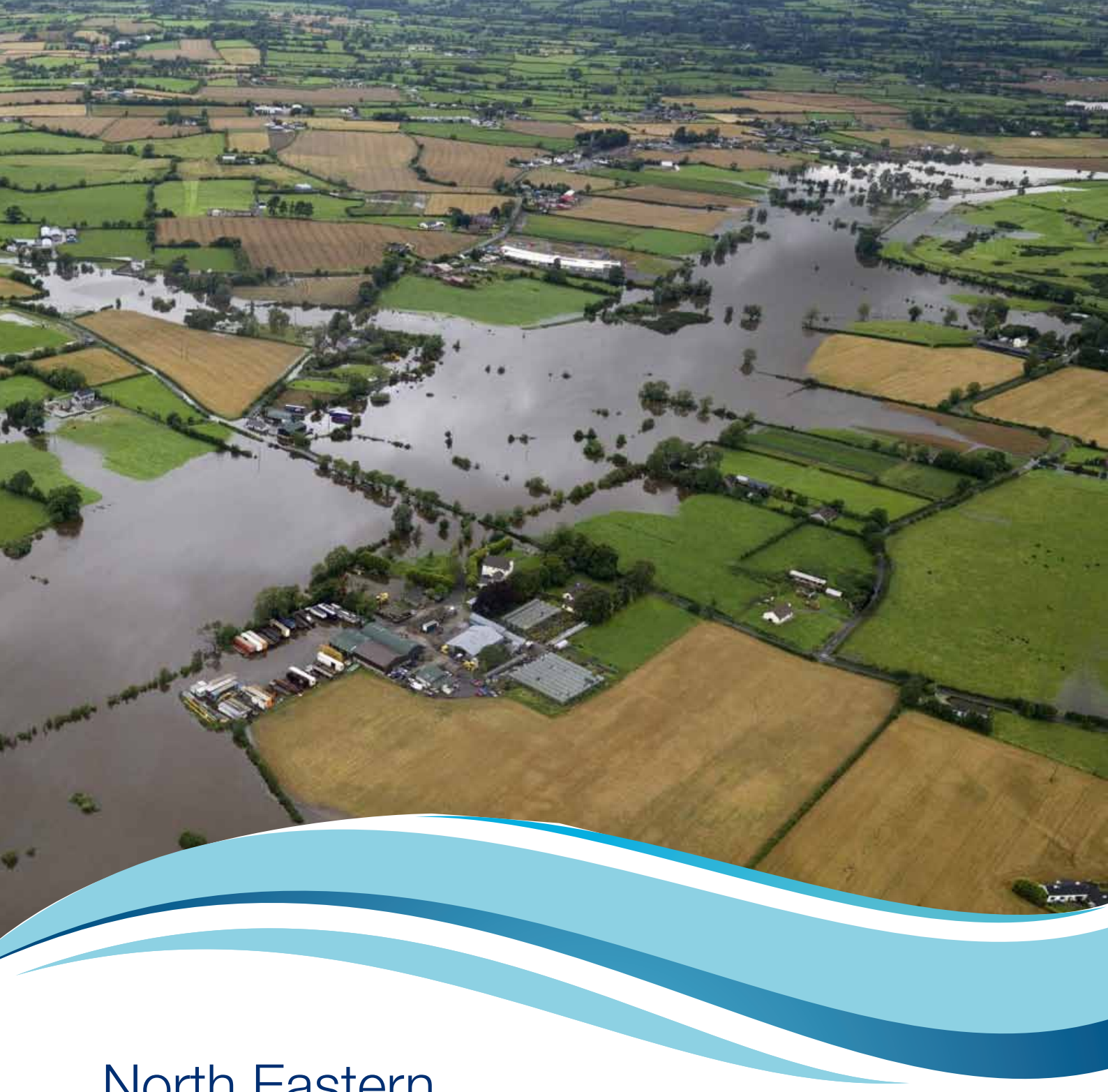

North Eastern Flood Risk Management Plan

RIVERS Agency

Department of Agriculture and Rural Development
www.dardni.gov.uk

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Foreword

There have been a number of very significant flood events during the last ten years which have had severe impacts on homes and businesses throughout the Province highlighting the vulnerability of many communities to flooding. These are clear reminders of our reliance on our critical infrastructure so the finalisation of these Flood Risk Management Plans is to be warmly welcomed. Climate change projections indicate that we should expect more heavy rain in the future and so flood risk is also likely to increase. Add to this the fact that sea levels are rising and it can be quickly concluded that flood risk must be proactively managed across government, with meaningful engagement with communities that are vulnerable to flooding. If the weather events we have experienced recently become more common, then planning for flooding is critically important.

The EU Directive on, "the Assessment and Management of Flood Risk" was introduced in 2007 and is widely referred to as the 'Floods Directive'. This legislation has been transposed into local regulations and it sets out a systematic approach to managing flood risk. Firstly it requires Member States to carry out a national risk assessment to understand the flood hazards and, using this information, to identify the most vulnerable areas. It then requires the production and publication of flood hazard and flood risk maps for those areas. Thirdly, and most importantly for those adversely affected by flooding, is the production and publication of these Plans which set out objectives and measures to manage the risks of flooding in a sustainable way. The Directive then requires these steps to be repeated on a six yearly cycle so that there is a process for refreshing our understanding of the risks and demonstrating where improvements to reduce such risks have been made.

A Preliminary Flood Risk Assessment was completed in 2011 and this identified twenty 'Significant Flood Risk Areas'; Flood Hazard and Risk Maps for these areas were published in 2014. These two steps have considerably enhanced our understanding of flood risk and this information is already being used to educate those communities at greatest risk about their vulnerability. The focus on 'Significant Flood Risk Areas' has highlighted the need for works to enhance flood protection within a number of our principal towns and cities and this is currently shaping our construction programme and informing our bids for capital funding. Planning policies together with the detailed flood maps are key to taking informed decisions on land use planning. These Plans also outline improvements in the emergency response to flooding and how flood warning and informing engagement activities with those at known flood risk, will help communities become more resilient to flooding.

The process of developing these Flood Risk Management Plans has also been important. It has provided numerous opportunities for information on flood risk to be shared with others for discussion to take place on alternative methods of flood mitigation and for the wider impacts on the environment to be better understood. These discussions have led to this very comprehensive document which will underpin the ongoing management of flood risk during a period when public expenditure is likely to be under continual downward pressure.

Extensive engagement with both the public and interested parties through a number of stakeholder groups and flood forums has also enabled those whose job it is to manage flood risk on a daily basis, to understand specific local needs. We have worked closely with the Department of Environment as the Flood Risk Management Plans need to have regard to the environmental objectives of the Water Framework Directive (2000/60/EC) so that both Plans achieve a wise use of resources.

Close working with colleagues in the Department for Regional Development has been required as we have developed a shared understanding of flood risk from different sources. This has also refined our collective understanding of the various roles and responsibilities in managing this risk. There is more work required in this area but we have started and the formation of the new Department for Infrastructure containing Rivers Agency, Transport NI and NI Water can only improve how we address and manage flood risk.

Importantly, we share two of our 3 river basins, North Western and Neagh Bann, with the Republic of Ireland and the Plans have been coordinated with the Office of Public Works (OPW) in the Republic of Ireland, through a structured programme of engagement.

We fully recognise the importance of the water environment in which we work and a Strategic Environment Assessment (SEA) and Habitats Regulatory Assessment (HRA) have been carried out on the Flood Risk Management Plans. This is a necessary requirement and the attached Environmental Report, SEA and HRA documents and Appendices set out the findings.

I hope that readers find these first Flood Risk Management Plans informative and I look forward to seeing the benefits of their implementation and further development over this initial 6-year Planning cycle.

David Porter
Chief Executive
Rivers Agency

Acknowledgments

Rivers Agency is grateful to all of the organisations that have supported, contributed to and helped develop these Flood Risk Management Plans. These include:

- Floods Directive Steering Group
- Flood Investment Planning Group (FIPG)
- Northern Ireland Water (NIW)
- DRD Transport NI
- DRD Water Policy Division
- DOE Northern Ireland Environment Agency

The Agency acknowledges the support and contribution made by members of the following consultative groups and organisations:

- Local Flood Forums
- Floods Directive Stakeholder Group
- Critical Infrastructure Stakeholder Group
- Respondents to the draft Flood Risk Management Plans

List of Abbreviations

AEP	Annual Exceedance Probability
ASSI	Area of Significant Scientific Interest
AOD	Above Ordnance Datum
BRA	Belfast Royal Academy
CPD	Central Procurement Directive
DARD	Department of Agriculture and Rural Development
DRD	Department for Regional Development
DOE	Department of Environment
FIPG	Flood Investment and Planning Group
FRMP	Flood Risk Management Plan
FRISM	Flood Risk Metric Tool
GIS	Geographical Information System
HEC-RAS	Hydrologic Engineering Center - River Analysis System
ICM	Integrated Catchment Model
IPPC	Integrated Pollution Prevention and Control
ISIS	Integrated Spectrographic Innovative Software
LFMA	Local Flood Management Area
LGD	Led Government Department
LiDAR	Light Detection and Ranging
LMA	Local Management Area
NIEA	Northern Ireland Environment Agency
NPV	Net Present Value
Nr	Number
PFRA	Preliminary Flood Risk Assessment
PPS 15	Planning Policy Statement 15
RBD	River Basin District
RCRG	Regional Community Resilience Group
RRA	Reservoir Risk Area
SAAR	Standard Annual Average Rainfall
SFRA	Significant Flood Risk Area
SOF	Standard of Protection
WFD	Water Framework Directive

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Appendices

Section 1

1. Introduction

Flooding in Northern Ireland in recent years has had significant impacts on communities, businesses, infrastructure and the environment. With a changing climate, there could be more extremes in the weather which may lead to more frequent and severe flooding. The management of this flood risk is most effectively approached by identifying areas where potential significant flooding may occur and developing plans that contain a broad range of measures which will reduce this risk. These Flood Risk Management Plans (FRMPs) highlight the flood hazards and risks from rivers, the sea, surface water and reservoirs and set out how the relevant authorities will work together, and with communities, to reduce flood risk.

1.1 Flood Risk Management Plans

Flood Risk Management Plans (FRMPs) are a key requirement of the Floods Directive *(Directive 2007/60/EC on the assessment and management of flood risks)* and are aimed at reducing the potential adverse consequences of significant floods on human health, economic activity, cultural heritage and the environment. The FRMPs are coordinated at the River Basin District level to align with the Water Framework Directive's River Basin Management Plans and focus on managing the flood risk in the twenty Significant Flood Risk Areas (SFRAs) identified through the Preliminary Flood Risk Assessment (PFRA) for Northern Ireland that was completed by the Department in December 2011. In practice, the FRMPs provide the information and evidence necessary to support risk management decision making. The Plans also help promote greater awareness and understanding of the risks of flooding amongst the public, Government Departments, local authorities and other organizations. This creates the opportunity for a more proactive and co-operative approach to flood risk management.

The Floods Directive encourages the active involvement of interested parties in the production of the FRMPs. The steps taken to provide opportunities for the general public, statutory consultees and other interested parties to participate in the exchange of information or views in preparing the Plan, including through formal consultation on the draft Flood Risk Management Plan, is detailed in section 4.3.2.

The FRMPs address all aspects of flood risk management, focusing on prevention, protection and preparedness and take into account the characteristics of the particular river catchments in which the SFRAs are located. Key elements contained within the FRMPs include:

- A description of the objectives set for the management of flood risks.
- Identification of structural and non-structural measures for achieving those objectives within each SFRA and their priority.

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- A summary of the information and consultation measures taken in connection with the preparation of the FRMPs and a description of the coordination process with the Republic of Ireland's Office of Public Works in relation to our shared International River Basin Districts.

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2. Background/Context

2.1 Sources of flooding

Flooding is a natural process that cannot be entirely prevented. It can happen at any time and there is a consequent risk to people, property, infrastructure and the natural environment. There are four main sources of flooding:-

- **Flooding from rivers**, also known as fluvial flooding, occurs when the river channel capacity is exceeded and water is conveyed and stored within the natural flood plain of the river. Northern Ireland has one of the largest rates of run-off per unit area in the British Isles. Much of the country is low-lying and many of its rivers and streams have gentle gradients in their lower reaches. With lowland soils that are mostly clay rich and of low permeability there is the widespread potential for localised flooding.

- **Coastal flooding** occurs when inundation from the sea takes place along coastal areas and estuaries as a result of a combination of high tides, storm surge and wave action.Significant coastal flooding is a relatively infrequent occurrence in Northern Ireland. However coastal flooding is often characterised by flows that are more rapid and dynamic than for other sources of flooding and therefore the consequential risk to public safety and property is relatively high. Also, the long term economic and environmental damage is generally higher due the effects of saltwater inundation. In order to reflect the relatively high potential impacts from coastal flooding the Flood Hazard and Risk Maps on the Flood Maps NI, webpage indicates the likelihood of coastal flooding occurring with a medium probability as a 200 year event, or an event with 0.5% chance of occurring in any one year.

- **Surface water,** also known as **pluvial flooding,** occurs as a result of rainfall which overwhelms natural or man-made drainage systems resulting in water flowing overland and ponding in depressions in the ground. It is a particular problem in urban areas, which are often dominated by non-permeable surfaces (i.e. roofs, roads and car-parks). As a consequence of the predicted increase in the frequency and intensity of extreme rainfall events urban areas are susceptible to an increasing risk of this type of flooding. It is estimated that in Northern Ireland, surface water flooding accounts for around 50% of recent flood events. Belfast has a long history of pluvial flooding and there are extensive reports of major flooding in the city as far back as the early 1900s. Responsibility for surface water flooding is cross departmental and is shared between DARD (Rivers Agency) and DRD (NI Water and Transport NI).The surface water flood map indicates that around 20,000 or 2.5% of the properties in Northern Ireland are sited in an area where the likelihood of flooding is greater

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than or equal to a 1 in 200 year event and at a depth greater than 300mm deep. Many of these properties would also already be at risk of flooding from fluvial and/or coastal flooding.

- **Flooding from reservoirs.** Flooding from water impounding structures such as reservoirs, constitute a potential source of flood risk. Flooding of surrounding areas can occur if the reservoir either fails structurally or by an unusually high release of water, via spillways. Although the likelihood of flooding is low, the impact on communities is high due to the sudden release and rapid inundation of flood water. The Department is acutely aware of the importance of managing the risk of flooding from reservoirs. It is for this reason that the Department sought, and obtained, the agreement of the NI Executive to bring forward primary legislation to regulate reservoirs in Northern Ireland capable of holding 10,000m³ or more of water. The primary legislation, known as the Reservoirs Bill, was introduced in the Assembly in January 2014 and completed the legislative process on 24th June 2015. The Reservoirs Bill received Royal Assent on 24th July 2015 and has received the title Reservoirs Act (Northern Ireland) 2015. While the precise number will not be known until the registration process is completed, it is considered that approximately 130 reservoirs in Northern Ireland will be regulated by this Act. This will ensure that those responsible for managing and operating reservoirs capable of holding 10,000m³ cubic metres or more of water do so to industry standards thereby reducing the risk of flooding from an uncontrolled release of water due to dam failure. More information on the Reservoirs Bill is available at **Appendix F.**

It is generally accepted that we are likely to experience more regular flooding in the future. In urban areas, surface water flooding may increase due to the development of green spaces and the paving of gardens and driveways. Most urban drainage systems are designed to cope only with a 1 in 30yr (3.3% AEP) rainfall event. In addition, deforestation, together with agricultural drainage and changing land management practices has, as a consequence, increased conveyances and flows in watercourses and increased flood risk in urban areas lower down the catchment areas. Climate change predictions also suggest a rise in sea level, an increase in winter precipitation and an increase in the frequency and intensity of extreme rainfall events.

A fundamental reason why many people and property are at risk of flooding is that many towns and cities are located within functional flood plains. Historically, people chose to select locations for settlement close to rivers based on the need for drinking water, foul drainage, transport, commerce and fishing. The pressure for development within towns and cities that have a known flood risk has continued largely unabated until the introduction of relatively recent planning policies such as PPS 15, “Planning and Flood Risk”.

Flood risk has historically been addressed through a reactive approach by providing local engineered solutions to solve repeated flooding. However, this approach, particularly on a larger scale can cause increased flooding elsewhere through the removal of valuable flood storage areas.

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2.2 Flood Risk Information

Flood risk information is currently presented through the use of the Flood Risk and Hazard maps on the Flood Maps NI webpage. The extent of the floodplains for river and coastal flooding for the significant risk areas included in the Plans have been estimated by using predictive computer modelling techniques. Each of the floodplains highlighted in the maps is associated with a flood event which has a particular chance of occurring. For example, the area highlighted within the 1% AEP floodplain outline for rivers has a 1% or greater chance of flooding in any year. The Flood Hazard and Risk Maps, Flood Maps NI, indicate 3 levels of flood risk:

- 1,000 year event - Flood Event with low likelihood of occurrence.
- 100 year event - Flood Event with medium likelihood of occurrence.
- 10 year event - Flood Event with high likelihood of occurrence.

It is estimated that around 5.5% or 46,000 properties in Northern Ireland are within either the 100 year fluvial floodplain or the 200 year coastal floodplain. One third of these properties currently have some level of protection.

The extent of surface water flooding is hard to predict, as small changes to the height of ground surfaces can markedly change the direction of surface water flows and it is difficult to predict with certainty the exact route along which surface water will flow and pond. It is for this reason, therefore, that the surface water maps are strategic in nature and use the 0.5% AEP or 1 in 200 year flood event to predict flooded areas.

2.3 Legislative Context

2.3.1 The Floods Directive

The FRMPs have been produced as a key requirement of *Directive 2007/60/EC on the assessment and management of flood risks* which was brought into force on 23 October 2007. This Directive known as the Floods Directive was introduced in response to recent catastrophic floods that occurred across Europe. It is estimated that over 213 major floods have occurred between 1998 and 2009 and that these have caused some 2016 deaths, displaced about half a million people and cost at least £52 billion in insured losses. The Floods Directive is designed to help Member States establish a framework for managing flood risk an aims to reduce the adverse consequences of flooding on human health, the environment, cultural heritage and economic activity.

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In August 2009 the Department consulted with the public on its proposed legislation for implementing the Floods Directive in Northern Ireland and in November 2009 the legislation was introduced and is known as the Water Environment (Floods Directive) Regulations (Northern Ireland) 2009.

The main requirements of the legislation and the dates for their completion are as follows:

- Carry out at Preliminary Flood Risk Assessment for each River Basin District and on the basis of this assessment identify areas for which potential significant flood risks exist or might be considered likely to occur. **22 Dec 2011**

- Prepare flood hazard maps and flood risk maps for each Significant Flood Risk Area (SFRA) identified, **22 Dec 2013**

- Consult the public on draft Flood Risk Management Plans that contain objectives and measures to reduce the flood risk within the SFRA and focus on prevention, protection and preparedness. **22 Dec 2014**

- Produce final Flood Risk Management Plans that take account of the views and representations received through the publication. **22 Dec 2015**

The Directive requires these deliverables to be reviewed, and if necessary updated, on a six yearly cycle.

2.3.2 The Water Framework Directive

The Water Framework Directive 2000/60/EC, which was introduced in 2000 has a number of links with the EU Floods Directive. Its primary focus, however, is improvement in water quality, rather than flooding. Its approach is based around the same River Basin Districts as the Floods Directive and this provides a number of opportunities for Government to dovetail the activities of both Directives.

2.3.2.1 Synergies between Flood Risk Management Plans and River Basin Management Plans

In December 2009, the Department of Environment (DoE), as competent authority for the EU Water

Framework Directive (WFD), published the first River Basin Management Plans (RBMPs) for Northern Ireland under the WFD. DoE Northern Ireland Environment Agency (NIEA) was responsible for delivery of these first RBMPs in conjunction with a number of Northern Ireland Executive Departments including the Department of Agriculture and Rural Development (DARD). This recognised the important roles DARD and Rivers Agency had in managing aspects of the water environment and in implementing WFD requirements.

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The RBMPs identified the condition of the water environment and set out objectives for the improvement, or the prevention of deterioration, of individual water bodies for the next three river basin planning cycles ending in 2015, 2021 and 2027. A Programme of Measures was published in the RBMPs setting out actions required to meet the objectives of improving the status of all water bodies. An interim update on the measures was published in 2012. The WFD requires that RBMPs are reviewed and updated every 6 years. Consequently the Department of Environment published its 2nd cycle draft Plans for public consultation between December 2014 and June 2015, aiming to publish new Plans by December 2015. In parallel with this timescale, DARD Rivers Agency published its first draft Flood Risk Management Plans (FRMPs) for public consultation again aiming to publish final FRMPs by December 2015.

The importance of coordination of FRMPs with the RBMPs is recognised by, and is a requirement of, the EU Floods Directive. To this end, the geographical coverage of the FRMPs in Northern Ireland is directly aligned with WFD's River Basin Districts of Neagh Bann, North Western and North Eastern, two of which (North Western and Neagh Bann) are International River Basins shared with the Republic of Ireland.

There is continued engagement between Rivers Agency, the competent authority for the Floods Directive and NIEA, the competent authority for the WFD through the interdepartmental Floods Directive Steering Group and the local Flood Forums. Rivers Agency is reciprocally engaged on the corresponding groups for WFD at interdepartmental, interagency and catchment stakeholder group level; this engagement has been on-going for many years and pre-dates the preparatory phase of the first cycle of RBMPs. In particular, the work of the Inter-agency group on River Restoration and Continuity (now the Catchment oversight Group) provides a sound basis for developing catchment based projects in future. This group aims to develop projects at the catchment and local level, through partnership working. In this way, both funding and benefits can be shared, providing better value for money, and developing the idea of adapting and delivering measures that have a number of drivers. Membership of the Catchment Oversight Group includes statutory fisheries groups, and DARD Countryside Management Division, thus providing excellent opportunities to develop partnership working and synergies in the long term.

The Flood Risk Management Plans focus primarily on areas which have been identified as being at potential significant flood risk. As these are predominately urban areas, any reduction in flooding as a result of implementing measures, may also reduce the risk of pollution incidents given the fact that flooding often results in pollution problems from oil tanks, sewerage overflows, etc. The development and implementation of measures proposed under the FRMPs also provides potential opportunities for more natural flood risk management e.g. improving floodplain storage, re-establishing connectivity, fish passage, sediment continuity, morphological and other enhancement of watercourses etc. during capital works. Collaborative working by personnel and stakeholders implementing the FRMPs could potentially both reduce flood risk and help to manage the adverse consequences that flooding has on the environment, human health, cultural

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heritage and economic activity, thus satisfying the requirements of both Directives. Where the sites of such measures overlap with 'Natura 2000' sites (under the Habitats and Birds Directives), or are hydrologically connected, there are opportunities to seek benefits through liaison and information sharing.

