Maintain Existing Regime 	€193	€0	-	-	-	-	Low	Low
Callan	1% Fluvial	38	<ul style="list-style-type: none"> Option 1 – Improvement of Channel Conveyance 	€5,868,697	€1,808,579	€2,357,008	0.77	696	295.16	Moderate	High
			<ul style="list-style-type: none"> Option 2 – Hard Defences 	€5,868,697	€1,808,579	€2,365,433	0.76	1206	509.71		
Freshford	1% Fluvial	93	<ul style="list-style-type: none"> Option 1 – Improvement of Channel Conveyance 	€45,011,056	€13,421,732	€3,802,493	3.53	1991	523.64	High	High
			<ul style="list-style-type: none"> Option 2 – Storage, Diversion of Flow and Improvement of Channel Conveyance 	€45,011,056	€13,421,732	€6,105,347	2.2	1741	285.18		

AFA	Design flood event (AEP)	Number of properties at risk in design flood event	Options	Area NPVd	Option NPVb (capped)	Option Cost (€m)	Benefit – Cost Ratio	Total MCA-Benefit Score	MCA-Benefit Score / Cost Ratio	Sensitivity to MRFS	Sensitivity to HEFS
Inistioge	1% Fluvial	30	<ul style="list-style-type: none"> Hard Defences 	€8,405,073	€6,546,412	1,489,836	4.39	1341	900.11	Moderate	High
Kilkenny (Breaghagh)	1% Fluvial	37	<ul style="list-style-type: none"> Hard Defences 	€947,216	€677,302	€1,225,768	0.55	883	720.37	High	High
			<ul style="list-style-type: none"> Hard Defences and Land Use Management 	€947,216	€677,302	€1,235,668	0.548	816	660.14		
Kilkenny (Nore)	1% Fluvial	20	<ul style="list-style-type: none"> Maintain Existing Regime 	€5,164,862	-	-	-	-	-		
Mountrath	1% Fluvial	40	<ul style="list-style-type: none"> Option 1 - Hard Defences and Improvement of Channel Conveyance 	€2,187,578	€1,546,066	€2,649,262	0.58	352	132.69	Moderate	Moderate
			<ul style="list-style-type: none"> Option 2 – Hard Defences and Improvement of Channel Conveyance 	€2,187,578	€1,546,066	€2,673,838	0.58	221	82.48		

AFA	Design flood event (AEP)	Number of properties at risk in design flood event	Options	Area NPVd	Option NPVb (capped)	Option Cost (€m)	Benefit – Cost Ratio	Total MCA-Benefit Score	MCA-Benefit Score / Cost Ratio	Sensitivity to MRFS	Sensitivity to HEFS
Rathdowney	1% Fluvial	44	<ul style="list-style-type: none"> Option 1 – Storage & Hard Defences 	€101,759,363	€8,488,850	€5,076,129	1.67	1071	210.99	Moderate	Moderate
Thomastown	1% Fluvial	135	<ul style="list-style-type: none"> Hard Defences 	€48,428,183	€16,479,422	€12,677,764	1.3	1447	114.15	High	High

6 THE DEVELOPMENT OF THE UoM15 DRAFT FLOOD RISK MANAGEMENT PLAN

6.1 DRAFT FLOOD RISK MANAGEMENT PLAN

The development of the draft flood risk management plans, which are the statutory output of the CFRAM studies, was led by the OPW. The OPW produced a template and undertook a series of consultations within the OPW, with other relevant government departments, national groups and the CFRAM Study Consultants.

The first draft of the template was produced for comment in July 2015. It was intended to indicate the overall format of the draft FRMP, and in particular, to identify the sections to be completed by the Consultants, and the structure of some template tables and forms that the OPW required to be used in order to facilitate reporting to the European Union, Common Implementation Strategy Working Group. A workshop with relevant FRAM Project Managers and RPS personnel was held in early May 2016 to discuss an initial version of the UoM07 draft FRMP (within the Eastern CFRAM Study area) and agree the level of detail required.

Revision C of the draft FRMP was produced by the OPW in May 2016, this version, incorporating later additions and policy updates, formed the basis of the draft plans that were consulted on during the second half of 2016.

The UoM specific material (text, maps and datasets) were populated by the CFRAM Study consultants drawing largely on the supporting technical studies on hydrology, hydraulics and the preliminary options assessments. The OPW reviewed the draft FRMPs at project level and also with regard to consistency at national level. The progress group members also reviewed the draft FRMPs providing information about relevant plans and programmes, previous projects and influenced the selection of the preferred measures identified within the draft FRMPs.

Within the draft FRMPs areas of further assessment (AFAs) considered to be at low risk were identified and the measures for such areas were not presented. The relevant measures remain available within the Preliminary Options Report and may be more readily implemented via a minor works programme. Within UoM15 there were two low risk AFAs, namely Ballyragget AFA and Ballyroan AFA. Kilkenny (Nore) AFA was also considered low risk due to the implementation of a flood relief scheme.

The draft plans were supported by the final core hazard and risk mapping (Volume II) and also the plan's statutory environmental assessments under the Strategic Environmental Assessment (SEA) Directive and the Habitats Directive (Volume III). The environmental assessment process, which resulted in an SEA Environmental Report and Natura Impact Statement, influenced:

- the development and assessment of measures,

- the selection of preferred measures,
- the identification of mitigation measures and
- an environmental monitoring programme during the Plan's implementation.

Key Findings:

The draft FRMP is a consultation document, its main deliverable being the list of preferred measures.

The draft plan incorporates a suite of certain prevention and preparedness measures related to flood risk management that form part of wider Government policy. These measures, set out below, should be applied across the whole of UoM15, including all AFAs:

- ***Sustainable Planning and Development Management***
- ***Sustainable Urban Drainage Systems***
- ***Voluntary Home Relocation***
- ***Local Adaptation Planning***
- ***Land Use Management and Natural Flood Risk Management Measures***
- ***Maintenance of Arterial Drainage Schemes***
- ***Maintenance of Drainage Districts***
- ***Flood Forecasting and Warning***
- ***Review of Emergency Response Plans for Severe Weather***
- ***Promotion of Individual and Community Resilience***
- ***Individual Property Protection***
- ***Flood-Related Data Collection***
- ***Minor Works Scheme.***

No measures were identified at Sub-Catchment scale however, the following AFA specific measures were identified either under the South Eastern CFRAM Study or as part of existing works being undertaken by the OPW or Local Authorities:

- ***Ballyhale Flood Relief Scheme: Diversion of Flow and Hard Defences***
- ***Callan Flood Relief Scheme: Hard defences***
- ***Freshford Flood Relief Scheme: Improvement of Channel Conveyance***
- ***Inistioghe Flood Relief Scheme: Hard defences***
- ***Mountrath Flood Relief Scheme: Hard defences and Improvement of Channel Conveyance***
- ***Rathdowney Flood Relief Scheme: Hard defences and Storage***
- ***Thomastown Flood Relief Scheme: Hard defences***
- ***Maintenance of the Kilkenny City Flood Relief Scheme***
- ***Kilkenny (Breagagh) Flood Relief Scheme: Hard Defences.***

It should be noted that there were some policy changes for measures between the preliminary option reporting and draft FRMP finalisation, such as mechanisms to support relocation and individual property protection.

Furthermore, whilst public consultation was undertaken on the preliminary options there was little opinion that necessitated revision of the options, RPS considers that this is, in part, due to the good level of engagement with the South Eastern CFRAM Study Progress Group, Stakeholder Group and the OPW representatives who reviewed the options ahead of public consultation.

However, it should be noted that at all stages of CFRAM consultation there was extensive interest regarding rural property and access road flooding, with many landowners advocating drainage and maintenance works on the watercourses outside of the AFAs.

Another common theme throughout the CFRAM Study consultation process was the need for a programme of when the measures would be implemented. The draft FRMPs did not have such an overall programme as this is dependent on the outcome of the consultation process, however, it is intended that the final FRMPs will have addressed the prioritisation of the measures on a national basis and relevant measures will be presented in an implementation programme. The key information fields to be prepared, in order to facilitate the prioritisation process, are presented in **Appendix A**.

6.2 DRAFT FRMP CONSULTATION & DEVELOPMENT OF THE FINAL FRMP

Project-level consultation activities were held during 2016 in relation to the draft Flood Risk Management Plans produced by the South Eastern Catchment-based Flood Risk Assessment and Management (CFRAM) Study. These comprised workshops with the South Eastern CFRAM Progress Group, a stakeholder workshop and a series of Public Consultation Days.

A Public Consultation Day relating to UoM 15 AFAs took place during August 2016, this event was held in Kilkenny.

In addition to providing a forum for discussion, these events supported the formal consultation process by raising awareness of how submissions on the draft FRMPs could be provided to the OPW for consideration.

Formal, national-level consultation in support of the draft FRMPs and supporting environmental assessments was undertaken in parallel during late 2016 by the OPW, comprising briefings to elected members, a website based portal for access to the draft FRMPs and supporting materials and to make on-line submissions and also statutory consultation in relation to the supporting environmental assessments.

The formal consultation period was open to the public between 19/08/16 and 28/10/16. The OPW received formal submission via the portal and also in written format and in total received 123 formal submissions.

The OPW, with technical support from RPS, collated responses and reported statutory consultation on the draft FRMPs for UoMs 11, 12, 13, 14, 15 and 17, within a series of Public Consultation Synthesis Reports relating to each Unit of Management.

The OPW hosted an environmental workshop at national technical co-ordination level, on 13th February 2017, to consider the environmental issues raised in the consultation responses on the draft FRMPs and supporting environmental reports with a view to developing standard environmental mitigations.

A workshop at project-level was held with relevant FRAM Section Engineers and RPS personnel in late February 2017 to discuss the South Eastern CFRAM consultation submissions in relation to the UoM15 draft FRMP and agree the actions required to reflect these in the final FRMP.

The development of the final FRMPs was again led by the OPW through the production of a template. The OPW undertook a series of consultations within the OPW, with other relevant government departments, national groups and the CFRAM Study Consultants and considered the submissions made on the national suite of draft FRMPs.

The template was provided for information on the 10/04/17 (revision A-3) with guidance on the key changes and updates required within the final plans, and as near final on the 18/05/17 (revision C-0) noting further updates and insets to be supplied (executive summary and mapping). Version C.1 of the template was received 15/06/17.

The UoM specific material (text, maps and datasets) were again populated by the CFRAM Study consultants where appropriate updating the material from the draft FRMP. The Progress Group again reviewed the final FRMPs, with the OPW examining with regard to both project-level detail and also national consistency, while the Local Authority Progress Group members provided local knowledge, and updated information about relevant plans, programmes and previous projects.