Measures within the draft RBMPs highlight the need for multi-agency working at a catchment level to deliver benefits for water status, morphology, flooding and fisheries through a coordinated, joined up approach. Similarly, the FRMPs identify the need to achieve the objectives of the WFD in terms of good status through the Environmental Objectives as set out in Section 3.1 of the FRMPs. The coordination of river basin planning and flood risk management planning is therefore important in delivering the objectives and measures of both Directives.

2.3.3 Strategic Environmental Assessment Directive, (SEA)

The SEA Directive, 2001/42/EC provides a framework for assessing the effects that certain plans and programmes may have on the environment. The Floods Directive promotes coordination with the Water Framework Directive, particularly in relation to sustainable land use practices, the retention of natural flood storage areas and the potential adverse consequences of flooding on the environment. It was considered that the Flood Risk Management Plans, are "likely to have significant environmental effects" and therefore a SEA assessment should be included as part of the development of the Plans.

2.3.4 Habitats Regulatory Assessment, (HRA)

The Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, (the Habitats Directive), provides the framework for the legal protection for species and habitats of European importance. Although the Habitats Directive has a narrower focus than the SEA, it has been deemed prudent to undertake an appropriate assessment of the Flood Risk Management Plans in order to determine whether they will have a "likely significant effect" on sites designated at an international level (European Designated Site) for their nature conservation value.

2.4 Broader Legislative and Policy context

In addition to, but outside the direct legislative requirements of the Floods Directive, it should be noted that work is ongoing on a number of other policy/legislative initiatives which will, over time, contribute to the longer term management of flood risk in Northern Ireland. As well as legislative requirements, we need to continue to meet our long term obligations and challenges for managing flood risk by developing policies and strategies that can be delivered in the longer term. Some of these, amongst others, include:-

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- **Long Term Water Strategy:** this is led by DRD and extends beyond flooding issues. However it highlights the need to manage flood risk in relation to integrated drainage systems, including funding and delivery arrangements.

- **Floods Bill:** work needs to commence on a Floods Bill to enable the effective delivery of all components of Flood Risk Management. This will add clarity to organisational roles and responsibility and encompass broader Flood Risk Management approaches.

- **Reservoirs Act:** as indicated in the Preliminary Flood Risk Assessment and Identification of Areas of Potential Significant Flood Risk report, legislation to regulate reservoirs was required. This legislation was enacted in July 2015 as the Reservoirs Act (Northern Ireland) 2015. The Act is similar to that which is in place elsewhere in the UK and it is proposed to commence the implementation of the Act in 2016. The Act places a legal responsibility on the managers of controlled reservoirs (i.e. 10,000 cubic meters or more capacity above the natural level of the surrounding land) to effectively manage controlled reservoirs and therefore any associated flood risk. Detailed inundation maps for each controlled reservoir will be published by the Department in 2016. These maps show the areas that could be flooded if controlled reservoirs were to fail and release the water they hold. The maps will be used by reservoir managers, government bodies, organisations and others dealing with flood risk from reservoirs, particularly those engaged in planning and emergency response.

- **Water Bill:** DRD is seeking to introduce a Water Bill to improve how water and sewerage services are delivered. One strand of this is to consider reducing the volume of surface water entering the public combined sewerage system by placing restrictions on the right to connect to public sewers and promoting the use of Sustainable urban Drainage Systems (SuDS)

- **Northern Ireland Climate Change Adaptation Programme:** As a result of the first Northern Ireland Climate Change Adaptation Programme, published early in 2014, a range of adaptation activities and actions has been identified for each Government Department with a role in flood risk management.

- **Building Regulations** Engagement with Department of Finance and Personal (DFP) is necessary for the inclusion in the Building Regulations of flood resistance/resilience construction techniques for those properties within flood risk areas.

- **Countryside Management Strategy** Opportunities need to be identified to build on the links between sustainable agricultural land use and managing flood risk. A catchment based approach,

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and practical linkages will be sought over the life cycle of these Plans. Other opportunities in relation to fishing measures and forestation will be explored as appropriate.

The use of Flood maps NI will be essential in determining areas of focus in terms of conveyance routes and areas with the potential to retain flood water.

The use of informed Agricultural and Forestry land use practice will also contribute to reduced run off and sediment control. Opportunities throughout the cycle of this plan will be explored to embrace this approach.

2.4.1 Stormwater Management and Sustainable Drainage Systems (SuDS)

The spread of urbanisation has increased the risk of flash flooding occurring after heavy downpours. Such flooding is becoming more frequent, with recent notable events occurring during 2007 and 2012 in Belfast and other towns. As areas of vegetation (green land) are replaced by impermeable concrete, bituminous macadam, roofed or paved areas (a process known as 'urban creep') the land loses its ability to absorb rainwater. In some instances, rainfall may be directed into combined sewers, often overloading them resulting in out-of-sewer flooding and pollution.

The probability of surface water flooding can be reduced by the use of sustainable drainage systems (SuDS) and surface water management, each of which is described below.

SuDS are systems designed to reduce the quantity and / or rate of runoff into drainage systems and watercourses; there are two broad types of SuDS:

- **Hard SuDS**: attenuation tanks, enlarged pipes and flow control devices within chambers

- **Soft SuDS**: systems that are open to the atmosphere. Examples of this type of system are:

    - retention basins (shallow landscape depressions that are dry most of the time when it's not raining);
    - rain-gardens (shallow landscape depressions with shrub or herbaceous planting);
    - swales (shallow normally-dry, wide-based ditches);
    - filter drains (gravel filled trench drain);
    - bio-retention basins (shallow depressions with gravel and/or sand filtration layers beneath the growing medium);
    - reed beds and other wetland habitats that collect, store, and filter dirty water along with providing a habitat for wildlife. Sometimes when soft SuDS contain vegetation as a key working element they are called 'vegetative' SuDS.

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Soft SuDS is preferred as it can provide a wide range of other benefits, including: aquifer recharge, provision of visually attractive amenity areas, provision of habitat for flora and fauna, and the removal of silt and pollutants carried by the stormwater before discharge.

SuDS can be used in a number of locations, such as:

- source control – which is the control of water before it enters any drainage pipes. For example water butts, rain water harvesting, permeable paving, small buried attenuation tanks (stormcells) and rain gardens.
- site control – which is the control of water before it leaves the boundary of the development site, for example filter strips, permeable paving (infiltration), permeable paving (retention), infiltration trenches, swales and geocelluar systems.
- system control – which is the control of water through the provision of systems that mimic the natural process such as ponds and lagoons, before discharge to streams and water courses.

The cost of building SuDS may be similar to conventional drainage whilst delivering a range of wider environmental benefits including the management of flood risk.

Surface Water Management

Surface water management is the use of other options to manage surface water. Techniques include the removal of surface water from combined sewers (which is called 'storm separation'), and the creation of preferential flood pathways to direct flows away from areas of high consequence when the capacity of the infrastructure has been exceeded (which is called 'design for exceedance').

Policy Development

Stormwater Management options are endorsed under the Department for Regional Development's (DRD's) draft strategy entitled 'Sustainable Water - A Long-Term Water Strategy for Northern Ireland (2014-2039)' with proposed measures to make SuDS the preferred drainage option, clarify long term maintenance issues and establish arrangements to deliver SuDS policy in new developments. To support implementation of this, DRD is currently developing 'Guidance for Implementation of Storm Water Separation' for use by NI Water and Transport NI. DRD believes that actively managing surface water and making provision for flood storage in urban areas is key to helping reduce the risk of urban flooding and the risk of pollution of rivers and groundwater sources. In addition, DRD's proposed Water Bill will require the consideration of SuDS for both residential and non-residential development.

A cross-Departmental Stormwater Management Group (SMG) was set up in April 2012 to examine a range of approaches to develop more integrated Stormwater Management. The SMG is co-chaired by NI Environment Agency and DRD Water Policy & Shareholder Division. Membership includes, NI Water,

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Transport NI, DARD Rivers Agency, DoE Planning Division and DoE Environmental Policy. The SMG has been working on developing policy and increasing awareness to promote Stormwater Management and the use of Sustainable Drainage in Northern Ireland. This includes the development of a NI SuDS Planning Process Protocol which will set out how a number of progressive changes in planning and development control processes could greatly assist the wider implementation of SuDS. One of the outcomes flowing from a pilot project developed by the SMG in Ballyclare, is now influencing a stormwater separation strategy for Greater Belfast, in order to mitigate diffuse pollution, reduce 'out of sewer', Combined Storm Overflow (CSO) events and reduce flood risk. The SMG is currently considering how to promote the more widespread use of SuDS during the forthcoming Flood Risk Management Plan period and will be engaging with planners and local government to ensure that opportunities for its promotion are maximised following the reform of local government and planning and the forthcoming Departmental re-organisation.

Planning for the integration of SuDS and Natural Flood Risk Management techniques on a catchment scale, will be taken forward during this Flood Risk Management Plan cycle (2015-21) with a view to increasing the pace of implementation in the next Flood Risk Management Plan cycle.

2.4.2 Natural Flood Management Measures

The traditional approach to flood risk has been to protect people and property by building flood defences, usually close to the locations at risk. As the construction of flood defences can be very expensive and may defend only specific localised areas, there is widespread interest in examining more closely, the potential for changing land management practices and other non-structural measures to deliver flood risk management benefits. This approach, often referred to as Natural Flood Management (NFM), is referenced within the EU Water Framework Directive and the EU Floods Directive.

NFM is most often defined as 'Working with or restoring natural flooding processes with the aim of reducing flood risk and delivering other benefits.' NFM aims to reduce the downstream maximum water height of a flood (the flood peak) and/or delay the arrival of the flood peak which could increase the time available for communities to prepare for possible flooding. It also aims to reduce the amount of water reaching the river channel at a range of stages within the catchment. These aims are achieved by storing and restricting the progress of water throughout the catchment by the introduction of a range of measures including for example:

1. Restoring natural catchment 'sponges' such as bogs
2. Creating new wetland habitats
3. Planting native forests in upland areas of catchments
4. Planting native woodlands in buffer strips
5. Recreating meanders and placing obstructions in watercourses
6. Adopting agricultural practices that reduce soil compaction.

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Within the last decade or so, there have been a large number of research projects and studies undertaken within the UK and beyond to examine the effectiveness and potential benefits of NFM. The majority of this research has focused on small scale catchments.

The effects of NFM techniques at a large catchment scale have proven difficult to establish because they are the result of aggregating many local scale effects, which are of themselves hard to quantify and are also dependent on the individual and often very different physical characteristics of catchments. This does not necessarily mean that there are no large scale effects or changes but simply they are often difficult to isolate and measure.

Whilst NFM measures by themselves may not provide a reliable and measurable method of managing more extreme flood risk events, they may however have a role in managing the 'unknown' aspects of flooding likely to arise from climate change. NFM measures may also have other tangible benefits, for example, biodiversity, reduction of soil loss, recreational opportunities and landscape benefits. They should be considered for their overall benefits and not for flood risk management alone. This range of benefits will require partnership involvement and a range of potential funding streams.

In September 2015 the Department hosted Northern Ireland's first workshop aimed at Planning for Natural Flood Management. The workshop, run as part of the Blue Green Cities project, provided a forum for a range of regulators and authorities within Northern Ireland, to get an appreciation of the range of potential measures which are available to contribute towards natural flood management. Whilst acknowledging that the measures alone are unlikely to entirely solve significant flooding issues, it was acknowledged they have a tangible role to play in managing any potential increase in flood risk, as well as providing other benefits to water quality and biodiversity.

NFM measures may offer potential for flow attenuation to improve flood warning times and also for mitigating increasing flood risks due to climate change. In Northern Ireland, the Department will build on the foundation of the recent Blue Green Cities workshop and look to develop studies (catchment planning) and projects through a partnership approach.

There is no doubt that NFM measures provide important wider benefits including water quality improvements, carbon sequestration, habitat restoration, biodiversity and recreation, among others. As things currently stand, much of the evidence suggests that the catchment scale flood risk reduction from NFM may be modest compared with the potential environmental and recreational benefits. Therefore, until we have evidence to the contrary, the key driver for land use changes may be to secure environmental benefits, and the changes should be deployed within priority catchments where the greatest benefits can be achieved. In selecting and prioritising such catchments, flood risk should be a factor but only as a part of a multi-criteria

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decision analysis that takes proper account of the relative importance of flood mitigation benefits in conjunction with the more significant wider environmental and recreational benefits. Due to the potential range benefits of such measures, it is likely that this area of work will be developed on an inter-agency basis, to share costs and benefits. Currently, there is an inter-departmental study underway, based on the Moyola river catchment in Co Londonderry, which will identify key players and issues.

In relation to the implementation of NFM for flood risk management, it should be recognised that such measures would involve changes to land management practices which may impact on landowners in parts of catchments which may be unaffected by flooding problems. This poses a challenge to incentivise landowners potentially in the upstream, rural parts of catchments, to change how they manage their land in order to benefit those at flood risk in the lower parts of a catchment. For this reason, it is necessary to look at multiple benefits and partnership working/funding for the implementation of such measures - these may be better considered under the heading, 'catchment management' rather than 'Natural Flood Management' as this better reflects the more holistic nature of the benefits. NFM measures also take considerable time to implement e.g. planting out new forest or undertaking regeneration of peat bog to create the desired attenuation, all takes time. The extended timescales for implementing NFM measures may not be acceptable to communities at flood risk. Therefore, while NFM measures may be introduced over time to mitigate against other gradual changes which may occur in a catchment, they should not be seen as an immediate solution to an urgent flooding problem.

It is acknowledged that there are many stakeholders promoting the widespread use of NFM, research to date indicates that NFM measures may complement, but are unlikely to replace, traditionally engineered solutions such as hard defences and built flood storage which have more predictable and reliable outcomes. Consequently, the Department sees the development of NFM measures at a catchment level, as an inter-departmental process which is aimed to deliver multi-benefits and not just flood risk management. The Department also sees NFM measures as part of an overall package of flood risk management tools which will include structural and non-structural measures.

The Department will consider the use of NFM measures where appropriate in its options appraisals for the flood studies that it undertakes through its capital works programme. These may include solutions such as upstream flood storage, removal of existing flood banks to reconnect rivers with their natural flood plains, removing (*daylighting*) existing culverts to restore natural river channels and the creation of wider and more environmentally sensitive two-stage channels, as opportunities may arise. The Department will also build on the success of the Blue green Cities workshop, and will seek to work with other departments and groups to examine catchment management measures which include those which are considered to have a flood risk management benefit.

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3. Objectives and Measures for Managing Flood Risk

3.1 The Flood Risk Management Plan Objectives

This Flood Risk Management Plan contains a number of objectives for the management of flood risk from all sources of flooding. The Objectives set out what needs to be achieved and, in accordance with the requirements of the Floods Directive; the Plan should give consideration to:

- Reducing the likelihood of flooding; and,
- Reducing the adverse consequences of flooding for human health, economic activity and the environment including cultural heritage.

The objectives set, in relation to each area of impact are:

Economic Activity

- To reduce the cost of potential future flood damages to properties and infrastructure;
- To reduce the economic costs caused by the disruption to essential infrastructure and services; and,
- To optimise the economic return on flood risk management investment.

Human Health and Social

- To reduce the risk to life, health and wellbeing.
- To increase awareness and understanding of flooding and its adverse consequences and improve community resilience.
- To reduce the impact on people caused by the disruption to essential infrastructure and services.
- To improve recreation and public amenities.

Environmental

- To consider the impact of Climate Change across all areas of impact;
- To support the objectives of the Water Framework Directive and contribute to the achievement of good ecological potential/status for water bodies;
- To protect and enhance the natural environment.

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3.2 The Flood Risk Management Plan - Measures

The Flood Risk Management Plan identifies Measures that are the specific actions which will deliver the Flood Risk Management Plan Objectives. In setting the Measures, the Floods Directive requires that these Flood Risk Management Plans should give consideration to:

- **Prevention** of increased flood risk through appropriate land use planning.
- **Protection** of communities and the environment by provision of schemes and approaches to reduce the likelihood of flooding.
- **Preparedness** arrangements to improve dealing with flooding when it occurs.

A table detailing the links between the Objectives and Measures is included at **Appendix H.**

In determining the proposed measures these Flood Risk Management Plans must have regard to:

- the Preliminary Flood Risk Assessment;
- the conclusions that can be drawn from the Flood Hazard Maps and Flood Risk Maps;
- the environmental objectives of the Water Framework Directive;
- the cost and benefits of the various options for managing flood risk;
- the opportunity for natural flood plain management; and
- the impacts of Climate Change.

The measures adopted are:-

3.2.1 Prevention

The Regional Development Strategy provides the strategic planning framework for sustainable development throughout Northern Ireland. It is therefore important that land-use planning decisions do not increase flood risk. Planning Policy Statement, PPS 15, “Planning and Flood Risk”, which has been revised recently, adopts a precautionary approach to development with the primary aim of preventing future development that may be at risk of flooding or that may increase the risk of flooding elsewhere. The policy takes account of climate change and emerging information relating to flood risk through the implementation of the EU Floods Directive. The new “Flood Maps NI” are therefore an important tool in identifying and assessing flood risk from the four main sources of flooding, at both the Development planning and Development application stages.

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The key approaches in terms of Prevention are:-

Keep new development outside Flood Risk Areas

- Inform the development planning process to ensure, as far as possible, that new zonings within local development plans are located outside flood risk areas.

- Input to the development control process to ensure, as far as possible, that individual applications are located outside flood risk areas.

Ensure new development within Flood Risk areas is suitably constructed

- In accordance with PPS 15 ensure that any development which has to be located, **"by exception",** in flood risk areas is built in the appropriate manner with adequate flood resistance/resilience measures commensurate with the flood risk to the development and that the development does not cause increased flood risk elsewhere.

- Ensure that all proposed development applications within flood risk areas are accompanied by a flood risk or drainage assessment.

3.2.2 Protection

Flood protection is required where existing property is already located within flood risk areas. Structural measures, such as flood defence walls /embankments or culvert diversion channels are utilised where there is an economic benefit to society that will allow the works to be financed. Environmental measures can also be factored into the scheme, as appropriate.

The key approaches in terms of Protection are:-

Maintenance of the Existing Drainage and Flood Defence Network

- Continue to inspect and maintain designated watercourses and grilles as appropriate;
- Continue to regularly inspect the condition of all drainage and flood defence assets;
- Continue to implement a prioritised programme of works for the maintenance of all drainage and flood defence assets; and,
- Continue to implement a prioritised programme of maintenance of public sewer and drainage infrastructure.

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New Flood Alleviation Schemes

- Continue to carry out feasibility studies to identify cost beneficial flood alleviation schemes in relation to property and communities at flood risk;
- Continue to implement a prioritised programme of flood alleviation schemes;
- Continue to implement a prioritised programme of works for integrated surface water drainage schemes; and,
- Continue to implement a prioritised programme of works to separate surface water systems from combined sewer systems.

Catchment Based Management

- Create opportunities to work with others, through partnership arrangements, to deliver sustainable flood risk management measures at a catchment level. These measures potentially include reduction in run-off through wetland creation and tree planting. Fishery enhancement works and improvements in water quality by lengthening flow paths and filtration techniques could also be considered as appropriate. These measures are likely to have a number of benefits that whilst unquantifiable, are still significant.

Photo 3.2.2 – River Bush Fishery Enhancement Measures

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Surface Water Management

- Promote the use of SuDS in all new development to ensure that the post development runoff is no greater than the pre development run off rate. Legislation which endorses the use of SuDS, as noted earlier, is essential in underpinning this approach. Design for exceedance needs also to be considered.

3.2.3. Preparedness

It is not possible to prevent or protect against all flooding. Even where flood defences exist, in an extreme event, it is possible that these could be over-topped and flooding could still occur. Consequently there is a need to be prepared for flooding. There will also be situations where a flood protection scheme is not economically viable or not yet in place and therefore it is critical that preparatory activity is undertaken.

The provision of an effective emergency response from Government is a key feature of Preparedness. It needs to be recognised that communities at risk also have a key role in working with Government in order to be better prepared to deal with flooding when it occurs.

The key approaches in terms of preparedness are:-

Flood Emergency Response

- Government Departments, Councils and the emergency services need to continue to maximize the effectiveness of a coordinated emergency response;
- Responders need to continue to share Information and resources in order to streamline the approach to emergency response;
- Emergency response plans need to be used to bring clarity and focus to emergency response.

Exercising

- Regular emergency planning exercises need to continue as part of responders' work programmes to facilitate learning and provide opportunities to test capacity and capability. Roles and responsibilities need to be clearly established and understood by all responders.

Lead Government Department - for the Coordination of Flooding Emergencies

- DARD must ensure that its role as Lead Government Department (LGD) is clearly understood, both internally and among other key responder organisations;
- DARD will continue to undertake such activity as is necessary to ensure that this role adds value to emergency response. This will include the development of emergency planning events,

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coordination of communications and provision of technical expertise to inform the overall emergency response from Government Departments and other organisations.

Civil Contingencies Multi-Agency Preparedness Structures with a role in Flooding Emergencies can be found at **Appendix G**.

Flood Warning and informing

Rivers Agency will continue to monitor and refine the approach to the provision of flood warning and informing, which has been developed in response to the PEDU report of 2012. Northern Ireland does not have a flood forecasting centre, unlike the rest of the UK. The reason for this is that catchments here are smaller and any warning time would be much shorter. This would greatly reduce the benefit of such a centre in Northern Ireland. However there are improvements in this area that have been be made.

In addition, Rivers Agency currently operates an internet web-based system which is able to provide government users and the general public with access to water level information. The link to this 'Netview' website is below:-

http://netview.ott.com/Rivers_Agency_Hydrometric_Network/

This Netview link will enable any user to gain access to water level information at over 30 locations in the Rivers Agency network of hydrometric and text alert stations.

At an early stage in this cycle of Flood Risk Management Plans, Rivers Agency intends to provide improved hydrometric information on-line to the general public through a new web site. This will include better information on river and lough levels as well as information on river flows.