The OPW undertook consultation and prioritisation of the preferred measures identified within the final FRMPs and published these separately in a National Flood Relief Capital Investment Programme which complements Ireland's final FRMPs.

The final FRMPs are also supported by statutory environmental assessments (Volume II), under the Strategic Environmental Assessment (SEA) Directive and the Habitats Directive and drafts of the final statements for these assessments which remain subject to amendment until formal adoption of the FRMPs.

Key Findings:

The final FRMP responded to consultation submissions which related to inter alia, development in national policy, environmental requirements and National Flood Relief Capital Investment Programme. Modifications were also incorporated to make the final FRMPs more nationally consistent.

The final FRMP generally contained a preferred measure for each AFA (unless there were requirements for further study to determine a preferred option). The consultations and submissions on the draft FRMP provided valuable information, which has been noted for detailed design. Within UoM15 the key development incorporated into the final FRMP was the inclusion of a preferred measure for the Kilkenny (Bregagh) AFA.

The final FRMP measures for UoM15 are presented in Table 6.1.

Table 6.1 Summary of Flood Risk Management Measures – UoM15

Measure	Implementation	Funding
Measures Applicable for All Areas		
Application of the Guidelines on the Planning System and Flood Risk Management (DECLG/OPW, 2009)	Planning Authorities	Planning Authorities
Implementation of Sustainable Urban Drainage Systems (SUDS)	Planning Authorities	Planning Authorities
Voluntary Home Relocation	Inter-Dept. Flood Policy Review Group	Homeowners, OPW (2017 Scheme)
Consideration of Flood Risk in Local Adaptation Planning	Local Authorities	Local Authorities
Assessment of Land Use and Natural Flood Risk Management Measures	EPA, OPW, Others	OPW, Others
Minor Works Scheme	OPW, Local Authorities	OPW, Local Authorities
Establishment of a National Flood Forecasting and Warning Service	OPW, D/HPCLG, Met Éireann and local authorities	OPW, D/HPCLG
Ongoing Appraisal of Flood Event Emergency Response Plans and Management Activities	Principal Response Agencies, Regional Steering Groups, National Steering Group	Implementation Bodies
Individual and Community Action to Build Resilience	Public, business owners, farmers and other stakeholders	N/A

Individual Property Protection	Home Owners, Inter-Dept. Flood Policy Review Group	Homeowners
Flood-Related Data Collection	OPW, Local Authorities / EPA, and other hydro-meteorological agencies	Implementation Bodies
Catchment / Sub-Catchment Measures		
No Sub-Catchment methods were found to be feasible within UoM15		
Community-Level (AFA) Measures		
Progress the project-level development and assessment of a Flood Relief Scheme, including environmental assessment as necessary and further public consultation, for refinement and preparation for planning / Exhibition and, if and as appropriate, implementation, for the Communities set out below.		
Ballyhale	OPW and/or Kilkenny County Council	OPW Minor Works
Freshford	OPW and/or Kilkenny County Council	OPW
Inistioge	OPW and/or Kilkenny County Council	OPW
Rathdowney	OPW and/or Laois County Council	OPW
Thomastown	OPW and/or Kilkenny County Council	OPW
Undertake a Detailed Assessment of the Costs of the Potential Measure for the Communities set out below.		
Callan	OPW and/or Kilkenny County Council	OPW
Kilkenny (Breaghagh)	OPW and/or Kilkenny County Council	OPW
Mountrath	OPW and/or Laois County Council	OPW

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 TECHNICAL

The South Eastern CFRAM Study was a significant and challenging project in terms of the detailed analysis it required, simultaneously across its six Units of Management, and in the context of a suite of similar studies nationwide, including the adjoining Suir CFRAM for UoM16.

The level of ambition to undertake catchment scale studies of this nature created a significant resource demand on many of the parties involved, including the organisations represented on project progress, steering and stakeholder groups. In particular, a shortfall in third party survey resource introduced a programme delay, of over one year, which meant that the final consultation deliverables (draft FRMP and accompanying documentation) were prepared in 2016, rather than 2015 as originally programmed. The pre-contract survey programme was a valid endeavour to try to spread the survey workload, but was not sufficiently progressed ahead of the CFRAM studies, and also allowed there to be a disconnect between the survey specification and the modeller requirements (this meant that a supplementary survey arrangement needed to remain in place until model validation was complete). Notwithstanding the programme constraints identified above RPS was able to review pre-contract specifications and tailor these to reduce survey programme and costs and ultimately progress all of the South Eastern survey under a single tender action. With the benefit of hindsight, RPS would suggest that the main CFRAM studies should have started earlier (in the period when the pre-contract survey arrangements were being progressed) with more programme allowance for the surveys to be distributed, thus allowing staged delivery by Unit of Management of all survey and subsequent deliverables.

In some cases within the Eastern CFRAM Study, the study programme had to be prioritised in response to flood risk or events. This was beneficial in terms of piloting, and agreeing, the detail of methodologies, providing results for particular watercourses or AFAs to allow certain projects to progress, and also dissemination of lessons learned from the process to the South Eastern CFRAM Study. The acceleration also shortened the programme duration for these areas and therefore reduced the risk of further interventions resulting in reworking of analysis which has been an ongoing project challenge. Based on this, RPS would recommend a prioritised approach to subsequent Floods Directive activities so that the completion of analysis for the final areas is not allowed to delay progress for the other areas. Such a staged approach has been adopted for the consultation on the draft FRMPs and offers the benefit of smoothing resource needs for activities such as statutory consultation.