The Agency considers that by making water level and river flow information more widely available, public users who are at risk of flooding, may be able to access this information easily to be better informed about river conditions during periods of heavy rainfall. This will help them decide if they should take action to be prepared for flooding.

Further details of Flood Warning proposals suitable for Northern Ireland are included at **Appendix D.**

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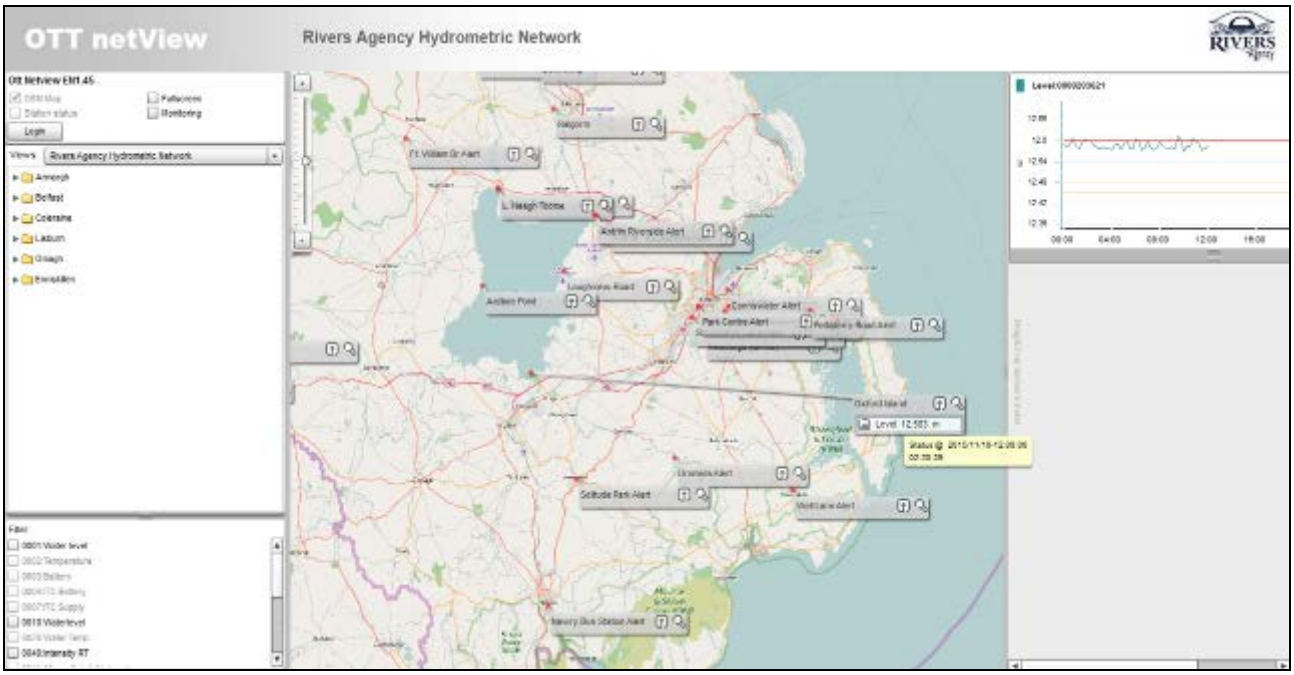

Figure 3.2.3 – Rivers Agency web page for water level information (Netview)

Photo 3.2.3 – Rivers Agency Text Alert Station

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Community Engagement – Informing and Building Resilience

- Rivers Agency will continue to work with the other Drainage Agencies, the Emergency Services, Local Government, NIHE, Red Cross, Consumer Council, Met Office, etc, to develop and establish a consistent approach to flood warning and informing activities across Northern Ireland.
- The Regional Community Resilience Group (RCRG), which was established in 2013, will continue to co-ordinate self-help activities, (Through the auspices of this group the co-ordination of self help activities is facilitated. This includes the pre-deployment of sandbags at areas known to flood and the use where appropriate of river level text alerts).
- During this first Planning cycle, Rivers Agency intends to install more Text Alert stations on some watercourses adjacent to communities at known flood risk. This forms a part of the Agency's plans to improve Community Resilience under the remit of the Regional Community Resilience Group and to extend the resilience programme to 20 new communities during the first cycle of Plans. As well as providing text alerts to communities at risk of flooding and to emergency responders, information generated by the new alert stations will be linked to the proposed new on-line website

Further details on the role of the RCRG can be found at **Appendix E**.

Flooding Emergency Communications

Rivers Agency will:-

- Continue to engage with communities to facilitate the informing aspect of 'Flood Warning and Informing' activities.
- Continue to update and improve flood risk information on Flood Maps (NI).
- Continue to improve information on flooding on the NI Direct Website.
- Continue to work with NI Direct in the development of the Flooding Incident Line (FIL).
- Continue to consult and hold flood forums with stakeholders and others to make them aware of their role and responsibilities in managing flood risk.
- Seek to issue timely media messages to inform the Public of significant flooding events.

Individual Property Protection

Within the first year of the Flood Risk Management Plans, the Department proposes to commence the first Grant Scheme for Property Level Flood Protection in Northern Ireland. Funding has been made available for this Scheme which will be piloted over a period of 2 to 3 years. The Scheme is supported by a Business Case which has received approval from the Department of Finance & Personnel N.I. Funding for the Scheme over the 3 financial years spanning 2015-18, will be approximately £950k.

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The Scheme which is entitled the 'Homeowner Flood Protection Grant Scheme (Northern Ireland)' is a government scheme being operated by the Department. It is designed to encourage the owners of residential properties that have flooded before and/or are located within known flood prone areas, to modify their properties through the installation of Property Flood Protection products, to make them more resistant to flooding. The Grant Scheme is specifically aimed at residential properties that have flooded internally in the past and which continue to be exposed to frequent flooding. Tenants of rental properties are not eligible to apply.

The Grant Scheme will cover 90% up to a maximum of £10,000, of the total survey and estimated installation costs. Homeowners, who successfully apply, will therefore be required to make a contribution of 10%, plus any additional cost that may be incurred above £10,000. This contribution must be paid before any installation work will commence. The cost of installing a package of flood protection measures varies from property to property but is typically £3,500 to £7,500 and therefore, the Homeowner contribution is likely to be between £350 and £750. The Grant will be paid directly to the Scheme's appointed building surveyor and building contractor so no monies will be paid directly to the Homeowner.

For each successful application, a building surveyor will be appointed to conduct a water entry survey of the Homeowners' property. The building surveyor will then develop a design for appropriate property flood protection measures. Once the Homeowner is content with the design and formally agrees this with the Department, an experienced building contractor will install the flood protection measures in accordance with the surveyor's agreed design and specifications.

On completion of the work to a property, it will be tested, in the presence of the Homeowner, to check its resistance to flood water. The Homeowner will also be provided with an instruction pack on how to maintain any equipment supplied and shown how to fit it in advance of threatened flooding. Should a Homeowner move house, the equipment installed must remain with the property.

While this type of installation is successful in reducing flood damage to individual properties, there is still no guarantee that it will exclude all flood water.

Information on the Homeowner Flood Protection Grant Scheme is available from:-

The Flood Protection Grant Scheme Manager
DARD Rivers Agency
Hydebank
4 Hospital Road
Belfast
BT8 8JP

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Flood Recovery, Welfare and Insurance Issues

In the aftermath of flooding, which extends well beyond the actual damage to property, Rivers Agency with others will-

- Continue to carry out and contribute to post flood investigations to gather information and improve knowledge and action on future flood events.
- Continue to report significant flood events to the European Commission as required by the Floods Directive.
- Continue to work with Councils and local communities at risk of flooding in providing advice and information to aid recovery after a flood event.
- Continue to engage and work with voluntary section organisations such as the Red Cross in providing Welfare Support.
- Continue to work with the insurance industry to assist them in introducing FloodRe to NI to help address long term flood insurance affordability issues.

FloodRe

The Flood Re scheme is a not-for-profit flood reinsurance fund, owned and managed by the insurance industry, and established to ensure that those domestic properties in the UK at the highest risk of flooding can receive affordable insurance cover for the flood element of their household property insurance.

Reinsurance is a way for insurers themselves to insure against large scale losses with other insurers. Insurers sell policies to their customers in the usual way, but then may pass the risk carried by those policies to a reinsurance company, or reinsurance vehicle like Flood Re, where those risks are pooled into a fund which pays out to the insurer if claims are made. The contractual responsibility for paying out to the customers if a claim is made still rests with the original insurer but they have their own back-up from the reinsurance pool which they can claim against. This helps insurers take on more risk as the consequences of large claims are more widely spread.

In 2011, the Insurance industry formally agreed to Flood Re as a long-term flood insurance solution; an outline agreement between the Government in GB and the insurance industry was reached in June 2013. In GB, subsequent Water Bill legislation and regulation has paved the way for ‘Flood Re’ to be designated as the scheme administrator of the Flood Re scheme.

The Flood Re website contains more information on the scheme and can be accessed via the following link: www.floodre.co.uk/

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Northern Ireland Climate Change Adaptation Programme

Northern Ireland's commitment to address the impact of climate change is set out in the UK Climate Change Act 2008 which requires Northern Ireland government departments to develop a climate change adaptation programme to address the findings identified in the Climate Change Risk Assessment (CCRA) for Northern Ireland, which was published in January 2012 as part of the overall UK CCRA.
(http://www.doeni.gov.uk/climate_change_risk_assessment_ni_2012.pdf).

The first Northern Ireland Climate Change Adaptation Programme (Adaptation Programme) was published by Department of the Environment NI in January 2014.
(http://www.doeni.gov.uk/index/protect_the_environment/climate_change/climate_change_adaptation_programme.htm).

It contains a number of actions and activities committed to by all government departments under 4 Priority areas:

- Water,
- Flooding,
- Natural Environment and
- Agriculture & Forestry,

to address the identified risks in the CCRA. Progress on the high level actions and key activities is being reported to the Executive through a Cross Departmental Working Group (CDWG) Annual Progress Report. Following the publication of a second UK CCRA (due in January 2017), a second NI Adaptation Programme will be laid before the Northern Ireland Assembly which will also contain an assessment of the progress made towards implementing the objectives, proposals and policies set out in the first Adaptation Programme.

Flooding

The CCRA for NI identifies flooding as potentially one of the most significant and urgent risks. A range of activities set out in the NICCAP to address these risks, include the preparation of flood hazard maps & flood risk maps for potential Significant Flood Risk Areas and the development of Flood Risk Management Plans. These are activities for which the Department (through Rivers Agency) is responsible and which are designed to mitigate identified flood risks.

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Section 4

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4. Floods Directive Work to Date

This section of the document provides details of the Flood Directive's key deliverables and actions that were completed in the lead up to the preparation of the FRMPs. It also describes the main activities taken to involve interested parties, including the public in the preparation of the FRMPs and the role of the groups and organisations that have influenced its development and will contribute to its implementation.

4.1 Preliminary Flood Risk Assessment (completed 22 December 2012)

The Floods Directive required each Member State to undertake a Preliminary Flood Risk Assessment (PFRA) for its respective territory by 22 December 2011. The PFRA is a high level screening exercise that uses available or readily derivable information, to assess the adverse consequences of potential future flooding for human health, economic activity, the environment and cultural heritage. The assessment covered all of the main flood sources, which for Northern Ireland has been determined to be rivers, the sea, surface water and reservoirs.

The principle objective of the PFRA was to identify those geographical areas where 'potential significant flood risk exists or might be likely to occur'. The identification of these areas, known as Significant Flood Risk Areas (SFRAs), is a critical milestone in the implementation of the Floods Directive as these are the only areas for which the later requirements to produce detailed flood risk maps and flood risk management plans apply.

The assessment of potential future flood risk required a detailed understanding of the flood mechanisms for each source of flooding, the magnitude and statistical probability of flood events and the scale of the potential adverse consequences arising from these events. The extent of the potential future flood hazards from rivers, sea and surface water for a range of return periods was predicted using digital flood models developed by Rivers Agency. To support the process a GIS application was developed to combine the various flood outlines produced for each of the flood sources with a wide range of readily available receptor datasets. Using this application, a broad range of 'Flood Fisk Indicators' were generated within 1km grid squares covering the whole of the Province. These Flood Risk Indicators were used in whole, or in part, to assess the potential adverse consequences on human health, economic activity, cultural heritage and the environment. By computing the Flood Risk Indicators at this spatial scale it was possible to compare and contrast the flood risk across the whole of the province at a broad community scale. Examples of Flood Risk Indicators used in the assessment include the:

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- Number of different property types flooded;
- Economic damage arising from flood damage;
- Number of people at risk;
- Vulnerability of people at risk;
- Number of key infrastructure assets flooded;
- Areas of designated environmental sites flooded;
- Number of Industrial Pollution Prevention Control Sites flooded, and
- Lengths of roads/railways flooded.

Full details of the PFRA for Northern Ireland can be found in Rivers Agency's report 'Preliminary Flood Risk Assessment and Methodology for the Identification of Significant Flood Risk (December 2011)' and is available on its website.

The Preliminary Flood Risk Assessment and Identification of Areas of Potential Significant Flood Risk Report (Dec 2011), indicated that management of the risk of flooding associated with reservoirs would be addressed through the introduction of legislation to regulate reservoir safety. This legislation, the Reservoirs Act (Northern Ireland) 2015, was enacted in July 2015 and is similar to legislation that is in place elsewhere in the UK. It is proposed to commence the implementation of the Act in 2016. The Act places a legal responsibility on the managers of controlled reservoirs (i.e. those with a capacity to hold 10,000m^3 or more above the natural level of the surrounding land) to effectively manage them to reduce any associated flood risk. Detailed flood maps that illustrate the potential areas that could be inundated from an uncontrolled release of water from for each controlled reservoir will be published by the Department in 2016. These maps show the areas that could be flooded if controlled reservoirs were to fail and release the water they hold. The maps will be used by reservoir managers, government bodies, organisations and others dealing with flood risk from reservoirs, particularly those engaged in emergency planning.

4.1.2 Significant Flood Risk Areas (SFRA)

Based on the PFRA, the Department determined that there are 20 SFRA within Northern Ireland and the details of these SFRA have been reported to the European Commission. The names of the SFRA along with the relevant the River Basin District in which they are located are listed below in Table **4.1** and their geographical extents are illustrated in Map **4.1**.

The stacked bar chart in Figure **4.1** uses the combined flood risk index to illustrates the variability in the level of flood risk between the 20 SFRAs and the degree to which each of the flood sources contributes to the overall flood risk in an area.

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4.1.3 Areas for Further Study (AFS)

At the time the PFRA for Northern Ireland was undertaken in 2011, the only flood mapping available on which to assess the flood risk to communities was the Strategic Flood Maps (NI). This 'strategic level' mapping was produced for the purposes of highlighting general areas that may be prone to flooding from rivers, the sea and surface water and it is acknowledged that there is a degree of uncertainty with the accuracy of this mapping. As a consequence of the uncertainty it was entirely possible that the risk to some areas could have been substantially higher or lower than estimated through the PFRA.

In view of this uncertainty the Department determined that, in addition to identifying the SFRAs, any area which was estimated to have a moderate risk of flooding would be classified as an Area for Further Study (AFS). In total, 49 AFS were identified through the PFRA process. The names of the AFS along with the relevant the River Basin District in which they are located are listed below in Table **4.1** and their geographical extents are illustrated in Map **4.1.1**. Detailed flood models for all of these AFS have been developed to the same standard as those produced for the SFRAs and these have been used to prepare flood hazard and flood risk maps which are available alongside those for the SFRA through Flood Maps NI.

Although the flood risk to these AFS is not specifically addressed within the FRMPs, this approach has provided the information necessary for a more robust assessment of the flood risk regionally. Where it is justifiable, this assessment may lead to the development of a flood alleviation scheme which may be taken forward through the normal business of the drainage authority responsible. The detailed flood maps produced for the 49 AFS will also be used for the purposes of development planning and emergency planning and response. They also serve to increase awareness among the general public, local authorities and other organisations, of the likelihood of flooding and to encourage them to take appropriate action to manage the risk.

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	Significant Flood Risk Areas	Areas for Further Study	
Neagh Bann Int. River Basin District	**Newry**	Magherafelt	Dungannon
	Portadown	Randalstown	Warringstown
	Warrenpoint	Glenavy	Coalisland
	Banbridge	Ballyclare	Keady
	Lurgan	Gracehill	Castledawson
	Glengormley & Mallusk	Cookstown	Rostrevor
	Antrim	Stoneyford	Armagh
	Ballymena	Moneymore	Ballygawley
	Coleraine	Ballymoney	Ahoghill
		Maghera	
North Western Int. River Basin District	**Londonderry**	Eglinton	Castlederg
	Omagh	Enniskillen	Ballinamallard
	Strabane	Lisbellaw	Coolkeeragh
		Newtownstewart	Sion Mills
		Ballymagorry	Fintona
		New Buildings	Maguiresbridge
		Beragh	Limavady
North Eastern River Basin District	**Belfast**	Larne	Ballynahinch
	Newtownards	Comber	Lisburn
	C'fergus & Kilroot Power St.	Ballygowan	Saintfield
	Bangor	Holywood	Ballygalley
	Newcastle	Dromore	Drumaness
	Newtownabbey	Bushmills	Carryduff
	Downpatrick	Whitehouse	Cushendall
	Dundonald	Ballycastle	Portrush

Table 4.1 Northern Irelands 20 Significant Flood Risk Areas and 49 areas of further study

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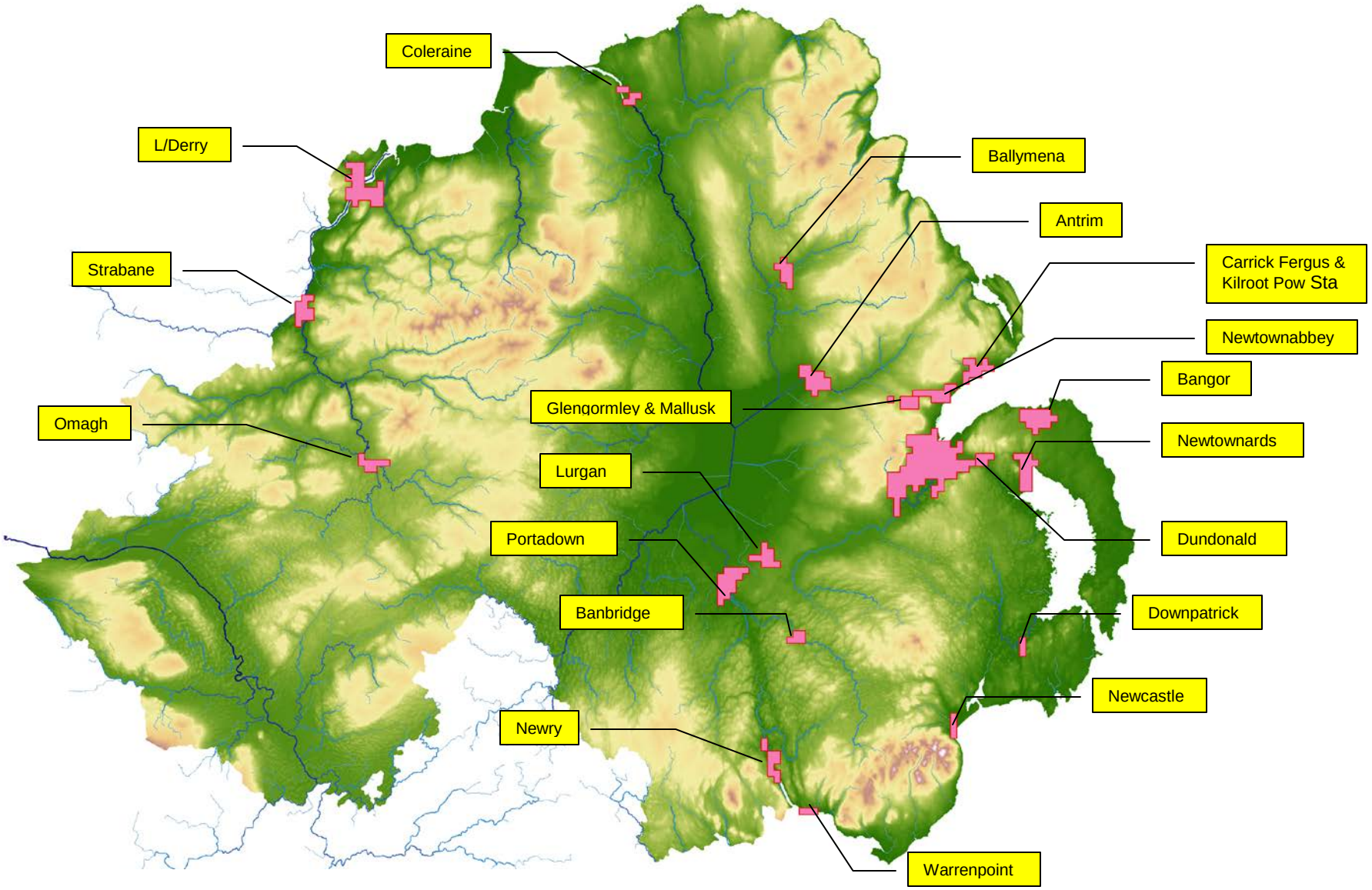
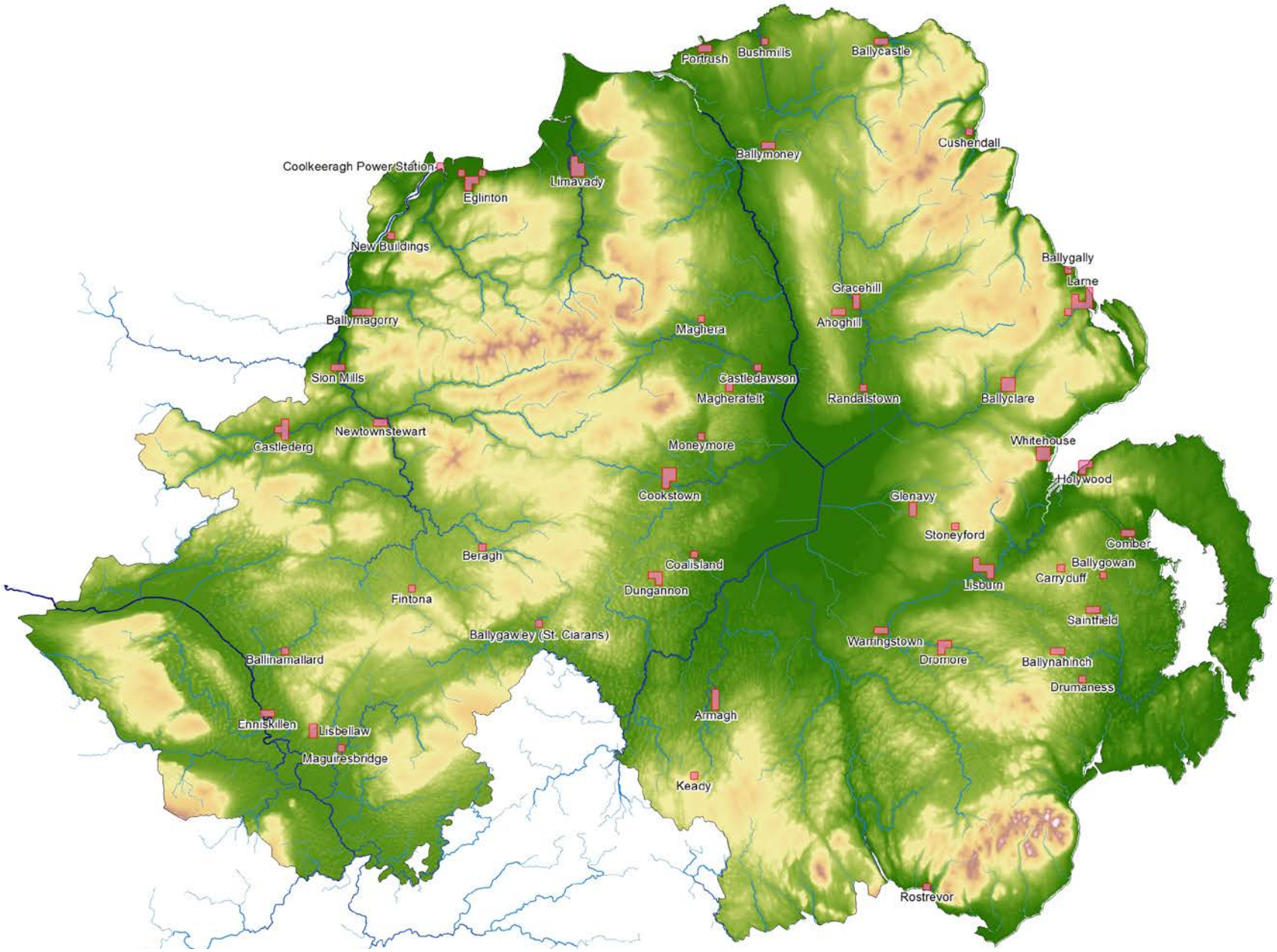


Map 4.1 - Map of Northern Irelands 20 Significant Flood Risk Areas



Map 4.1.1- Map of Northern Irelands 49 Areas of Further Study

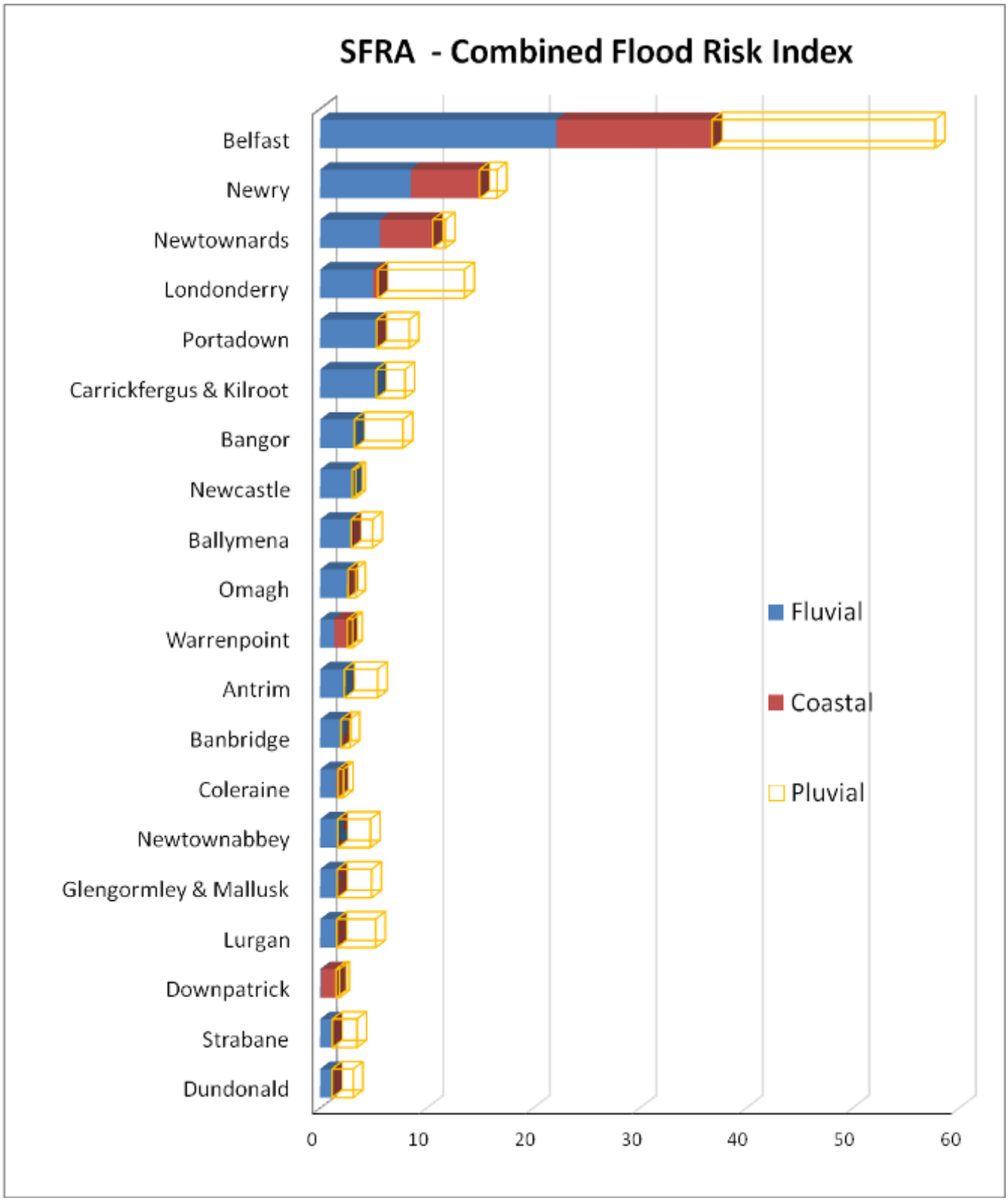


Figure 4.1 - Northern Irelands 20 Significant Flood Risk Areas

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4.1.4 Flooding in New Areas

Every effort has been made to ensure that the Flood Risk Management Plans (FRMPs) have been based on the best available up to date information at the time of publication. The FRMPs focus on the 20 most significant flood risk areas in Northern Ireland and also mention 49 areas for further investigation. While flood mapping and assessment methodologies provide a high degree of certainty that the areas identified to be at significant risk have been assessed correctly, there is still the chance that future incidences of serious flooding could possibly occur in areas outside those 69 areas. Therefore, it must be recognised that should major flooding occur elsewhere in Northern Ireland outside of those 69 areas, new objectives and measures to address such flooding may be developed and prioritised ahead of those currently included within the FRMPs. Any necessary re-prioritisation of objectives and measures will be included within progress reports on implementing the FRMPs.

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4.2 Flood Maps

Rivers Agency in conjunction with Planning NI, published the online **Strategic Flood Maps** for NI in October 2008. This first generation of indicative maps was developed to provide a general indication of the areas that may be at risk of flooding from rivers and the sea and used mainly to inform the development planning process. A strategic surface water flood map was added subsequently published in December 2011. Due to the onerous requirement to produce flood maps that cover the whole of the province, it was necessary to develop the strategic flood models using a broad-scale modeling methodology and techniques that had clear limitations. These limitations meant that the estimated floodplain outlines and inundation areas were not considered sufficiently accurate to determine the flood risk to particular properties or point locations.

This strategic level mapping was used for the PFRA and the identification of SFRAs. To facilitate a more robust assessment of the flood risk within the SFRA and inform the development of the development of the FRMPs the Floods Directive requires the preparation of more detailed flood mapping for each of the SFRA. As stated above in section 4.1.3 – Areas of Further Study, the Department has identified an additional 49 AFS and has prepared similarly detailed maps for these areas.

The Floods Directive's requires the preparation of Flood Hazard Maps and Flood Risk Maps, to cover the geographical areas within each of the SFRAs that could flood i low, medium and extreme event scenarios. Within Northern Ireland the following flood return periods have been used for preparing the maps for this range of probability scenarios.

Flood Source	**Event Scenario**			**Model Type Strategic or Detailed**
	High	Medium*	Low	
Rivers	1 in 10 year 10% AEP	1 in 100 year 1.0% AEP	1 in 1000 year 0.1% AEP	Detailed
Sea	1 in 10 yr 10% AEP	1 in 200 year 0.5% AEP	1 in 1000 year 0.1% AEP	Detailed
Surface Water	1 in 30 year	1 in 200 year	1 in 1000 year	Detailed
** Flood Hazard Maps are also available for the Climate Change 2030 epoch. These illustrate the estimated floodplains for the year 2030 and are based on the best available predictions for the meteorological conditions and sea levels for that time.*				

Table 4.2 – Flood Hazard & Risk Map Scenarios

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By comparison with the strategic flood maps the accuracy and scope of the information provided by the Flood Hazard and Flood Risk Maps is greatly improved. Most importantly, this mapping is now considered suitable for identifying the level of risk to individual properties and specific point locations.

It should be noted that the surface water mapping for the SFRA continues to be strategic in nature. The surface water maps simply highlight the low spots and depressions in the landscape that may fill with water if the local natural and engineered drainage systems are overwhelmed. These maps are suitable for the purposes of emergency planning and are used by the planning authority to advise applicants of potential water surface flood risk to proposed developments that must be considered and mitigated were appropriate. Importantly, the surface water maps within Flood Maps (NI) are not suitable for decision making in regard to capital investment on infrastructure for the purposes of flood alleviation. Areas that are at high risk of flooding from surface water will continue to be identified through historical flood records and not through broad-scale predictive flood models.

4.2.1 Flood Hazard Maps

Flood Hazard Maps essentially describe the characteristics of the predicted flood for each of the flood event scenarios and include information such as the:

- Geographical extent of the estimated flood inundation areas;
- The floodwater depth and height; and
- The flow and velocity of the floodwater.

The Flood Hazard Maps for the 20 SFRA and 49 AFS are available to general public through Flood Maps (NI) which is an interactive online map-viewer that enables users to access the latest flood hazard information available from government. Flood Hazard Map coverage throughout Northern Ireland is extensive and continues to increase. Flood Maps (NI) will continue to display the strategic flood maps for the geographical areas that are not covered by the Flood Hazard Maps. The difference in the uncertainty between the ‘strategic’ and detailed ‘hazard’ maps is reflected in how they are displayed within Flood Maps (NI). The hazard maps are published at 1 in 5000 scale to enable the identification of individual properties at risk of flooding, whereas strategic maps are displayed at 1 in 10,000 scale which is more appropriate for assessing the risk at a street/community level.

The publication of the flood maps is designed to:

- Enable flooding agencies, infrastructure providers and others to manage their work to reduce flood risk.
- Encourage people living and working in areas prone to flooding to take appropriate action.
- Inform anyone applying for planning permission if flooding is likely to be a material consideration.

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A sample copy of the Flood Hazard Maps available through Flood Maps NI is shown in Figures **4.2.2** and **4.2.2.1**. This map shows the 1 in 100 yr (medium probability) fluvial flood plain for the Westwood Development in Lurgan.

4.2.2 Flood Risk Maps

The Flood Risk Maps essentially describe the main adverse consequences of the predicted flood for each of the scenarios listed in Table **4.2**. The specific information that is required to be included in Flood Risk Maps is:

- The number of inhabitants that could be affected;
- The effect on economic activity;
- The areas within nationally important environmental areas that could be flooded, particularly those which could be accidentally polluted from an Industrial Pollution Prevention Control Site.

The Flood Risk Maps prepared for Northern Ireland collate and display this information on a 250m grid. A sample copy of the Flood Risk Maps available through Flood Maps NI is shown in Figure **4.2.2.2.** This map shows the 1 in 100 yr (medium probability) fluvial flood plain for Lurgan. The Department has published Flood Risk Maps for fluvial (river) and coastal flood risks on the Department's website.

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Figure 4.2.2 – Example Flood Hazard Extent Map for Lurgan

Figure 4.2.2.1 – Example Flood Hazard Depth Map for Lurgan

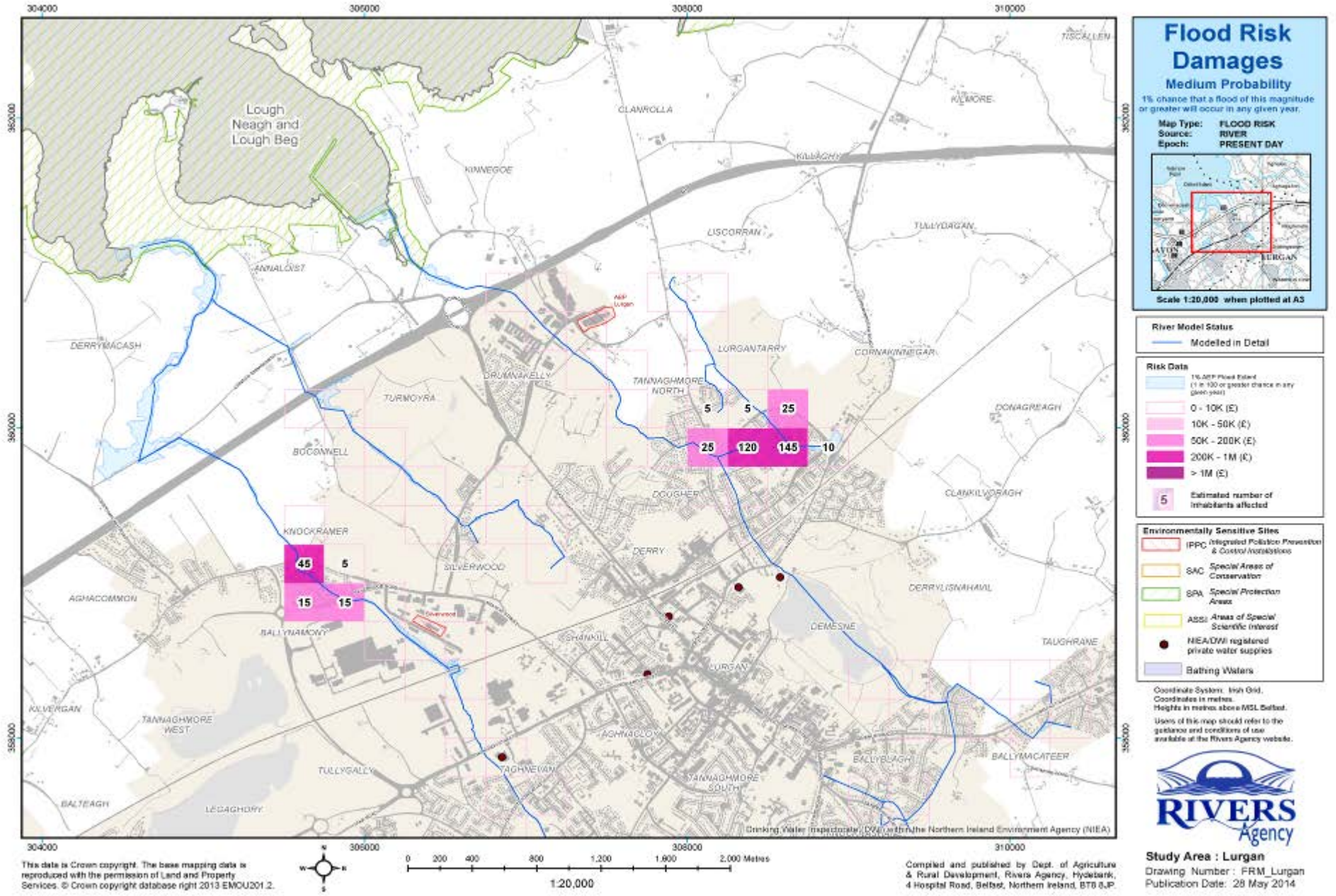

Figure 4.2.2.2 – Medium Probability Flood Risk Map for Lurgan

Mapping for Climate Change

The Floods Directive does not specifically require the preparation of flood maps that take account of climate change. However, it is widely accepted that our climate is changing and that with the passage of time, extreme rainfall events may become more frequent and intense and the sea around our coastline will rise and become stormier. The Department recognises that that the long-term flood risk management decisions that are taken today, will only be sustainable if they are future proofed and take into account the potential increased flood risk from climate change. This is particularly important for decisions in relation to the provision of flood defences and development planning. Therefore, to inform these important decisions the Department has prepared a range of climate change flood hazard maps. These maps illustrate the estimated flood plains for the year 2030 and are based on the best available predictions for the meteorological conditions and sea levels for that time. The medium probability climate change (2030 year) epoch flood maps for each of the main flood sources are available through Flood Maps (NI).

Reservoir Inundation Maps

Reservoir inundation maps are not available at the time of the publication of the FRMPs. Rivers Agency is developing predictive flood models for each of the Controlled Reservoirs that have been identified. This will facilitate the implementation of the Reservoirs Act (Northern Ireland) 2015. It is anticipated that maps highlighting the potential flood inundation areas resulting from an uncontrolled release of water from these reservoirs will be available in early 2016 and will be published in Flood Maps (NI).

4.3 Communication and Engagement

The Floods Directive Regulations place a general duty on government departments and other public bodies to execute and coordinate their relevant functions *'in a manner which secures compliance with the requirements of the Floods Directive.'* It also requires that appropriate steps are taken *'to provide opportunities for the general public and public bodies to participate in discussion and the exchange of information or views in relation to the preparation of the plan and, in particular, shall give access to the documents and information used in such preparation.'*

4.3.1 General Arrangements for Stakeholder Involvement

The general arrangements that were established to secure compliance with the requirements of the Directive in relation to communication and engagement are outlined in the Timetable and Work Programme for the Preparation of Flood Risk Management Plans which was published for public consultation on 20 December 2012.

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The consultation network that was set up to ensure that all relevant stakeholders had an opportunity to participate in discussion and the exchange of information and views in the preparation of Flood Risk Management Plans is illustrated in Figure 4.3. The roles of the main groups in this process are as follows.

Floods Directive Steering Group

The successful implementation of the Floods Directive requires effective communication, cooperation and coordination across a number of government departments, agencies, councils and a government owned company NI Water. To ensure that there is an appropriate level of engagement and commitment within government, DARD Rivers Agency, as Competent Authority for the Floods Directive, set up the cross-departmental Floods Directive Steering Group in January 2008. This group, which comprised senior representatives from all of the key government stakeholders with an interest flood risk management, was responsible for providing the strategic direction for the implementation process and ensured that each organisation undertakes its functions and aligned its policies in a manner that supports the effective implementation of the Directive in Northern Ireland.

Floods Directive Stakeholder Group

The Floods Directive Stakeholder Group was established in June 2009 to satisfy the Directive's requirement to encourage the active involvement of interested parties in the development of the Flood Risk Management Plans. This Group includes representatives from both statutory and non-statutory organisations with broad range of interests including the environment, fisheries, navigation, transportation networks, essential services (such as water, sewerage and telecommunications), insurance, flood emergency planning/response, business and health and social care. This Group is an effective conduit for the transfer of relevant information to and from knowledge holders and ensures that key stakeholders have an opportunity to identify and consider all issues, challenges and opportunities associated with potential flood mitigation measures within a catchment based flood risk management framework.

Flood Forum Groups

A Flood Forum Group has been established for each the three River Basin Districts (i.e. one for each FRMP area) since March 2013. However, the North East Forum has essentially grown through an expansion of the membership of the Belfast Flood Forum which has been in existence since May 2010. The aim of the Flood Forums is to create the opportunity for local community groups, relevant NGOs and the public, through their elected representatives, to influence and contribute to the development of the Flood Risk Management Plans. The aim of the Forums is to:

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- raise the general awareness of flooding at the local community level and to input into the aims and objectives of the Flood Risk Management Plans;

- create the opportunity for all groups, organisations and individuals to share their knowledge and experience of local flooding with decision makers and;

- contribute to the development of flood mitigation solutions that are affordable, appropriate for the local area and support the environmental objectives of the Water Framework Directive.

Photo 4.3 – Local Flood Forum 20th January 2015, Greenmount, Antrim

4.3.2 Public Consultation on the Draft Flood Risk Management Plan

The Directive requires that draft Flood Risk Management Plans are published not less than one year before the beginning of the period to which they relate and that the public and statutory consultees are invited to make representations on the Plans.

In accordance with this requirement, the draft Flood Risk Management Plan was published for consultation on Rivers Agency's website on 22 December 2014 with hard copies available on request. Details of the

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consultation were advertised in the main local newspapers and on the Department's website and representations on the Plan were invited throughout a six month consultation period which ended on 22 June 2015. The timing of the consultation on the draft FRMPs was coordinated with the Northern Ireland Environment Agency's public consultation on its Draft River Basin Management Plans that were produced in compliance with the Water Framework Direction. The coordination of these consultations is a requirement of the Floods Directive and aims to secure efficiency in obtaining the active involvement of parties with a common interest in the objectives of both Directives. In total the Department received twenty eight responses to the public consultation on the draft FRMPs which included:

8 from Councils / Local Government
5 from Government bodies
5 from environmental organisations
4 from fishing organisations
2 from blue light responders
1 from farming Industry
1 from a political party
1 from and independent consumer organisation
1 from a professional engineering organisation

The Response to the Consultation on the draft Flood Risk Management Plan was published week commencing 30th November 2015 and is available on the DARDNI website via the link: https://www.dardni.gov.uk/publications/response-consultation-draft-flood-risk-management-plan.

The Department has taken into account all of the views and representations that it received on the draft Plans and made appropriate changes to the Plans were it has determined that this was justified. A summary of the substantive changes that were made to the FRMPs as a consequence of the representations received from the consultation exercise can be found in Appendix B.

4.3.3 Other Public Information Measures

In addition to the Directive's requirements to actively involve and consult with interested parties in the production of the FRMPs it was also necessary to make available to the public, the preliminary flood risk assessment and the flood hazard maps and flood risk maps.