7.2 COMMUNICATIONS

Communications are often a challenge on projects of this complex nature and duration. This is applicable at a number of levels:

- The South Eastern CFRAM Study benefitted from the regular and ongoing communication between the OPW FRAM project management team and RPS with key personnel remaining engaged throughout the study's duration, providing regular updates and participating in focussed workshops.
- The South Eastern CFRAM Study's integrated Progress/Steering Group generally engaged well throughout the study, perhaps benefiting from personnel who were involved together in previous catchment scale flood risk management studies. The resource demands that a study of this nature put on Local Authority partners is acknowledged and there was change of some Local Authority representation during the process.
- Early collaboration via a National Technical Co-ordination group was of some benefit, despite the group's large membership, these two day meetings evolved into targeted workshops on specific topics. RPS would suggest that further such workshops would have been of benefit in the latter stages of the projects and whilst the OPW's production of the draft FRMP template and covers, and their review of the draft FRMPs, ensured a reasonable degree of consistency, this may have been better facilitated by the continuation of the co-ordination group or workshops engendering more of an ethos of partnership and providing more direct communication and access to policy level decision. For example, specific topics could have been; the use of the unit cost database and inputs to the draft FRMP.
- Engagement with stakeholders and the wider public was harder to achieve given the longevity of the studies, initial technical content and the early programme delays, which may have partially disengaged some participants. RPS would endorse our early views that the quality, rather than quantity, of consultation events remains the focus of future consultation phases, that the publicising the events is given a high priority going forward with engagement of national groups under an overall communications strategy, opportunities to tap into similar local engagement programmes are utilised (for example WFD engagement), and, that information be made available using flexible electronic visualisation applications as well as hard copy deliverables.
- It is noted that the OPW are already engaged with a number of relevant groups, for example national stakeholders and cross border fora, which are beyond the remit of the CFRAM studies to review. However, it is considered important that all engagement is maintained.

Within the realm of communications RPS found the use of key messages during every formal presentation to be helpful with managing expectations. This was complemented by using less technical language and both addressing, and clearly communicating, the confidences and uncertainties in the process and its outcomes.

In some AFAs or along some watercourses there was insufficient information to provide high confidence in the analysis of flood risk and this can only be redressed by collecting data as and when

events occur. However, the best use of available data was made so that in most cases recommendations could be made to progress flood risk management measures without recourse to further study. In other areas where data was sufficient, and especially where Flood Event Response was undertaken during the study, there was more confidence in the findings and these could readily be displayed to the wider public audience. Communities subject to recent events are understandably sensitive, and must be dealt with sympathetically, however, in every location where flooding had occurred RPS were especially well received once it was known that there had been recording of the event to inform the CFRAM Study process. The Flood Event Response enabled complex mechanisms to be better understood and replicated and this task is a valuable activity for those undertaking the modelling to be involved with.

The “live” nature of some of the tasks was challenging and led to reworking of deliverables and delayed closure of certain tasks. Whilst tasks were initially envisaged as sequential under the specification, for example finalised hydrology available in advance of final hydraulics and mapping consultation, this was not a realistic expectation and RPS advocated this from the study’s outset which led to the establishment of an infill survey contract to allow further data collection if any problems were encountered during hydrological and hydraulic analysis.

In addition, there were competing demands on the time of the group representatives which meant that they could not always provide the information needed or respond to requests to meet the South Eastern CFRAM Study timescales. To try to facilitate engagement with the progress group, in an efficient manner for all parties, RPS held a series of workshops with Local Authority engineering and planning personnel at key study stages. RPS found this addition to be a useful mechanism to ensure the quality of the modelling outputs and the optioneering and would recommend this approach for future stages.

In particular, there was ongoing uncertainty with regard to the defence asset database, which was populated during the study, but is “live” and therefore needs continual review and update, RPS would suggest that this particular task should have preceded the main study (with an update element and surveys included under the South Eastern CFRAM Study). Having populated the database during this cycle to the degree possible, it is important that the database is maintained centrally for future use.

7.3 GENERAL

Throughout the process there was a degree of conflict between maintaining a strategic and plan level of detail, to develop a catchment-scale plan, and the need to address the often very localised issues and nuances of particular flooding problems. In all relevant cases, it should be recognised that the subsequent analysis for progressing detailed design will involve some degree of remodelling to account for site investigations, service details, land owner requirements, and consequently this type of study provides “line and level” solutions with variations and refinements to be realistically expected in subsequent stages.

There are many peripheral, but nevertheless valuable, activities which could have been further explored within the Floods Directive's first cycle assessment; however, due to the number of AFAs which were being assessed and brought together for catchment-scale analysis, focus had to be maintained on the project's core activities. Whilst other analysis was piloted within various studies (for example culvert blockage, Natural Flood Risk Management and detailed climate change adaptation) these were not able to be implemented across the country due to programme constraints. RPS would recommend that such additions and innovations are taken forward during the Flood Directive's second cycle alongside the implementation of the first cycle's plans. In particular, RPS would recommend trialling/piloting measures, such as Natural Flood Risk Management and wetland/bog restoration, which may be of mutual benefit to the implementation of the Water Framework and Habitats Directives, as these integrated catchment measures are untested in the Irish context but may be relevant tools to help offset the impacts of future changes assessed under the first cycle of CFRAM studies and provide benefit where structural schemes are not financially viable.