The Preliminary Flood Risk Assessment for Northern Ireland was published and made available for public inspection through the Department's website on 22 December 2011 with hard copies available on request.

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The flood hazard and flood risk maps for each of the 20 Significant Flood Risk Areas were prepared and made available to the public on 22 December 2013. Initially maps were available only for specific locations on request and supplied on paper or as digital PDFs. Public accessibility to the flood hazard maps was significantly improved on 2 June 2014 when Rivers Agency launched its web-based interactive flood map service for Northern Ireland, Flood Maps (NI). Through Flood Maps (NI) the public have direct access to the detailed flood hazard maps for each of the 20 SFRA and the 49 Areas for Further Study. Public awareness of the flood maps was generated through a publicity campaign which involved local television, radio and newspapers and was supported by the DARD Minister.

4.3.4 Cross-Border Coordination in International River Basin Districts

In recognition of the fact that many river catchments throughout Europe cross national boundaries, the Floods Directive requires that Member States coordinate their flood risk management practices in shared river basins and shall in solidarity not undertake measures that would increase the flood risk in neighbouring countries. Northern Ireland shares 3 (International) River Basin Districts (RBD) with the Republic of Ireland; the North Western IRBD, Neagh Bann IRBD and Shannon IRBD. In the case of the Shannon IRBD, only 3.5km² of its 18,000km² is located within Northern Ireland and therefore for practical purposes the responsibility for the preparation of the FRMP for this RBD rests solely with the RoI.

To ensure that a coordinated approach is adopted for the two substantive IRBDs, and building upon a long-standing history of cooperation between the two organisations, working groups on the implementation of the Directive have been established between the OPW and the Rivers Agency. These groups have taken into account the catchment areas, their flood history, topography and the significant flood risk areas within them, in order to assign and plan work between the two jurisdictions.

It was been decided that Rivers Agency and the Office of Public Works will develop their FRMPs separately within their own jurisdictions but will closely coordinate on all technical matters and proposed flood mitigation measures. There is no likelihood that any measures will be taken in one jurisdiction that will increase the flood risk in the other.

The two main cross- border groups set up to coordinate the activities and share information are the Cross Border – Floods Directive Implementation Group and the Cross Border – Floods Directive Technical Coordination Group. The specific aims of these groups are described in the Figure **4.3.**

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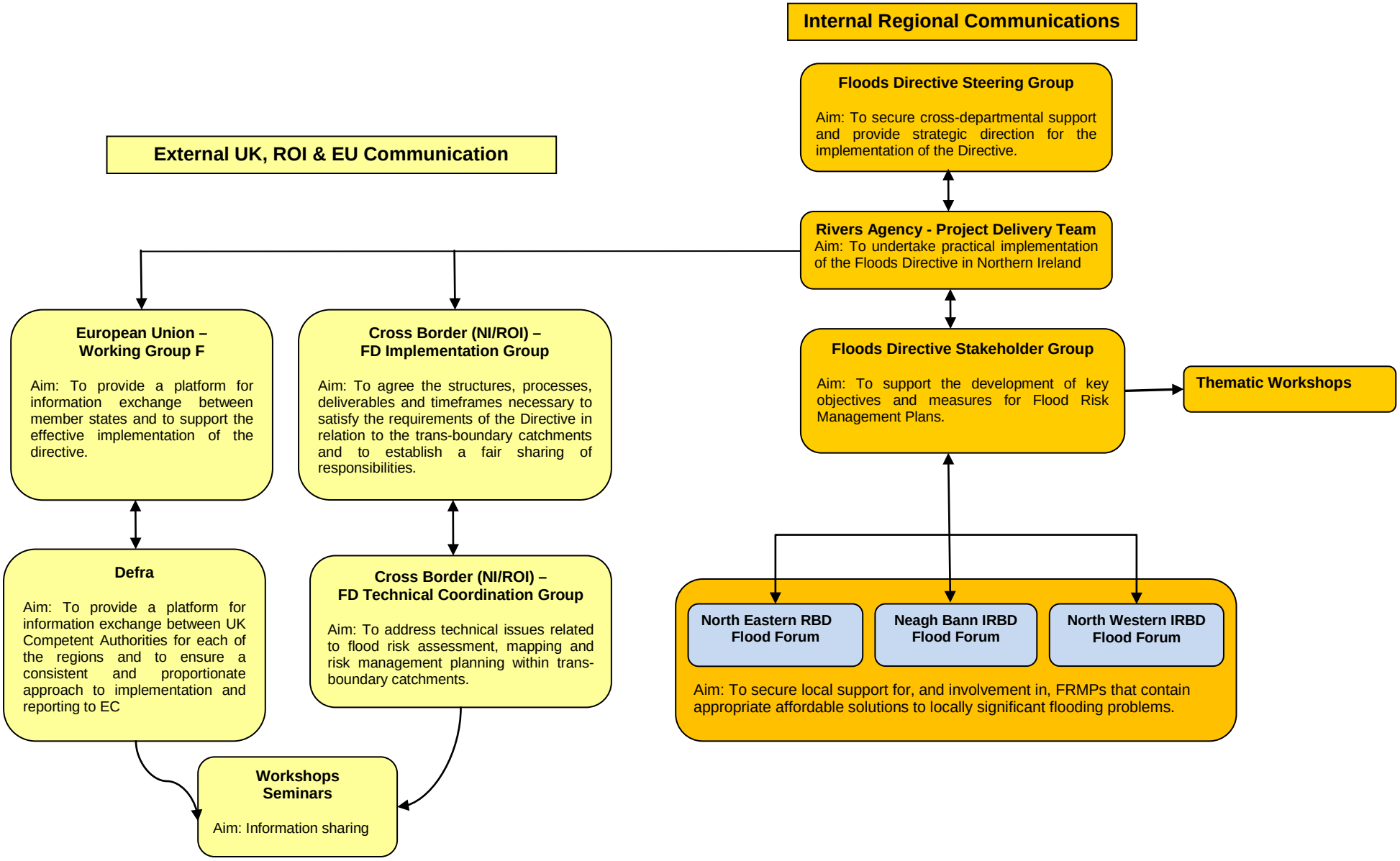

Figure 4.3 – Floods Directive Communication/Engagement Network

4.4 Flood Risk Management Organisations

The management of flood risk is the responsibility of a number of organisations, mainly Rivers Agency, Transport NI, NI Water, Planning NI and Local Councils. Their respective roles and functions in relation to flood risk management are described below.

River Agency

The Department of Agriculture and Rural Development (DARD) is the statutory drainage and flood defence authority for Northern Ireland. The Department is also the competent authority in Northern Ireland for the implementation of the EU Floods Directive, which reinforces the legislative basis for the Agency's flood risk management role.

Under the terms of the Drainage (Northern Ireland) Order 1973, the Department has permissive powers to:

- Maintain watercourses and sea defences which have been designated by the Drainage Council for Northern Ireland.
- Construct and maintain drainage and sea defence structures.
- Administer advisory and enforcement procedures to protect the drainage function of all watercourses.

In addition to its role under the Drainage Order and Floods Directive, the Agency is also has a responsibility for:

- Taking forward legislation on reservoirs safety;
- Maintaining flood defence and drainage infrastructure assets;
- Constructing new flood infrastructure to provide enhanced flood protection to people and property;
- Providing a flood emergency response service during flooding events;
- Fulfilling the role of Lead Government Department for the Co-ordination of Flooding Emergencies;
- Providing advice on flood risk;
- Providing advice to business, developers and the public on drainage and flood related issues;
- Providing advice to Planning NI on the flood related aspects planning policy and to Local Councils on Local Development Plans and planning applications.

Further information on Rivers Agency can be found on the NI Direct web site, Rivers and flooding.

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Northern Ireland Water (NIW)

NI Water is a Government Owned Company, set up in April 2007 to provide Northern Ireland's water and sewerage services including the collection of surface water. As owner of the key urban drainage infrastructure, NI Water has a major role to play in cooperation with the other drainage agencies, Rivers Agency and Transport NI, to manage the risk from surface water flooding. NI Water is committed to:

- Work with Rivers Agency, Transport NI, Councils and other relevant stakeholders to develop and contribute to the implementation of integrated solutions to manage surface water flood risk in urban areas (for example, the Living with Water Programme);
- Contribute to the development and implementation of sewerage recommendations and policies arising from the Stormwater Management Group in relation to future sustainable drainage planning;
- Implement drainage and sewerage related measures set out in FRMPs;
- Contribute to the delivery of an efficient and effective coordinated response from Government during flooding incidents; and
- Implement the inspection and maintenance requirements of the Reservoir Bill to reduce the flood risk from Controlled Reservoirs.

NI Water also maintains a register of properties at risk of sewer flooding (DG5 Register) and delivers a prioritised programme of works to remove properties from this register in accordance with targets agreed with the Utility Regulator.

The Department for Regional Development has responsibility for the policy on water and sewerage services in Northern Ireland under the Water and Sewerage Services (Northern Ireland) Order 2006. This responsibility will pass to the Department for Infrastructure when established in May 2016.

Transport NI

Transport NI is the sole Roads Authority in Northern Ireland. It has responsibility for over 25,000 km of public roads, together with 9,000 km of footpaths and a substantial number of bridges, street lights and public car parks.

Transport NI deals with the impacts of roads-related flooding. They maintain road drainage systems, organise road closures and traffic diversions, clear blockages during flooding and remove debris once the flood has receded. They will also take action to protect property that may be affected by road flooding.

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Transport NI applies Sustainable Drainage Systems (SuDS) solutions to schemes costing in excess of than £1 million.

Planning NI

From 1 April 2015 the Northern Ireland planning system was reformed and restructured from a unitary system, where all powers rested with the Department of the Environment, to a new two-tier model of delivery whereby local councils have primary responsibility for the implementation of the following key planning functions:

- preparation of local development plans;
- development management (excluding regionally significant applications); and
- planning enforcement.

DOE, Planning NI retains responsibility for planning legislation, regional planning policy and the determination of regionally significant and called-in applications. It also provides oversight, guidance for councils, governance and performance management functions.

The DOE's Strategic Planning Policy Statement for Northern Ireland (SPPS), published in September 2015, sets out the regional planning policies for securing the orderly and consistent development of land under the reformed two-tier planning system. The SPPS is consistent with the Executive's Regional Development Strategy 2035 (RDS 235) which sets out the framework for the spatial development of Northern Ireland.

The SSPS produced by Planning NI must be taken into account by councils in the preparation of their Local Development Plans and are material to all of their decisions on individual applications and appeals. Included within the SSPS are the policies that describe how potential flood risks must be taken into account and in essence these are designed to prevent inappropriate new development that will be at risk of flooding or which may increase the flood risk elsewhere.

Planning NI's strategic policy functions will transfer from DOE to the new Department for Infrastructure which is to be formed in May 2016.

Further information on Planning NI can be found on the website Planning NI.

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Local Government

As mentioned earlier, from 1 April 2015, the responsibility for planning is shared between the 11 local councils and the Department of Environment. Within this two-tier system, councils have a responsibility for the preparation of Local Development Plans for their areas, taking decisions on the majority of planning applications and planning enforcement. Consequently, councils have a key role to play in preventing inappropriate development in areas known to be at risk of flooding or that may increase the risk of flooding elsewhere.

Local Government also has a key role in undertaking co-ordination and support activities to facilitate the emergency response to flooding in conjunction with the statutory authorities. Emergency Planning Coordination Officers (EPCOs), and a Regional Local Government Coordinator continue to have a key role in facilitating emergency response activities in relation to flooding both at a local and regional level.

The interaction between the key organisations, including Local Government, in relation to the co-ordination of the emergency response to flooding is detailed in the OFMDFM 'Framework for the Co-ordination of Flooding Emergencies'.

In addition, Emergency Planning Groups (EPGs) have recently been set up and these provide a forum to focus on flood emergency response action. Councils also have a leading role in the 'recovery phase' after a flooding event has occurred.

In the immediate aftermath of significant flooding within their areas, Councils have a responsibility for the administration of the 'Scheme of Emergency Financial Assistance to Councils '(SEFA). SEFA offers individual householders, who have suffered severe inconvenience due to flooding, immediate practical assistance in the form of a monetary payment, to ensure homes are made habitable as quickly as possible.

Impacts of Organisational Changes within government on Flood Risk Management Plans

In producing these Flood Risk Management Plans (FRMPs), it should be recognised that major changes in both local and central government in Northern Ireland are underway. These changes may impact on organisations and people responsible for implementing the FRMPs.

In relation to the 'Prevention' aspects of Flood Risk Management `there is a need to ensure that flood risk continues to be given full consideration within the new development planning processes by both DoE and the

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11 new council planning departments. Rivers Agency will work with council planning departments to ensure that they have the necessary information to appropriately consider flood risk as part of the planning process.

During the early period of the forthcoming Flood Risk Management Planning cycle, there will be significant changes made to government departments in Northern Ireland. Fundamentally the number of departments will reduce from twelve to nine. In relation to Flood Risk Management, the Department's Rivers Agency is to join up with the DRD infrastructure agencies of Transport NI and NI Water in the formation of a new Department for Infrastructure (DfI). This is recognised as a positive step for managing flood risk as the 3 main providers of drainage infrastructure will be located within the one department from May 2016.

In taking forward the proposed measures, in these Flood Risk Management Plans it should be recognised that the achievement of the objectives within the Plans will depend on resource and capital funding being available.

Office of Public Works, Republic of Ireland

The Office of Public Works (OPW) is the lead State body for the coordination and implementation of Government policy on the management of flood risk in the Republic of Ireland. The OPW has a long history of working closely with colleagues in Rivers Agency on areas of common interest and, as both organisations are the competent authority for the implementation of the Floods Directive in their respective territories, are sharing information and coordinating activities on the development of FRMPs for shared International River Basin Districts. Further information on the OPW can be found at the following website The Office of Public Works.

4.5 Flood Risk Management Groups

A number of groups have been established in recent years to take forward various initiatives, both at strategic and operational level.

Flood Strategy Steering Group

The Flood Strategy Steering Group (FSSG) was established in 2003 to provide oversight and direction to ensure the co-ordinated multi-agency response to flooding emergencies. The role of the group is to:

- Develop strategies to improve flood response;
- Provide a steer to the Flood Working Groups linked to the Emergency Planning Groups (EPGs) which deal with issues at an operational level;

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- Monitor and review the effectiveness of flood response during and following major events; and
- Ensure that there are effective communication channels and processes in place at strategic level among the flood response organizations.

Membership

The FSSG comprises membership from the following organisations:-

- Rivers Agency (Chair)
- Transport NI
- NI Water
- Department of Agriculture & Rural Development (DARD) Core
- Department of Regional Development (DRD) Core
- Local Government Emergency Planning
- Police Service Northern Ireland (PSNI)
- Northern Ireland Fire & Rescue Service
- NI Direct

Multi-agency Civil Emergencies Preparedness Groups (EPGs)

Four additional multi-agency Civil Emergencies Preparedness Groups (EPGs) (North, South, East and West) have now been formally established alongside the existing Belfast Resilience Group.

Each EPG is responsible for:

- agreeing a joint approach to emergency preparedness and response and co-ordinate the multi-agency planning effort;
- conducting local risk assessments to provide a robust basis for planning;
- ensuring that relevant multi-agency plans, procedures, training and exercising are in place to address all local area risks; and
- addressing the implications of regional initiatives and the work/ decisions of the Civil Contingencies Group (NI) for the local area.

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Flood Investment and Planning Group (FIPG)

The FIPG was established in the aftermath of the severe flooding which occurred in June 2012 and in response to concerns that greater collaboration between government departments was required to effectively manage the risks from flooding when there is no obvious infrastructure ''owner''. The causes of flooding are often complex due to hydraulic inter-dependencies between our sewerage and drainage networks, rivers and the sea. The Group comprises members from DRD Water Policy and the three agencies with a drainage responsibility; NI Water, Transport NI and Rivers Agency. FIPG will not be involved in flooding issues which are considered to be the sole responsibility of one of the drainage agencies.

The role of the FIPG is to ensure that there is a coordinated approach to the investigation flood of flooding, agree responsibilities, propose potential solutions, prioritise investment and ensure joint responses including making the case for investment.

Living with Water Programme Board

It is acknowledged that Belfast's drainage infrastructure requires significant future capital investment in order to, enhance the water environment, reduce the risk of flooding and allow for the continued economic growth of the city. To facilitate the development of optimum solutions to address the flooding and environmental risks arising from the drainage network, it was agreed by the NI Executive in July 2014 that the Department of Regional Development (DRD) should set up an inter-departmental group to produce a Strategic Drainage Infrastructure Plan for the city. This plan will be developed through the Living with Water Programme which is being progressed through a series of interlinked work package. The Programme Board includes representatives from DRD water Policy, NI Water, Rivers Agency, Transport NI, Belfast City Council, Department of Environment, NI Environment Agency , Department of Finance and Personnel and the Strategic Investment Board. All of these organisations will contribute to the development of the resulting Strategic Drainage Infrastructure Plan. Further details of the Living with Water Programme can be found in section **7.1.7.**

DRD Water Policy Division

Department for Regional Development's Water Policy and Shareholder Division is responsible for advising Northern Ireland Assembly Ministers on policy in relation to the water and sewerage industry and for discharging the DRD's statutory and other duties under the Water & Sewerage Services (NI) Order 2006.

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They are responsible for contributing to the health and well being of the community and the protection of the environment by developing and maintaining the policy and regulatory environment to provide a modern, high quality water and sewerage service, at the lowest possible cost.

The main areas of responsibility are:

- legislative framework for the water and sewerage industry
- strategic planning on water and sewerage service related environmental and social matters
- policy advice on water and sewerage issues
- regulatory governance of the water industry
- DRD's regulatory role on water and sewerage services
- coordination of flood investment planning by NI Water, Rivers Agency and Transport NI
- NI Water subsidy and charging policy
- Communication and Co-ordination with NI Water's Stakeholders
- Development of the Long Term Water Strategy and it's delivery Action Plan
- Programme Management for Strategic Drainage Investment Planning

Stormwater Management Group (SMG)

The Stormwater Management Group (SMG) is an inter-departmental policy coordination and implementation group that was established in 2011 to facilitate the implementation of the NIEA's Strategy for Promoting the Use of Sustainable Drainage Systems within Northern Ireland. It is jointly chaired by NIEA's Water Management Unit (WMU) and DRD's Water Policy Division and has cross-departmental support with representatives from Rivers Agency, NI Water and the Utility Regulator. The fundamental aim of the SMG group is to examine a range of approaches to develop a more integrated, catchment based approach to stormwater management in reducing flood risk.

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Section 5

North Eastern RBD - SFRAs

Flood Risk Assessments
&
Measures

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5.1 River Basin Overview

This Flood Risk Management Plan refers to the North Eastern River Basin District which has a land area of just over 3000km² and a further 1000km² of marine waters. It takes in large parts of Counties Antrim, County Down and a small portion of County Londonderry. The District is flanked by the Antrim Plateau and Glens of Antrim to the north and the Mourne Mountains, which include Slieve Donard, the highest peak in Northern Ireland, to the south.

Over 0.7 million people live in the District which includes the most densely populated region of Northern Ireland, the Belfast Metropolitan Area, and the surrounding commuter areas including Lisburn, Newtownabbey, Carrickfergus, Bangor and Newtownards. Most of the main urban areas are located beside rivers or on the coast. In rural areas, many people live in small villages or single dwellings. Industry is mainly concentrated around the urban areas with much of the rest of the District given over to farming. Farmland in the Lagan valley and other lowland areas is very productive. Commercial fish farming is also significant in the area, whilst boating is a popular recreational activity.

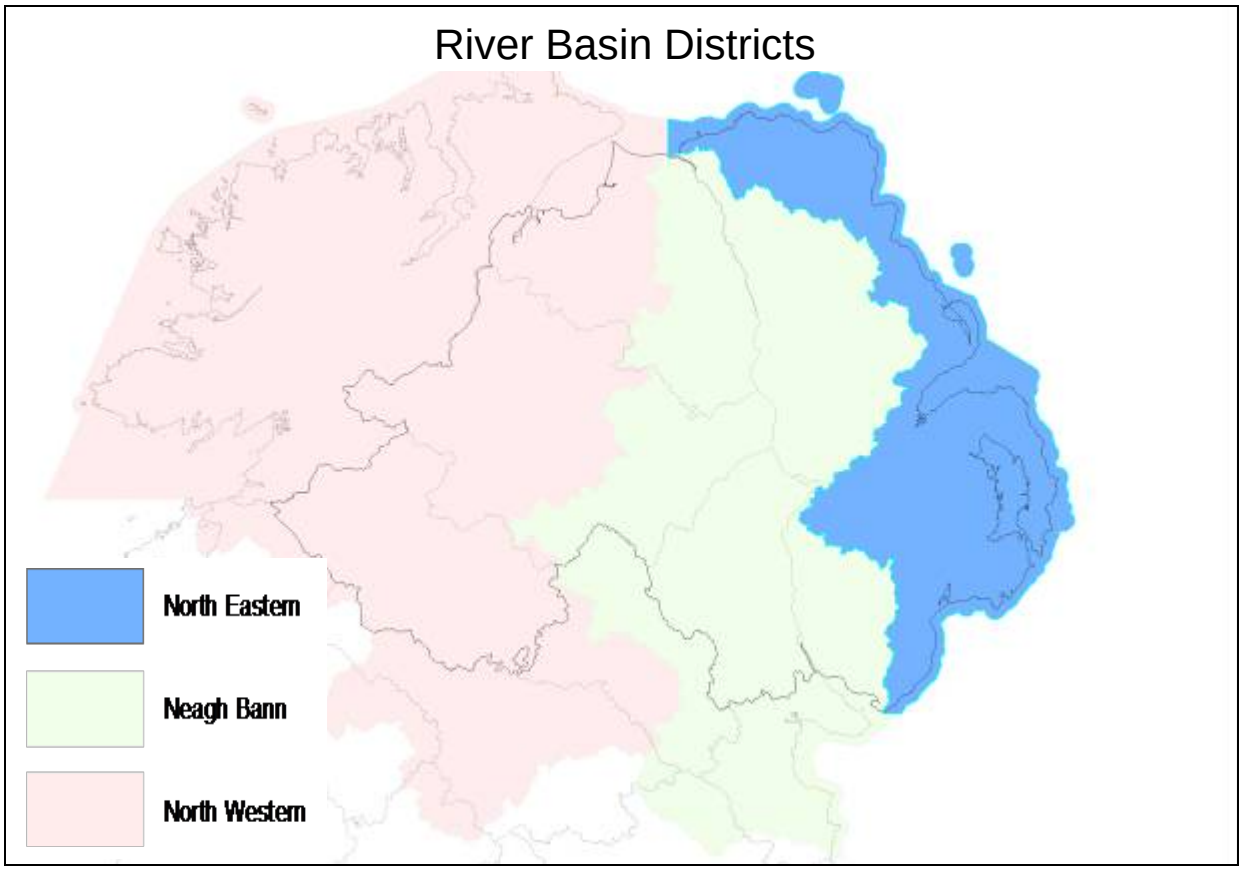

Figure 5.1.1 – North Eastern River Basin District (Blue)

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5.2 Areas of Significant Flood Risk

Following the Preliminary Flood Risk Assessment which was completed in 2009, twenty areas of potential significant flood risk were identified within Northern Ireland. Eight of the Significant Flood Risk Areas (SFRA) are located in the North Eastern River Basin District and named as follows:

- Belfast
- Downpatrick
- Dundonald
- Bangor
- Newcastle
- Newtownards
- Carrickfergus & Kilroot Power station
- Newtownabbey

The locations and geographical extents of the SFRA are illustrated in Figure 5.2.