The project has enabled the collation and development of a very detailed and valuable dataset of flood risk management information. It has provided a strong evidence base to enable strategic decisions to be taken on how best to manage flood risk within UoM15 and across the South Eastern CFRAM Study area. It has also provided sufficient clarity to allow, for the first time, a national prioritisation process to be undertaken for presentation in the final plans. The prioritised programme for the advancement and implementation of ongoing flood relief projects and also the flood protection measures set out within the FRMPs provides the basis for the short and long term planning for flood risk management expenditure in Ireland.

Importantly the project also identified weaknesses, such as where flooding mechanisms are still not fully understood or the risk could not be quantified sufficiently. Part of the next step will be to study these areas in more detail to further inform the planning of flood risk management into the next cycle of the Floods Directive and beyond.

However, it should be noted that at all stages of CFRAM consultation there was extensive interest regarding rural property and access road flooding, with many landowners advocating drainage and maintenance works on the watercourses. These issues could not be adequately addressed under the first CFRAM cycle and will need to be assessed further taking the wider damages and risks into account and possibly considering alternative standards of protection for such rural flooding issues.

The CFRAM studies in this first cycle were ambitious and whilst they had been informed by pilot studies there were areas where the methodology was untested at a CFRAM study scale which led to some delays and iteration throughout the process. The methodology and scope for the second cycle should be developed as soon as possible to enable pilot studies and trials to be undertaken and a realistic programme to be developed. This should enable more efficient working in the next cycle.

8 REFERENCES & BIBLIOGRAPHY

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3. S.I. No. 495/2015 - European Communities (Assessment and Management of Flood Risks) (Amendment) Regulations 2015
4. National Flood Risk Assessment and Management Programme, Catchment-based Flood Risk Assessment and Management (CFRAM) Studies, Stage I Tender Documents: Project Brief, Office of Public Works, 2010
5. National Flood Risk Assessment and Management Programme, South Eastern River Basin District Catchment-based Flood Risk Assessment and Management (CFRAM) Study, Stage II Tender Documents: Project Brief, Office of Public Works, 2011
6. South Eastern CFRAM Study, HA15 Inception Report, IBE0601Rp0008 (RPS, 2012)
7. South Eastern CFRAM Study, HA15 Hydrology Report, IBE0601Rp0010 (RPS, 2016)
8. South Eastern CFRAM Study, HA15 Hydraulics Report, IBE0601Rp0015 (RPS, 2016)
9. South Eastern CFRAM Study, UoM15 Preliminary Options Report, IBE0601Rp0025 (RPS, 2016)
10. South Eastern CFRAM Study, UoM15 draft FRMP, IBE0601Rp0039 (RPS, 2016)

APPENDIX A

KEY INFORMATION UoM15

FIELD NAME DESCRIPTION

1 RBD Name of the RBD / IRBD

2 UoM No. The number of the UoM, as per Appendix A of the Note on the Format of Measure Codes (18/05/16)

3 AFA Code If at AFA level, the number of the AFA, as per Appendix C of the Note on the Format of Measure Codes (18/05/16) - If measure is at UoM / Catchment level, insert '-999'

4 AFA Name If at AFA level, the name of the AFA, else leave blank

5 Measure Name The name of the measure

6 Code The Measure Code

7 Measure Description The short description of the measure

8 Implementation The name(s) of the nominated body or bodies responsible for implementation of the measure

9 Funding The name(s) of the nominated body or bodies responsible for funding of the measure

10 Type of Measure Type of Measure Code, as per Appendix B of the Note on the Format of Measure Codes (18/05/16)

11 1.a.i Unweighted MCA score for the Objective (1.a.i) – Social - Human Health

12 1.a.ii Unweighted MCA score for the Objective (1.a.ii) – Social - High Vulnerability Properties

13 1.b.i Unweighted MCA score for the Objective (1.b.i) – Social - Social Infrastructure

14 1.b.ii Unweighted MCA score for the Objective (1.b.ii) – Social - Local Employment

15 2.a Unweighted MCA score for the Objective (2.a) - Economic - Economic Risk

16 2.b Unweighted MCA score for the Objective (2.b) - Economic - Transport

17 2.c Unweighted MCA score for the Objective (2.c) - Economic - Utilities

18 2.d Unweighted MCA score for the Objective (2.d) - Economic - Agriculture

19 3.a Unweighted MCA score for the Objective (3.a) - Environmental - WFD

20 3.b Unweighted MCA score for the Objective (3.b) - Environmental - Natura Sites

- 21 3.c Unweighted** MCA score for the Objective (3.c) - Environmental - Flora and Fauna
- 22 3.d Unweighted** MCA score for the Objective (3.d) - Environmental - Fisheries
- 23 3.e Unweighted** MCA score for the Objective (3.e) - Environmental - Visual Amenity
- 24 3.f.i Unweighted** MCA score for the Objective (3.f.i) - Environmental - Cultural (architectural)
- 25 3.f.ii Unweighted** MCA score for the Objective (3.f.ii) - Environmental - Cultural (archaeological)
- 26 4.a Unweighted** MCA score for the Objective (4.a) - Technical - Operationally Robust
- 27 4.b Unweighted** MCA score for the Objective (4.b) - Technical - Health and Safety
- 28 4.c Unweighted** MCA score for the Objective (4.c) - Technical - Adaptability to Climate Change
- 29 MCA Benefit Score Weighted** total MCA Score (i.e., sum of weighted scores for each objective)
- 30 Cost (€m)** Cost of the proposed measures in €m
- 31 Uncapped NPVd (€m) Uncapped** value of Net Present Value Damages in €m
- 32 NPVb (€m)** Capped Net Present Value of Benefits of measure in €m
- 33 MCA BCR (score/€m)** MCA Benefit - Cost Ratio - **NOTE:** As per GN28, the MCA Score for the purposes of calculating the MCA Benefits **excludes** the scores for Technical Objectives
- 34 Economic BCR** Economic Benefit - Cost Ratio
- 35 No. Residential Properties Protected** No. of Residential Properties that would be protected by the proposed measure
- 36 No. Non-Residential Properties Protected** No. of Non-Residential Properties that would be protected by the proposed measure
- 37 Technical Uncertainty** A ranking of the technical uncertainty as 'High', 'Medium' or 'Low' - This should reflect the uncertainty in technical parameters such as hydrological flows, flood levels, flood extents, etc. A description of each ranking category is provided below.
- High - There is significant uncertainty - Further data capture (e.g., hydrometric monitoring) is strongly required before the measure is advanced
- Medium - There is moderate level of uncertainty - Further should be collected if possible in advance of or during the progression of the development stage of the measure, but this data is not deemed critical before the measure may advance

Low - There is a low level of uncertainty, and, providing a reasonable freeboard / safety factor is allowed, the measure may progress without further data collection

38 Technical Uncertainty Comment A brief (2-3 lines) explanation as to why the Technical Uncertainty ranking assigned was selected

39 Project Risk A ranking of the risks in implementing the measure as 'High', 'Medium' or 'Low' - This should reflect the complexity and nature of the proposed measure, and what level of risk there may be to completing this measure within a defined timeline and the cost indicated. A description of each ranking category is provided below.

High - There are significant risks in progressing the measure, for example, the measure might involve complex construction, and/or, major works in confined urban areas, and/or significant environmental issues in advancing the measure (such as channel / river bank works in a protected Freshwater Pearl Mussel site)

Medium - There are moderate risks in progressing the measure, for example, a major construction project involving some construction in urban areas, or a smaller, but complex construction project, and/or moderate environmental issues in advancing the measure

Low - There are low risks in progressing the measure, for example, a construction project in a green-field site, with no particular environmental issues or risks

40 Project Risk Comment A brief (2-3 lines) explanation as to why the Project Risk ranking assigned was selected

41 Environmental Sensitivity/Impact A ranking of the likely environmental impact in implementing the measure as 'High', 'Medium' or 'Low' - This should reflect the derived from the outcome of the Strategic Environmental Assessment and/or the Appropriate Assessment.

42 Environmental Impact Comment A brief (2-3 lines) explanation as to why the Environmental Sensitivity/Impact ranking assigned was selected

43 AA Screening Required? Whether Appropriate Assessment Screening will be required at Project Level for that Measure / Location.

EXTRACT FROM KEY INFORMATION SPREADSHEET

FIELD NUMBER																		
3	4	5	6	7	8	9	29	30	31	32	33	34	35	36	38	40	42	43
LOCATION		MEASURE					Total MCA		Uncapped		MCA BCR	Economic	No. Residential	No. Non-Residential	Technical	Project	Environmental Impact	AA Screening Required?
AFA Code	AFA Name	Name	Code	Measure Description	Implementation	Funding	Benefit Score	Cost (€m)	NPVd (€m)	NPVb (€m)	(score/€m)	BCR	Properties Protected	Properties Protected	Uncertainty	Risk	Sensitivity /Impact	
140150	Athy	Progress the development of the Athy AFA Flood Relief Scheme	IE14-140150-0114-M33	Progress the Athy Flood Relief Scheme, to project level development and assessment for refinement and preparation for planning / exhibition and, as appropriate, implementation.	OPW Kildare and/or County Council.	OPW	1642	4.11	30.28	13.54	399.45	3.29	75	24	Low: There is good confidence in both the hydrology and hydraulics of the Athy AFA due to the presence of a gauging station and flood extent verification events.	Medium: Extensive works located adjacent to existing properties. Potential high level of stakeholder engagement required due to a regeneration scheme.	Medium: The River Barrow and River Nore SAC is within, upstream and downstream of Athy. The AFA is within the Barrow Freshwater Pearl Mussel sensitive area. Potential for short term, slight negative impacts on biodiversity, water, fisheries and angling from the construction of hard defences within and adjacent to a sensitive waterbody. These impacts are mainly construction phase disturbances that could be mitigated for with good planning and management.	Yes. Potentially 3 European sites to be screened at the project level.
140156	Castledermot	Undertake a Detailed Assessment of the Costs of the Potential Measure for Castledermot	IE14-140156-0114-M25	Undertake a detailed assessment of the costs to determine if an economically viable measure may exist that could justify the progression to full project-level assessment.	OPW Kildare and/or County Council.	OPW	-76	2.3	1.71	1.14	-33.03	0.5	12	6	Medium: There is moderate confidence in both the hydrology and hydraulics of the Castledermot AFA due to a lack of flood extent verification events and no gauging station present on the model extents.	Medium: Localised works incorporating walls, embankments and a road raise. BCR below unity and potentially sensitive to cost. Potential for Drainage District support.	Medium: The River Barrow and River Nore SAC is within, upstream and downstream of Castledermot. The AFA is within the Barrow Freshwater Pearl Mussel sensitive area. Potential for short term, slight to significant negative impacts on biodiversity, water, fisheries and angling from the construction of hard defences set back from the sensitive waterbody where possible. These impacts are mainly construction phase disturbances that could be mitigated	Yes. Potentially 3 European sites to be screened at the project level.