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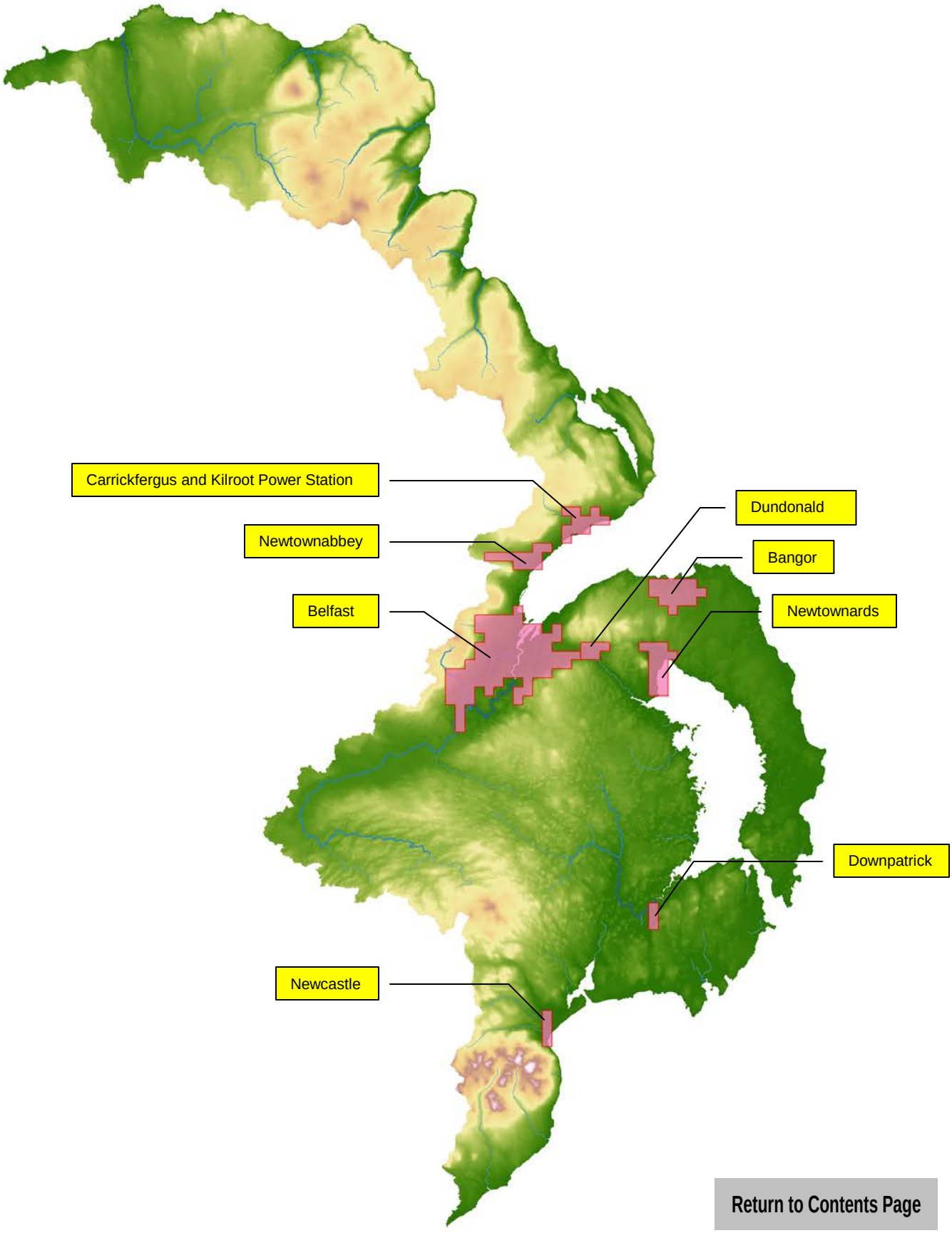

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Figure 5.2 – North Eastern RBD, Significant Flood Risk Areas

5.3 Belfast Significant Flood Risk Area

The geographical extent of the Belfast SFRA, which has been determined through the PFRA, is located within the Belfast Lough and Tidal Lagan Local Flood Management Area and to a lesser extent the Lagan Local Flood Management Area. The boundaries of the SFRA are illustrated in Figure 5.3.1 below.

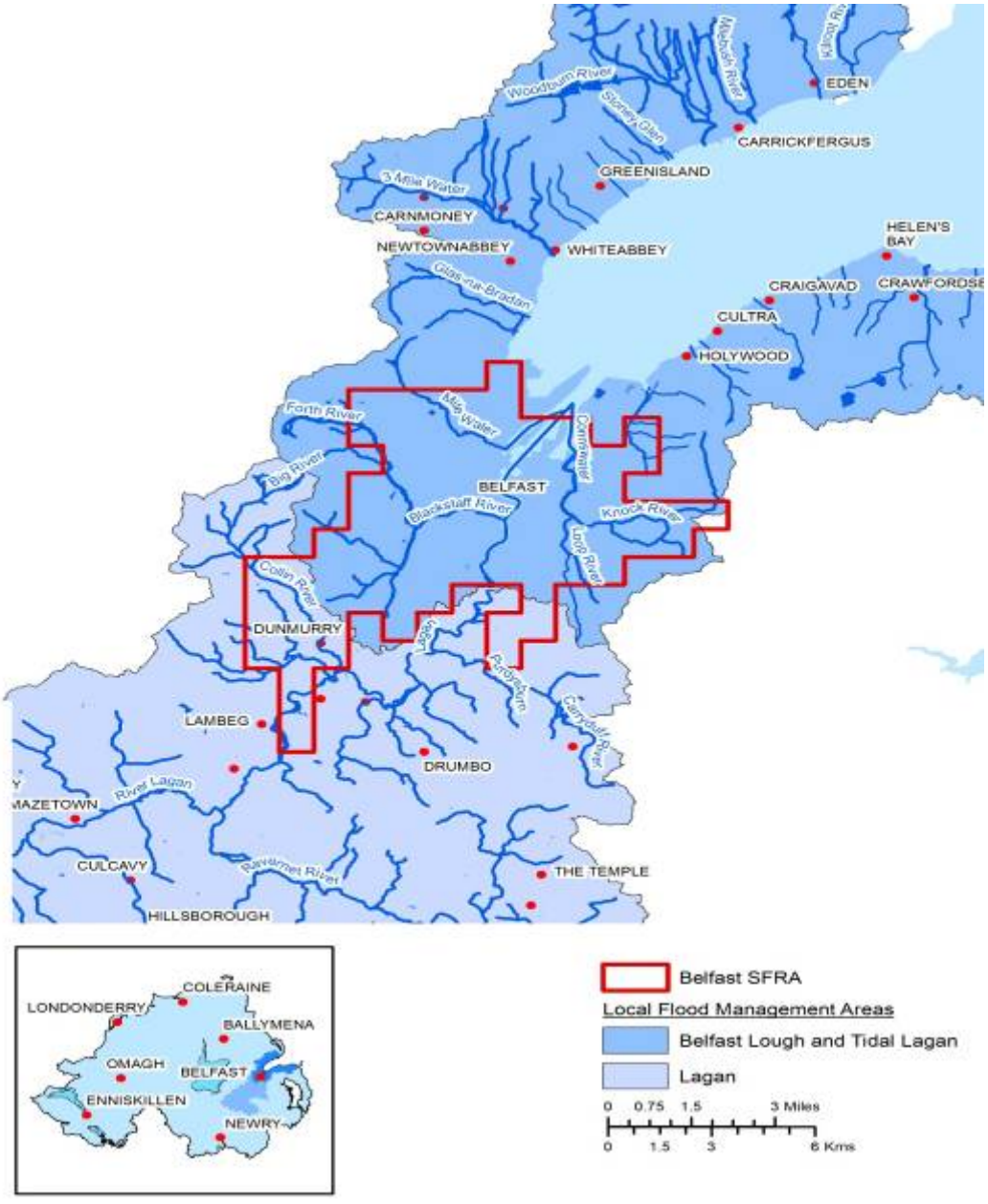

Figure 5.3.1 - Belfast Lough and Tidal Lagan Local Flood Management Area and Belfast SFRA

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5.3.1 Flooding History

Early Significant Flooding

There are documented reports of flooding in Belfast as far back as the 1600s. It is notable that in 1656, the Town Landlord insisted that the Farset River at High Street was '*walled in'* to prevent flooding and, as a result of this work, High Street was raised above its original level by around 1m. Historically, the original wide floodplain of the Blackstaff River was regularly flooded in winter and this extended as far as the Victoria Square and Anne Street areas which would often flood to depths of several feet. There are detailed newspaper accounts of two major floods that occurred in 1901 and 1902. In November 1901 a severe rainstorm, which lasted for two days, coupled with an extreme high tide, caused the River Lagan to overtop its banks at a number of locations and flood extensive low lying areas of the city. This flooding was reported in the Belfast Telegraph as *'beyond any like occurrence for 50 years'*. However, only a year later on 3rd September 1902, Belfast experienced even greater flooding. Many of the main rivers including the Blackstaff, Pound Burn, Connswater and the Farset overtopped their banks and flooded much of the city centre. Again, this was due to a combination of heavy rainfall and high tides. The floods were described in the newspapers as unprecedented, with reports of enormous property damage and the closure of the majority of the mills and factories in the city. In addition to tidal and fluvial flooding, a dam on the Springfield Road burst and spilled to the nearby Blackstaff River causing it to burst its banks. The newspaper estimated that due to the dam burst, a nearby street flooded to a depth in excess of 4m. In many other locations around the city the flood exceeded window levels and standing water ponded to a depth of 1.5m. The Blackstaff was finally culverted in the early 19th century, after which the likelihood and severity of flooding in the city centre area reduced significantly.

There is also evidence of a major flood event that occurred in May 1916 which caused substantial flooding to several parts of the city including Greencastle, the Grosvenor Road and Connswater (see Photograph 5.3.1.1).

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Photo 5.3.1.1 - Belfast Flooding, 25th May 1916

Recent Significant Flooding

On 1st December 2005 an active front moved east across Northern Ireland during the morning and produced several hours of heavy rain in parts of Armagh, Down and south east Antrim. The worst of the rain affected the Belfast area where some parts in the south of the city received 25 to 30mm of rain in a 4 hr period. This rainfall event was estimated to have a return period of around 20 years. The areas most badly affected were the Lower Ormeau Road and Sydenham where floodwater inundated 40 and 12 homes respectively. All of the flooding on this occasion was related to surface water and/or out-of-sewer flooding. Although the rainfall was quite severe, other factors appear to have played a part in the flooding on this occasion. Heavy rain had already fallen in the weeks prior to this extreme rainfall event and as a consequence the River Lagan was higher than normal and a high tide coincided with the period of the heaviest rainfall. In addition, a NI Water pumping station, located in the Lower Ormeau area failed, which resulted in a much reduced ability for the local drainage infrastructure to cope with the run-off.

On 12th June 2007 large parts of Northern Ireland experienced extreme 'summer storms' which were high in intensity and relatively short in duration. The intense rainfall caused widespread flooding in East Belfast. The extent of the flooding was exceptional and rivers, sewers and road drainage systems were overwhelmed leading to 48 separate flooding incidents. Although initial estimates put the number of properties flooded at around 400, Belfast City Council made emergency flood relief payments to 959 homeowners. Therefore,

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given that some homeowners of flooded properties probably didn't claim and the owners of non-residential properties are not eligible for a payment under the SEFA, it is likely that the actual number of flooded properties was substantially higher than 1000. Figure 5.3.1.1, is a 'heat map' that uses the flood relief payments to illustrate the extent to which individual areas within Belfast were impacted by the flooding.

Figure 5.3.1.1 - Belfast Flooding, 12 June 2007 – 'Heat map' produced using Flood Relief

On 16th August 2008 a significant widespread rainfall event affected most parts of the province and it is estimated that between 80 to 100% of the normal monthly average rainfall occurred in a single day. The rainfall depths were typically in the range 40 to 65mm with the greatest accumulation at Portglenone where 75mm was recorded. Although Belfast was worst affected by the flooding, other areas in Antrim, Ballymena, Down, Newtownabbey, Craigavon, Banbridge, Beragh and Castlereagh were also significantly impacted. The newly completed Broadway underpass was flooded to a depth of around 4.6m when a grille blocked on the River Clowney and as a result, the West link closed for 4 days. In addition, more than 100 roads were closed across the province and the Fire and Rescue Service had to rescue people from their cars and homes. There was significant damage to infrastructure, services and property and local councils received in excess of 1600 applications from householders for emergency flood relief payments, around 500 of these relate to property in the Greater Belfast Area. Subsequent to the event, it was estimated that the main

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source of flooding was surface water (pluvial) and that this may have contributed to around 60% of the total damage.

Photograph 5.3.1.2 - Flooding of West Link (Broadway Underpass), 16 August 2008

On 27th June 2012 relatively localised torrential rain affected the Belfast area with around 44mm of rain falling in less than 3 hours. This event was estimated by the Met Office to have a return period of between 50 and 100 years. As with the previous large scale event in 2008, the extreme rainfall overwhelmed drainage/sewerage systems and some urban watercourses. On this occasion it is apparent from the SEFA payments issued to the owners of flooded homes that in excess of 1400 properties flooded. The flood event severely affected parts of South Belfast with significant flooding to clusters of property in the Finaghy area at Kinnegar Road, Locksley Park, Sicily Park, Priory Park, Ashton Park, Greystown and Orchardville.

Following this flooding the Executive asked the Performance and Efficiency Delivery Unit (PEDU) to review the emergency response to this event and make recommendations for improvement. The PEDU report is available on the website of the Northern Ireland Executive at
http://www.northernireland.gov.uk/pedu-review-flood-response-june-2012.pdf

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Coordination of the implementation of the recommendations made in the PEDU report was handled by an Implementation Group, which was chaired by the Chief Executive of Rivers Agency with representatives from DRD, Transport NI, NI Water, DOE, Local Government, OFMDFM and NI Direct.

In April 2013 PEDU prepared a *'Follow up Report on Review of Response to Flooding on 27 & 28 June 2012'*. The Executive agreed the follow up report without amendment on 4 July 2013.

3rd January 2014 - There hasn't been any significant flooding in Belfast within living memory that can be solely attributed to the sea with certainty. There have however, been a number of near misses; the most recent of which occurred on 3 January 2014. On this occasion the UK Coastal Monitoring and Forecasting Service, which provides tidal information and level alerts to Rivers Agency, gave advance warning of a predicted extreme tidal surge for Belfast Lough and the rest of the Northern Ireland coastline. This alert triggered a major flood emergency response to prepare for the possibility of serious flooding from the sea. The response was led by the PSNI and involved a number of bodies, including Local Government, Rivers Agency, the Office of the First Minister and Deputy First Minister, Northern Ireland Fire and Rescue Service, Transport NI, NI Water, Belfast Health Trust, NI Electricity, British Telecom and Translink. In this instance a major flood event was narrowly averted. The tide peaked at around 2.75m OD which, as can be seen from the photographs below, is only a few centimetres below the top of the various sections of the walls and embankments, which act as a form of coastal defence to low lying areas of the city centre. Although the sea did not actually overtop the quasi defence structures on this occasion, the emergency response operation, led by the PSNI, was considered a success.

Photograph 5.3.1.3 - Belfast Harbour – Tidal Event 3rd January 2014

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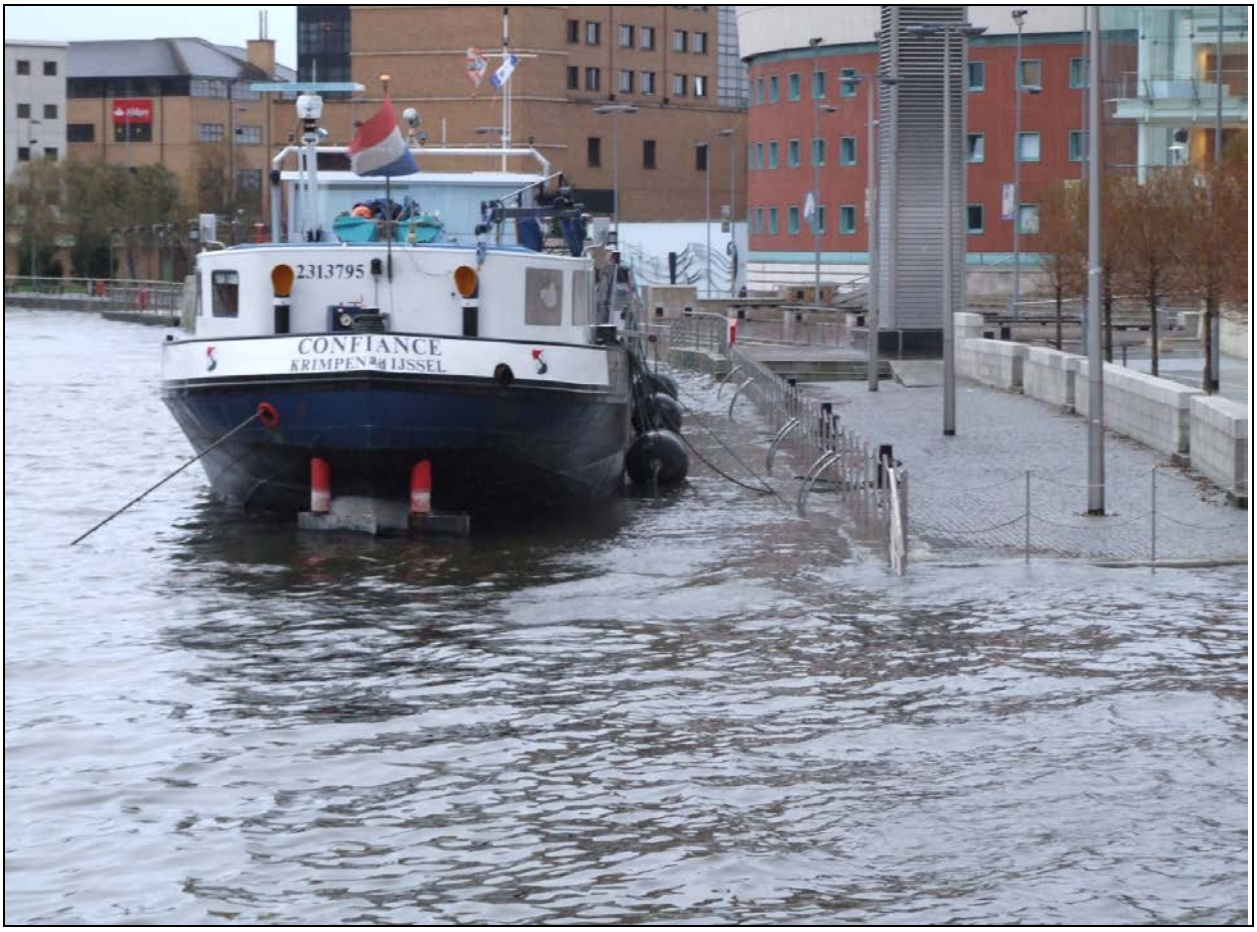

Photograph 5.3.1.4 - Belfast Harbour – Tidal Event 3rd January 2014

Therefore, on the basis of the flood history alone, Belfast is evidently at significant risk of flooding from rivers, surface water, urban drainage systems and the sea.

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Existing & Ongoing Flood Protection Works

The Blackstaff River System

The Blackstaff River system rises in the Belfast Hills to the south and west of Belfast and approaches the city from the south-west. In the 1950s, the Belfast Corporation constructed the 2.2 km long Blackstaff Relief Culvert, which consists mainly of tunnel and runs from Broadway through the Botanic Gardens to discharge to the River Lagan at the Stranmillis. With a 13ft diameter, it is one of the largest river culverts in Belfast and diverts around half of the extreme flows from Blackstaff and Clowney River catchments away from the city centre to outflow safely into the River Lagan. The construction of the relief culvert has significantly reduced the likelihood of flooding to the inner city from the Blackstaff River.

In the 1980s, DARD Rivers Agency undertook a major study of the Blackstaff River and its tributaries. The study resulted in the Lower Blackstaff River Flood Alleviation Scheme which was aimed at reducing the flood risk to an area around Great Victoria Street and Grosvenor Road which had flooded in the 1960s and 70s and an extensive area around the city Hall, Donegall Place, and Chichester Street which was predicted to be at risk. The Scheme involved the construction of large reinforced concrete 'box' culverts on the Lower Blackstaff, from the West Link dual carriageway through the city centre to connect with existing twin brick-arch culverts lower down the system at Dublin Road. It replaced existing inadequate underground culverts which were undersized, hydraulically inefficient and structurally unsound. It was also of an environmental benefit as it culverted reaches of industrialized, heavily polluted open watercourse. The Scheme availed of a 'window of opportunity' to utilize a clear construction path through the city centre which is now no longer available due to commercial development of the city centre.