FIELD NUMBER																		
3	4	5	6	7	8	9	29	30	31	32	33	34	35	36	38	40	42	43
LOCATION		MEASURE					Total MCA		Uncapped		MCA BCR	Economic	No. Residential	No. Non-Residential	Technical	Project	Environmental Impact	AA Screening Required?
AFA Code	AFA Name	Name	Code	Measure Description	Implementation	Funding	Benefit Score	Cost (€m)	NPVd (€m)	NPVb (€m)	(score/€m)	BCR	Properties Protected	Properties Protected	Uncertainty	Risk	Sensitivity /Impact	
																	for with good planning and management.	
140162	Graiguenamanagh	Progress the development of the Graiguenamanagh AFA Flood Relief Scheme	IE14-140162-0314-M33	Progress of the Graiguenamanagh Flood Relief Scheme, to project-level development and assessment for refinement and preparation for planning / exhibition and, as appropriate, implementation .	OPW and/or Kilkenny/Carlow County Councils.	OPW	1096	9.06	35.93	10.26	120.89	1.13	24	40	Low; There is good confidence in both the hydrology and hydraulics of the Graiguenamanagh AFA due to the presence of a gauging station and flood extent verification events.	High: Complex works in a constrained urban setting, steeply sloping and narrow watercourses adjacent to existing properties. Potential interaction with drainage system. Ground conditions requiring sheet piling. Potential impact on local community in relation to access and to the local economy through tourism. BCR marginal.	Medium: The River Barrow and River Nore SAC is within, upstream and downstream of Graiguenamanagh. The AFA is within the Barrow Freshwater Pearl Mussel sensitive area. The Ballymurphy and Mountain / Aghnabrisky FPM habitats and sensitive areas are upstream of the AFA by 3km and 7km respectively. Potential for short term, slight to significant negative impacts on biodiversity, water, fisheries and angling from the construction of hard defences adjacent to, within and upstream of the sensitive Barrow River. These impacts are mainly construction phase disturbances that could be mitigated for with good planning and management.	Yes. Potentially 4 European sites to be screened at the project level.
140162	Graiguenamanagh	Progress the Graiguenamanagh/Thomastown IPP Pilot	IE14-140162-4914-M43	Progress the Thomastown IPP Pilot through Feasibility Stage to include the design of an Early Flood Warning System along with proposals	Kilkenny County Council	OPW	-	-	-	-	-	-	-	-	-	Further study required	Low: Low impact provided any works carried out in line with best practice standards.	Yes. Potentially 4 European sites to be screened at the project level.

FIELD NUMBER																		
3	4	5	6	7	8	9	29	30	31	32	33	34	35	36	38	40	42	43
LOCATION		MEASURE					Total MCA		Uncapped		MCA BCR	Economic	No. Residential	No. Non-Residential	Technical	Project	Environmental Impact	AA Screening Required?
AFA Code	AFA Name	Name	Code	Measure Description	Implementation	Funding	Benefit Score	Cost (€m)	NPVd (€m)	NPVb (€m)	(score/€m)	BCR	Properties Protected	Properties Protected	Uncertainty	Risk	Sensitivity /Impact	
				for individual property protection.														
140166	Leighlinbridge	Progress the Leighlinbridge AFA Flood Relief Scheme	IE14-140166-0414-M33	Progress the Leighlinbridge Flood Relief Scheme, to project-level development and assessment for refinement and preparation for planning /exhibition and, as appropriate, implementation .	OPW and/or Carlow County Council.	OPW	805	3.29	29	3.91	244.56	1.19	42	15	Low: There is good confidence in both the hydrology and hydraulics of the Leighlinbridge AFA due to the presence of a gauging station and flood extent verification events.	Medium: Potential interaction with drainage system. Local works, based on site investigation, may require sheet piling. Uncertainty associated with raising and extending existing defences.	Medium: The River Barrow and River Nore SAC is within, upstream and downstream of Leighlinbridge. The AFA is within the Barrow Freshwater Pearl Mussel sensitive area. Potential for short term, slight to significant negative impacts on biodiversity, water, fisheries and angling from the construction of hard defences adjacent to the Barrow sensitive waterbody. These impacts are mainly construction phase disturbances that could be mitigated for with good planning and management.	Yes. Potentially 3 European sites to be screened at the project level.
140168	Mountmellick	Progress the development of the Mountmellick AFA Flood Relief Scheme	IE14-140168-0514-M33	Progress of Mountmellick Flood Relief Scheme, to project-level development and assessment for refinement and preparation for planning / exhibition and, as appropriate, implementation .	OPW and/or Laois County Council.	OPW	1456	3.14	19.87	5.97	464.38	1.9	44	2	Low: There is good confidence in both the hydrology and hydraulics of the Mountmellick AFA due to the presence of several gauging stations and flood extent verification events.	Medium: Extensive works adjacent to existing properties	Medium: The River Barrow and River Nore SAC is within, upstream and downstream of Mountmellick. The AFA is within the Barrow Freshwater Pearl Mussel sensitive area. Potential for short term, slight to significant negative impacts on biodiversity, water, fisheries and angling from the construction of hard defences adjacent to and within sensitive waterbodies of the Barrow tributary	Yes. Potentially 6 European sites to be screened at the project level.