Farset – Glenwood River System

In the past 30 years or so, several schemes to upgrade and improve the Glenwood and Farset culverted systems from a flood alleviation perspective, have been carried out. These have been undertaken as distinct flood alleviation schemes or, when opportunities arose, through culvert replacements which could be included within planned road upgrading works. During this process, a multitude of old brick and masonry arch conduits, previously used to feed water from the Farset to industry, have been rationalized and abandoned and so the River Farset now has a more defined drainage path and its culverts are in better structural condition. However, its culverted reaches upstream of Crumlin Road have not received the same degree of upgrading and flood risk in this area remains a concern.

The construction of the West Link dual carriageway in the 1970s and early 1980s impacted significantly on the culverted Farset River because the new road cut through the river at a point where the roadway required an underpass. A bifurcation was constructed on the upstream side adjacent to the proposed road and the Farset flow was split in two directions - eastwards along the normal course of the River and southwards into the new

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Pound Burn culvert system. This system connects Farset flows to the Lower Blackstaff River at the Translink bus and rail station just south of Grosvenor Road; hence substantial flows from the Farset can be diverted into the Lower Blackstaff system. The normal course of the River towards the city centre had to be diverted significantly to cope with the West Link alignment. Downstream of the West link, the Farset flows eastwards into Belfast and its flow capacity has been considerably constrained because of the hydraulics and inadequacies of its culverts. It is also impacted upon by tidal conditions in its lower reaches. Therefore, the ability of the Farset to vent flood flows is dependent on capacity in the Lower Blackstaff system because of their inter-connection via the Pound Burn.

NI Water Belfast Sewers Project

Belfast's sewer network which dates back to the Victorian era, had been suffering as a result of sustained under-investment coupled with inadequate capacity due to Belfast's continued expansion. To address this problem, NI Water undertook a major £160 million Stormwater Management project called 'The Belfast Sewers Project'. The main project involved the construction of a tunnel, approximately 10 Km in length and up to 4 metres in diameter, starting at Cromac Street and ending at a terminal pumping station sited adjacent to the Belfast Wastewater Treatment Works in Duncrue Street. The aim of this project was to provide improvement to water quality in both the River Lagan and Blackstaff River while reducing the risk of flooding within the inner city. It also incorporated the rehabilitation and upgrading of the sewer network to ensure compliance with European Union environmental standards. The project was completed in 2010 and has benefitted residents and businesses through reduced risk of flooding, enhanced water quality in the River Lagan, and an efficient sewerage infrastructure for future economic development in Greater Belfast

East Belfast Flood Alleviation Scheme (ongoing) - Connswater, Knock and Loop River

The extensive upgrading works which have been undertaken in the 1980s and 1990s on the Blackstaff and Farset systems have provided flood alleviation benefits in north and west Belfast. However, until the current decade, East Belfast had not received a similar level of investment to upgrade river systems for flood alleviation purposes. Since the year 2000 there has been recurring flooding in East Belfast around Ladas Drive, Castlereagh and Orangefield areas. Development around the periphery of, and infill within East Belfast, has increased flows in these rivers and caused serious flooding to homes and commercial properties during adverse weather conditions. The Connswater outfall to Belfast Lough at Sydenham is subject to a strong tidal influence and presents a serious flood risk to the adjacent residential area at Sydenham which is at risk of inundation during extreme high tides. Flooding of this area due to an extreme tidal surge was narrowly avoided in January 2014. This heavily developed area is also susceptible to flooding due to its proximity to the Sydenham Wastewater Pumping Station. This WwPS has suffered a number of technical failures in recent years that have caused serious flooding to homes in the immediate vicinity.

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The significant flood risk to this area is being addressed through the ongoing East Belfast Flood Alleviation Scheme (EBFAS) which is aimed at reducing the flood risk to an estimated 1700 properties. DARD, Rivers Agency is investing £11 miilion to deliver the EBFAS in partnership with Connswater Community Greenway (CCG) project. The CCG project has been developed by the East Belfast Partnership and is being delivered with the Belfast City Council. The CCG which is estimated to cost around £40 million will create a 9km linear park along the course of the Knock, Loop and Connswater rivers; creating safer, cleaner and greener space, whilst connecting people and places. For more information on the CCG project visit its website at http://www.communitygreenway.co.uk/

Significant elements of the EBFAS works are located within the same geographical envelope of the CCG works. Therefore, it was decided that where practicable the flood mitigation works should be packaged with the CCG works and undertaken through construction contracts managed by Belfast City Council. By adopting this collaborative approach it has been possible to effectively deliver the respective environmental and flood alleviation objectives, achieve value for money and minimise disruption to the local communities and businesses affected by the works.

The CCG works which include elements of the EBFAS were split into two phases:

Phase 1, which includes flood mitigation works at Orangefield Park and Victoria Park are completed. Flood Alleviation works within Orangefield Park comprised earth flood banks, retention ponds, flood walls and most importantly, included the diversion of the Knock River into a new two stage channel in the middle of the Park. Within Victoria Park the landform was reshaped to include the creation of earth bunds that cut-off potential tidal flow paths to the Sydenham area.

Phase 2, which is ongoing, includes extensive flood alleviation works at numerous discrete locations on the Connswater, Knock and Loop Rivers and typically includes the construction of flood banks and flood walls (most notably at the lower reaches of the Connswater). The anticipated completion date for Phase 2 is December 2016.

In addition Rivers Agency is managing a ‘stand alone’ contract for a significant portion of the flood alleviation scheme at locations where there was minimal interaction with the CCG project. This contract focuses mainly on upgrading the flow carrying capacity of the Loop and Knock rivers and their tributaries at major road crossings. It is anticipated that these works will be completed early in 2016.

The Lagan Weir

The Lagan Weir is located between the Queen Elizabeth Bridge and the M3 Bridge and was constructed in 1994 by the Laganside Corporation. This non-governmental public body was established to create

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momentum for the regeneration of a largely derelict waterfront area alongside the River Lagan in Belfast city centre. The river is tidally influenced downstream of the Stranmillis Weir and, before the construction of the Lagan Weir, the water level in this section of the river varied by up to three metres during a tidal cycle. The main reason for the construction of the Weir was to impound water throughout this reach and cover the mudflats that were exposed at low tide, as these were unsightly and emitted a strong odour, particularly in the summer months.

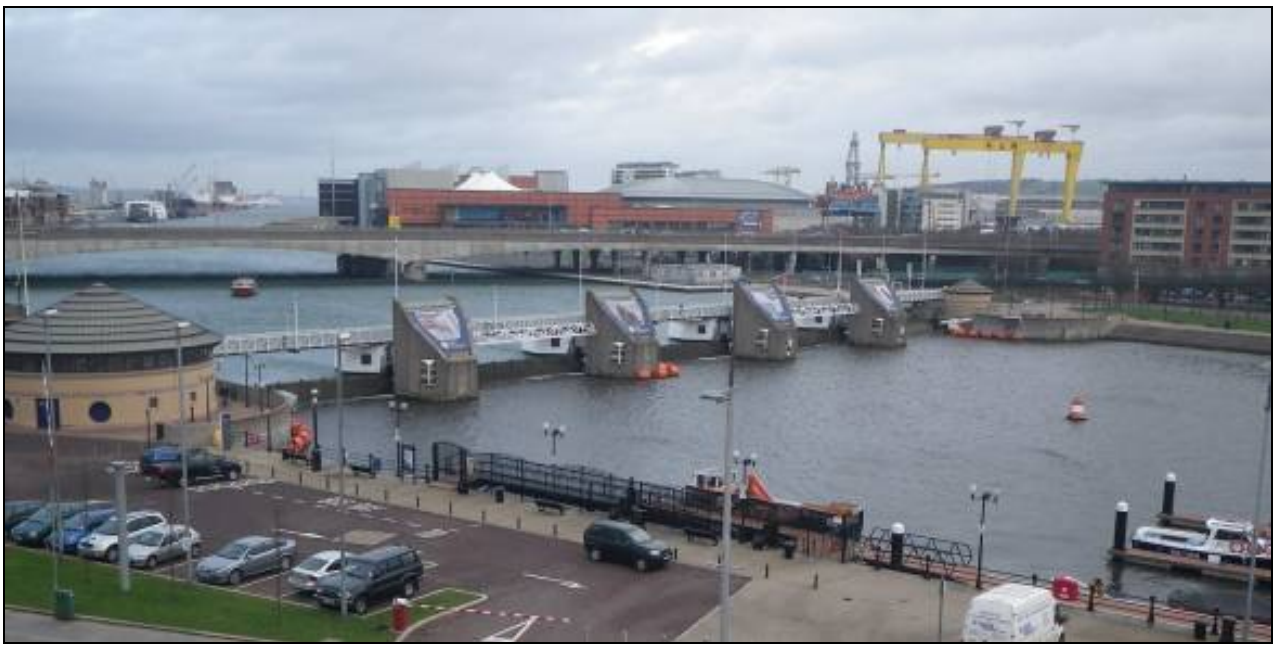

Figure 5.3.1.5 - Belfast SFRA – Lagan Weir

During normal tidal and river flow conditions the Weir gates are raised on each falling tide to impound the river upstream. The gates are then lowered when, on the next tidal cycle, the sea level rises above the impounded control level for the river. The Weir gates create an impoundment between Donegall Quay and Stranmillis Weir which reduces the tidal range from 3.1m to around 1.2m for spring tides. The construction of the Weir created an attractive riverside environment which proved to be the catalyst for private investment to redevelop the area. The Laganside Corporation was dissolved in 2007 and the Weir is now owned and operated by the Department of Social Development (DSD).

Although here are no formal flood defences along the frontage to the tidal reaches of the River Lagan, the city is protected from tidal inundation to some degree by a combination of dock walls and raised channel-side revetments. The Lagan Weir also plays a limited role in protecting upstream areas (around Annadale and Stranmillis Embankments) from tidal and/or fluvial flooding and DSD controls the gates to an operating regime that has been agreed with Rivers Agency to minimise the risk of flooding. As part of the ongoing

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Belfast Tidal Flood Risk Study (see section 5.3.5 for details), the possibility of raising the Weir gates above their normal level of 3.0m OD by around 200mm to 300mm is being examined. If this is technically possibly, the Lagan Weir could be used as a tidal barrier to protect residential areas upstream at the Annadale and Ormeau embankments from extreme tidal events up to and including the 1 in 200 year event.

5.3.2 PFRA – Identification of Potentially Significant Flood Sources

According to the Preliminary Flood Risk Assessment (Dec 2011) the city of Belfast, in terms of the potential adverse consequences of flooding, is ranked highest of the twenty SFRA within Northern Ireland (see Figure 4.1). On the basis of this initial assessment, which was undertaken using the Strategic Flood Maps, it was determined that the city was potentially at significant risk from both tidal and fluvial flooding. It was predicted that a large proportion of the city centre lay within the 'undefended' 1 in 200 year coastal floodplain and as many as 8000 properties were potentially at risk of flooding from the sea. The extent of the strategic coastal flood plain is illustrated in Figure 5.3.2.1 below.

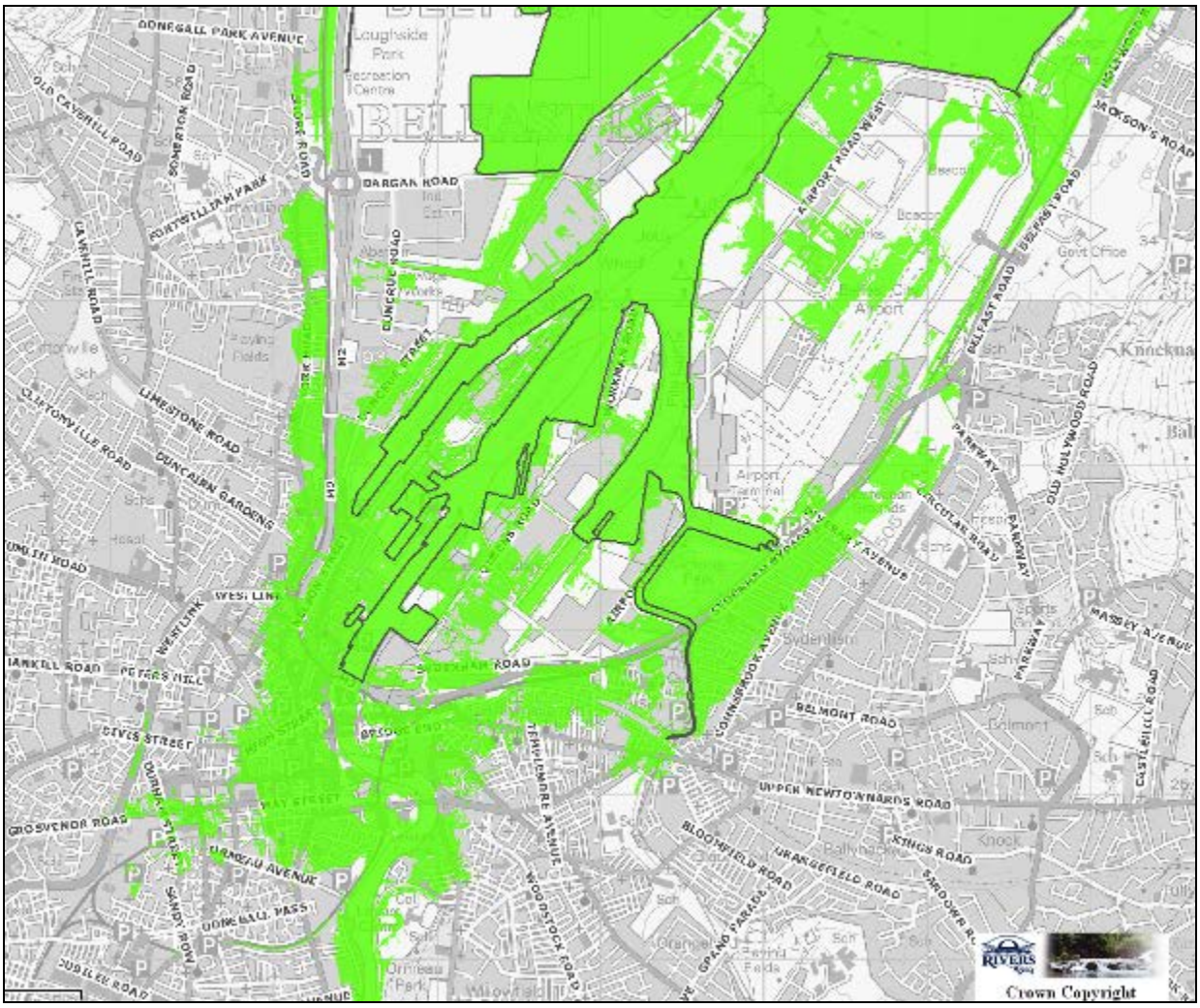

Figure 5.3.2.1 - Belfast SFRA – Undefended Coastal Flood Plain, Strategic (0.5% AEP) 1 in 200 yr

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The extents of the fluvial floodplains, predicted using the strategic models developed for the rivers and watercourses in the Belfast area, are shown in Figure 5.3.2.2. On the basis of this initial assessment, it was estimated that up to 9,800 properties were potentially at significant risk of flooding from rivers. The assessment also indicated that around 6,000 of this number would be at risk of flooding from both rivers and the sea and almost all of these are located within the floodplain of the tidally influenced lower reaches of the River Lagan. Apart from the River Lagan, the other main watercourses that were estimated to contribute substantially to the overall flood risk to property are the Connswater River and its tributaries (Knock River & Loop River) in the east of the city and in the west, the Blackstaff and Clowney rivers and their tributaries

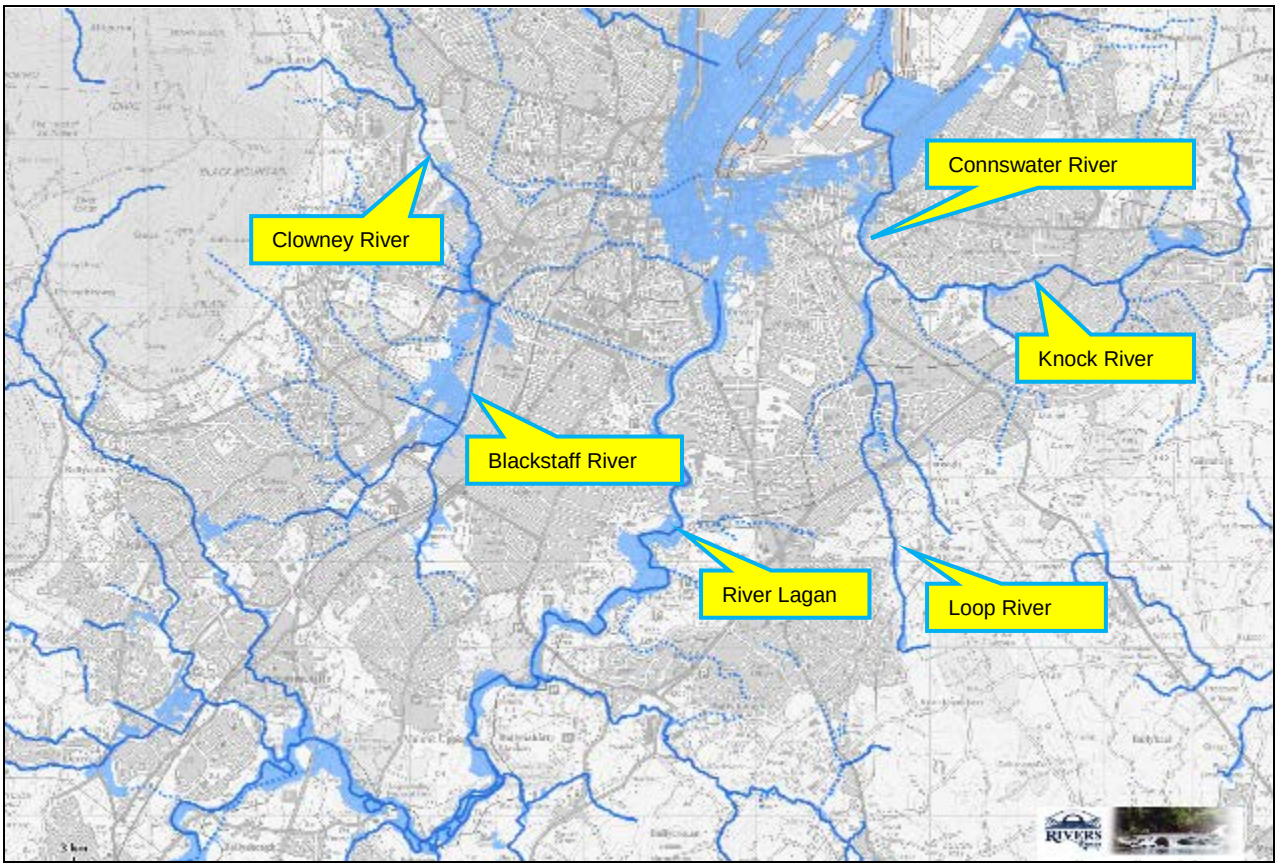

Figure 5.3.2.2 - Belfast SFRA – Undefended Fluvial Flood Plain, Strategic (1% AEP) 1 in 100 yr event

5.3.3 Catchment Description

Belfast, the capital of Northern Ireland, is the largest settlement in the region. It is located at the head of Belfast Lough in the valley of the lower reaches of the River Lagan. It lies in a basin that is flanked to the northwest by the escarpment of the Antrim Plateau and to the southwest by the more gentle slopes of the Castlereagh and Hollywood Hills. The development of the city began in the 17th century, with the early

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settlements established around the mouth of the river to serve as a port and market place for the surrounding areas. As the city has expanded over the centuries, so too has the harbour and today the walls of the various docks and channels, which fringe the extensive harbour area, form a significant the proportion of the Belfast frontage. Although Belfast has no formal sea defences the dock walls at the harbour and channel-side revetments of the rivers serve as a quasi coastal defence which protects extensive low lying areas of the city centre from flooding, in all but the more extreme tidal events.

From a drainage aspect, Belfast is dominated by the River Lagan and its tributaries. The Lagan, which is around 70km long rises on the western slopes of the Slieve Croob Mountains near Dromara (County Down) and drains an area in excess of the 600km^2. It flows from its source in a westerly direction through Donaghcloney after which it turns steeply and continues in a north easterly direction, through Lisburn and on to its tidal outlet at Belfast Lough. Although the river is tidally influenced downstream of the Stranmillis Weir in Belfast, this influence has been limited to extreme high tides only, due to the construction of the Lagan Weir (see previous section for details).

Within the city, various tributaries feed into the River Lagan from the west and the east. The East Belfast catchment covers an area of 26km^2 and the two main watercourses draining this area are the Loop River and Knock River which combine to form the Connswater which discharges into the Musgrave Channel in Belfast Harbour. The West Belfast catchment is approximately 55km^2 and the main watercourses draining this area are the Blackstaff and the Farset, which rise in the hills to the north of the city. Within the urban extents of the city, almost all of main watercourses and their tributaries are heavily modified and partially culverted, while those on the west side are substantially culverted.

5.3.4 Coastal Flood Risk Assessment

Belfast Lough Flood Model and Levels

For the purposes of producing detailed flood hazard mapping for the tidal inundation of Belfast , the extreme sea water levels for a range of return periods were derived using the methodology described in the Rivers Agency's report *Strangford and Belfast Extreme Tides Boundary Condition (August 2009)*. The table at Figure 5.3.4.1 below gives the estimated value of the extreme sea levels for a range of scenarios. It should be noted that the Rivers Agency's normal design standard for sea defences is to protect to the 1 in 200 year level with appropriate freeboard.

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	Belfast Lough – Belfast Estimated Extreme Water levels	
	Annual Exceedance Probability - (Return Period)	**Extreme Water Level (m OD)**
Present Day	10% AEP - (1 in 10 year)	2.50
	1% AEP - (1 in 100 year)	3.07
	0.5% AE - (1 in 200 year)	3.17
	0.1% AEP - (1 in 1000 year)	3.30
Year 2030	10% AEP - (1 in 10 year)	2.57
	1% AEP - (1 in 100 year)	3.14
	0.5% AEP - (1 in 200 year)	3.24
	0.1% AEP - (1 in 1000 year)	3.37
Year 2100	10% AEP - (1 in 10 year)	3.24
	0.5% AEP - (1 in 200 year)	3.92
	0.1% AEP - (1 in 1000 year)	4.05

Figure 5.3.4.1 - Belfast SFRA – Belfast Lough, Estimated Extreme Water Levels

Using these tidal boundary conditions the tidal simulations for Belfast Lough and the lower, tidally dominated reaches of the River Lagan and Connswater River, were undertaken using an Infoworks RS 2D model for the tidal frontage combined with 1D models for the rivers. The details of this model development and its results are contained in Rivers Agency's *Belfast Tidal Modelling – Hydraulic Modelling Technical Report (July 2012)* and copies this report are available on request.