FIELD NUMBER																			
3	4	5	6	7	8	9	29	30	31	32	33	34	35	36	38	40	42	43	
LOCATION		MEASURE					Total MCA		Uncapped		MCA BCR	Economic	No. Residential	No. Non-Residential	Technical	Project	Environmental Impact	AA Screening Required?	
AFA Code	AFA Name	Name	Code	Measure Description	Implementation	Funding	Benefit Score	Cost (€m)	NPVd (€m)	NPVb (€m)	(score/€m)	BCR	Properties Protected	Properties Protected	Uncertainty	Risk	Sensitivity /Impact		
																		and the Owenass River. These impacts are mainly construction phase disturbances that could be mitigated for with good planning and management.	
140173	Portarlinton	Progress the development of the Portarlinton AFA Flood Relief Scheme	IE14-140173-0614-M33	Progress the Portarlinton Flood Relief Scheme, to project-level development and assessment for refinement and preparation for planning / exhibition and, as appropriate, implementation .	OPW and/or Laois/Offaly County Council.	OPW	664	5.56	26.06	13.62	119.49	2.45	102	42	Low: There is good confidence in both the hydrology and hydraulics of the Portarlinton AFA due to the presence of a gauging station and flood extent verification events.	Medium: Extensive works adjacent to existing properties	High: The River Barrow and Nore SAC is within, upstream and downstream of Portarlinton. The AFA is within the Barrow Freshwater Pearl Mussel sensitive area. Potential for short term, significant negative impacts on biodiversity, water, fisheries and angling from the construction of hard defences within and adjacent to the sensitive waterbody. These impacts are mainly construction phase disturbances that could be mitigated for with good planning and management. However there is the potential for medium and long term minimal negative impacts on fisheries and angling with restrictions to river access with the new hard defences. There is the potential for short term, moderate negative and medium and long term minimal negative visual impacts on the river corridor of local moderate	Yes. Potentially 4 European sites to be screened at the project level.	

FIELD NUMBER																			
3	4	5	6	7	8	9	29	30	31	32	33	34	35	36	38	40	42	43	
LOCATION		MEASURE					Total MCA		Uncapped		MCA BCR	Economic	No. Residential	No. Non-Residential	Technical	Project	Environmental Impact	AA Screening Required?	
AFA Code	AFA Name	Name	Code	Measure Description	Implementation	Funding	Benefit Score	Cost (€m)	NPVd (€m)	NPVb (€m)	(score/€m)	BCR	Properties Protected	Properties Protected	Uncertainty	Risk	Sensitivity /Impact		
																		sensitivity.	
140174	Portlaoise	Progress the development of the Portlaoise AFA Flood Relief Scheme	IE14-140174-0714-M61	Progress the Portlaoise Flood Relief Scheme, to project-level development and assessment for refinement and preparation for planning / exhibition and, as appropriate, implementation .	OPW Laois and/or County Council.	OPW	376	3.92	6.67	3.34	96.01	0.85	63	13	Medium: There is moderate confidence in both the hydrology and hydraulics of the Portlaoise AFA due to the presence of a gauging station and flood extent verification events.	Medium: A series of localised works incorporating hard defences including a significant area of upstream storage. BCR below unity.	Medium: The River Barrow and Nore SAC is over 9km downstream of Portlaoise. The AFA is within the Barrow Freshwater Pearl Mussel sensitive area. Potential for short term, slight to significant negative impacts on biodiversity, water. Fisheries and angling from the construction of hard defences set back from and within non-sensitive waterbodies and from the creation of a storage area. These impacts are mainly construction phase disturbances that could be mitigated for with good planning and management. There is the potential for short, medium and long term slight negative impacts on the local river corridor landscape	Yes. Potentially 5 European sites to be screened at the project level.	
140178	Suncroft	Undertake a Detailed Assessment of the Costs of the Potential Measure for Suncroft	IE14-140178-0814-M25	Undertake a detailed assessment of the costs to determine if an economically viable measure may exist that could justify the progression to full project-level assessment.	OPW Kildare and/or County Council.	OPW	1226	2.83	3.07	2.24	433.26	0.79	19	2	High: There is poor data available for Suncroft AFA with which to verify the model hydrology and hydraulics.	Medium: A series of localised works incorporating hard defences including a significant area of upstream storage. BCR below unity.	Medium: The River Barrow and River Nore SAC is 4km downstream of the AFA. The AFA is within the Barrow Freshwater Pearl Mussel sensitive area. Potential for short term, slight to moderate negative, and medium and long term minimal negative impacts	Yes. Potentially 3 European sites to be screened at the project level.	

FIELD NUMBER																			
3	4	5	6	7	8	9	29	30	31	32	33	34	35	36	38	40	42	43	
LOCATION		MEASURE					Total MCA		Uncapped		MCA BCR	Economic	No. Residential	No. Non-Residential	Technical	Project	Environmental Impact	AA Screening Required?	
AFA Code	AFA Name	Name	Code	Measure Description	Implementation	Funding	Benefit Score	Cost (€m)	NPVd (€m)	NPVb (€m)	(score/€m)	BCR	Properties Protected	Properties Protected	Uncertainty	Risk	Sensitivity /Impact		
																		on biodiversity and water from the construction of permanent hard defences, increasing conveyance and recurring dredging events. There is the potential for short term, construction phase slight negative visual impacts on the low sensitivity landscape.	
140155	Carlow	TBC	TBC	TBC	TBC	TBC	-	-	-	-	-	-	35	0				Yes. Potentially 3 European sites to be screened at the project level.	