The tidal flood model was run for six tidal surge scenarios for both the present day and predicted future 2030 year sea level and climatic conditions. The scenarios modelled included the predicted T10 (i.e. 1 in 10 year), T50, T75, T100, T200 and T1000 tidal surge water level profiles combined with 1 in 2 year fluvial event in the River Lagan and Connswater. A selection of the tidal hazard maps which include the present day T10, T200 and T1000 are available through the Flood Maps NI.

Tidal Flooding Mechanisms

It is evident, from the improved tidal hazard flood maps, that the Strategic Flood Maps used for the PFRA overestimated the geographical extent of the tidal flood inundation areas for Belfast. The main reason for this difference is simply that the improved tidal model is much more accurate than the strategic model. The

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strategic model assumed that all land behind the quay walls and channel revetments, that is lower in elevation than the estimated sea water level, would flood with water to the same height as the tide. However, this simplified approach took no account of the fact that these raised structures effectively act as a weir and that the sea flows over these raised structures only for a limited period at the 'top' of the tidal cycle and not for long enough for all of low lying areas to flood to the same height of the extreme high tide. This 'real world' flooding mechanism is fully represented in the improved tidal model and results in a substantial contraction of the predicted extents of the flood inundation areas, when compared with those produced by the strategic model for extreme events with the same return period.

For the most part, the height of the Belfast frontage (which is comprised of the quay walls and channel-side revetments on the River Lagan) is typically greater than 3.0m OD, although there are a number of distinct areas where the levels dip to as low as 2.7m OD. Behind the frontage there are vast areas of the city centre and other areas to the east, as far as Victoria Park, that are very much lower than the frontage, in some cases up to 2m lower. This low lying basin is occupied by some of the province's most valuable commercial/retail property and some residential areas with extremely high density housing.

A number of computerised animations to illustrate where the Belfast frontage is predicted to breach during extreme tidal events and how the floodwater travels across the surface and ponds in the low lying areas, are currently available on the internet through the Vimeo website at http://vimeo.com/floodriskmanagementni/videos .

Figure 5.3.4.2 below illustrates the geographical extents of each of the discrete areas that are at risk from inundation at the 0.5% AEP (1 in 200 year) tidal surge event.

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Belfast SFRA – Main Tidal Flood Zones

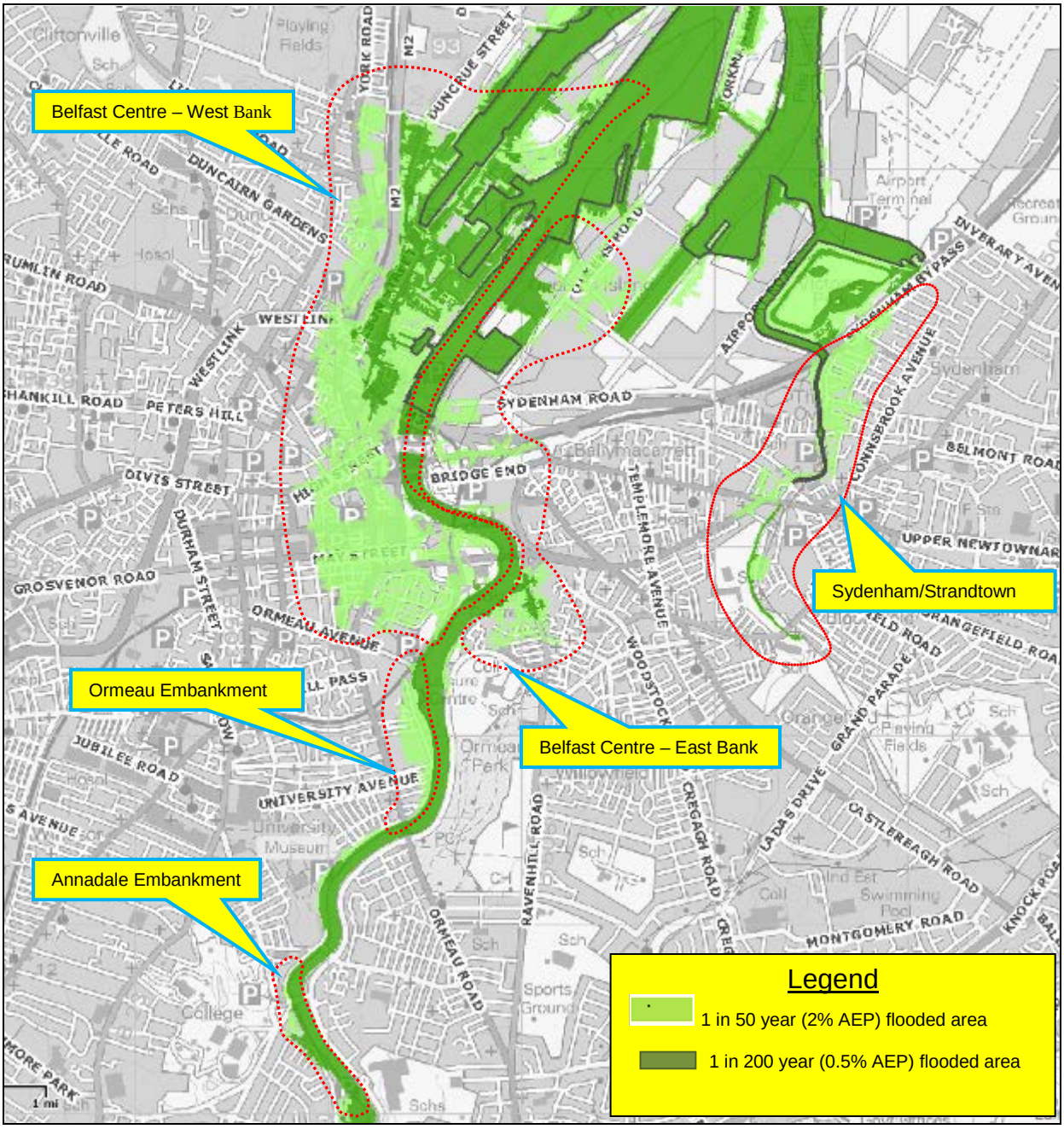

Figure 5.3.4.2 - Belfast SFRA – Main coastal flood inundation areas (1 in 200 year event)

The developed areas in Belfast that are prone to flooding due to tidal inundation, together with a description of the flooding mechanisms are as follows.

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Belfast Centre – West Bank

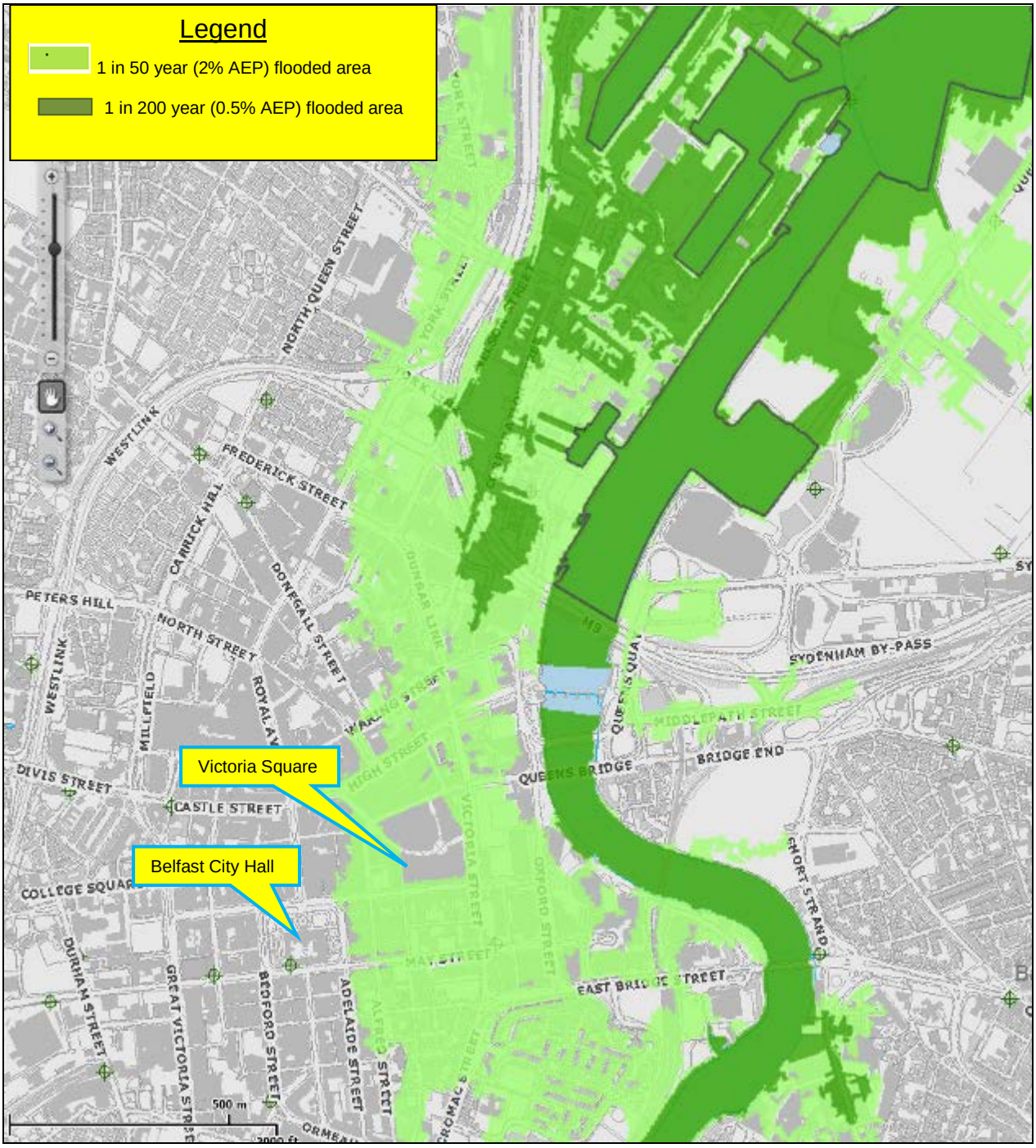

Figure 5.3.4.3 - Belfast SFRA – Tidal Flood Plain (1 in 200 year event) - Belfast Centre West

Although the model indicates that shallow flooding to a small number of commercial properties in the immediate vicinity of the docks is estimated to occur at the 1 in 10 year event, it is not until the 1 in 50 year that a substantial breach of the tidal frontage occurs. At this extreme event the spill- over points are limited

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to a few localised low spots in the quay walls at the Pollock Dock and York Dock. Having spilled over the walls the floodwater flows south and ponds to a shallow depth at a number of locations within the general area between the frontage, the M2 Motorway to the west and the M3 to the south. At the more extreme 0.5% AEP (1 in 200 year) tidal event, the sea spills over the frontage at numerous locations from Donegal Quay to the Pollock Dock as many sections of the quay walls are lower than the estimated peak tide level of 3.17m OD. At the 1 in 200 year event it is estimated that an area of around 2km^2 within the city centre will be inundated to depths in excess of 2m. Flooding will affect the heart of the retail/commercial centre including the Victoria Square and residential areas such as the Markets and Sailor Town. The potential adverse consequences of the predicted future floods for a range return periods are recorded in Table 5.3.1.3 which shows that the estimated property damages due to future floods have a present day value of around £29m.

Ormeau Embankment

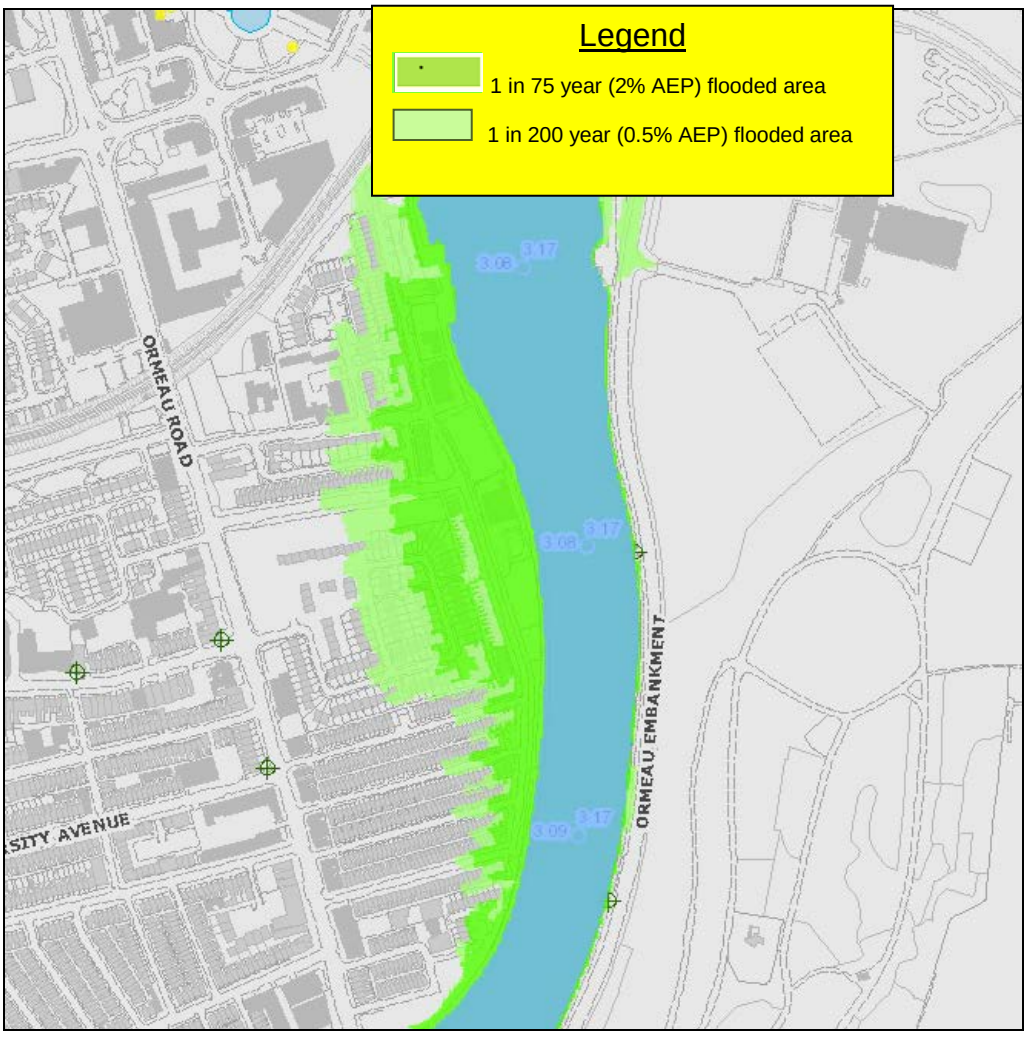

Figure 5.3.4.4 - Belfast SFRA – Tidal Flood Plain (1 in 200 year event) – Ormeau Embankment

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The model predicts that at the 1.33% AEP (1 in 75 year) tidal event floodwater begins to overspill the left bank of the lower (tidal) River Lagan between the Ormeau Road Bridge and the railway embankment at Cromac Springs. The height of the cycle path which fronts this section of the river is generally less than 2.8m OD and can therefore be overtopped throughout its length by all tidal events with return periods in excess of the 1 in 75 year event which has an estimated peak level of 2.93m OD. Behind the immediate frontage area, which is occupied by a row of recreational buildings and playing pitches, the land is markedly lower by up to 1m and occupied by high density terraced housing. Although flooding at the 1 in 75 year event is limited to a few residential properties, there is a marked increase to around 100 properties at the 1 in 100 year event and at the 1 in 200 year event it is estimated that as many as 272 residential and 5 non-residential properties will flood to depths of up to 2m. The estimated cost of the property damages due to potential future floods have a present day value of around £918k.

Annadale Embankment

The model predicts that at the 10% AEP (1 in 10 year) tidal event, floodwater first begins to overspill the frontage of the tidal River Lagan at a number of locations along a section between the QUB Boat Club and the Belfast Boat Club 600m upstream. At this relatively high frequency event, flooding is limited to the boat houses and surrounds of the various rowing clubs that occupy this section of the frontage and to around 10 terraced houses opposite the Cutters Wharf bar/restaurant. Although the extents of the predicted inundation area increases with the severity of the tidal events, even at the 1 in 200 year event the flooding is fairly tightly constrained within a narrow corridor and is estimated to adversely affect 41 residential properties and 9 non-residential properties. The estimated cost of the property damages due to potential future floods have a present day value of around £532k.

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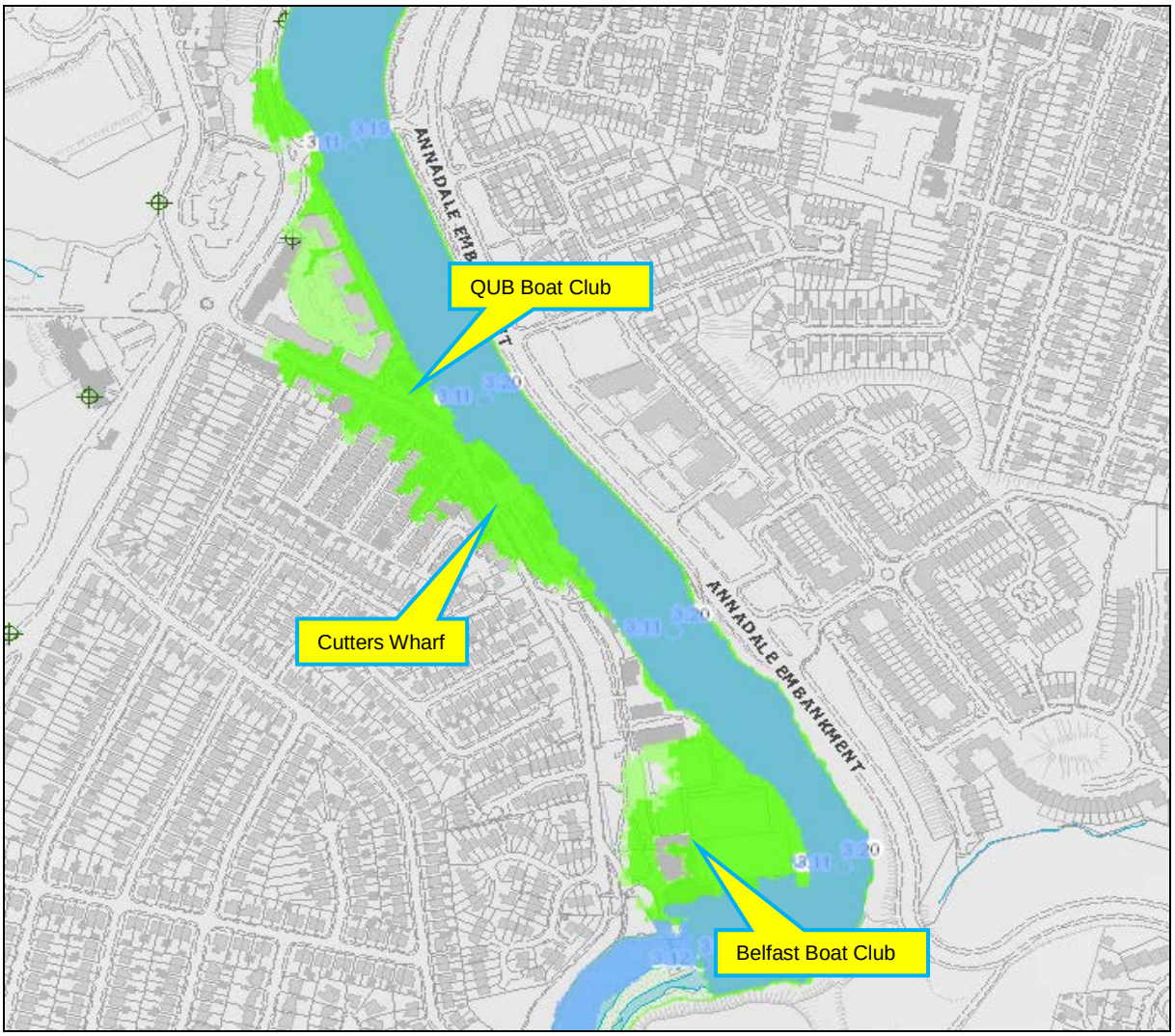

Figure 5.3.4.5 - Belfast SFRA – Tidal Flood Plain (1 in 200 year event) – Annadale Embankment

Sydenham, Strandtown

The Connswater River is tidally dominated in its lower reach from the Connswater Bridge at the Newtownards Road to its sea outfall at the Musgrave Channel behind Victoria Park. There are no formal flood defences along the Connswater River; however the raised embankment surrounding Victoria Park is an informal defence which provides some resistance against the inundation of the park and the subsequent flooding of the Sydenham estate.

The model predicts that flooding of Victoria Park commences at the 2% AEP (1 in 50 year) tidal event via a low spot in the embankment at the north-eastern corner and is overtopped more generally at the 1 in 75 year event. As the water level in Victoria Park rises, it begins to flow through a subway under the Sydenham Bypass and inundates large areas of the Sydenham estate which contains high density terraced housing.

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Floodwater at is also predicted to overspill the right bank of the lower Connswater from Hollywood Arches to the Sydenham Road Bridge some 750m downstream. The footpath running along this section of the bank sits on top of a raised embankment which is at least 1m higher than the ground level of the residential area which is located immediately behind. However, as the level of this raised bank is typically around 2.85m OD it is predicted to be overtopped by all tidal events equal to or more extreme than the1 in 75 year event which has an estimated height of around 3m OD. The photo below illustrates how close the embankment was to overtopping during the tidal surge event in January 2014 which peaked at around 2.75m OD. It is estimated that at the 1 in 200 year tidal event the floodwater overspilling the right bank of the lower Connswater will inundate a residential area that extends to around 0.17km^2 and cause flooding to around 500 homes and 50 commercial and retail properties.

Photograph 5.3.4.1 - Lower Connswater (looking upstream) – Extreme Tidal Event - 3 January 2014

There is also predicted to be flooding to property due to overtopping of the left bank in the vicinity of the culvert outlet at the Ballymacarrett Walkway; although this is limited to around 20 properties in the vicinity of the Newtownards Road/ Connswater Street Junction. In total, the estimated cost of the property damages due to potential future floods at the Sydenham/Ballyhackamore area described above have a present day value of around £2.35m.

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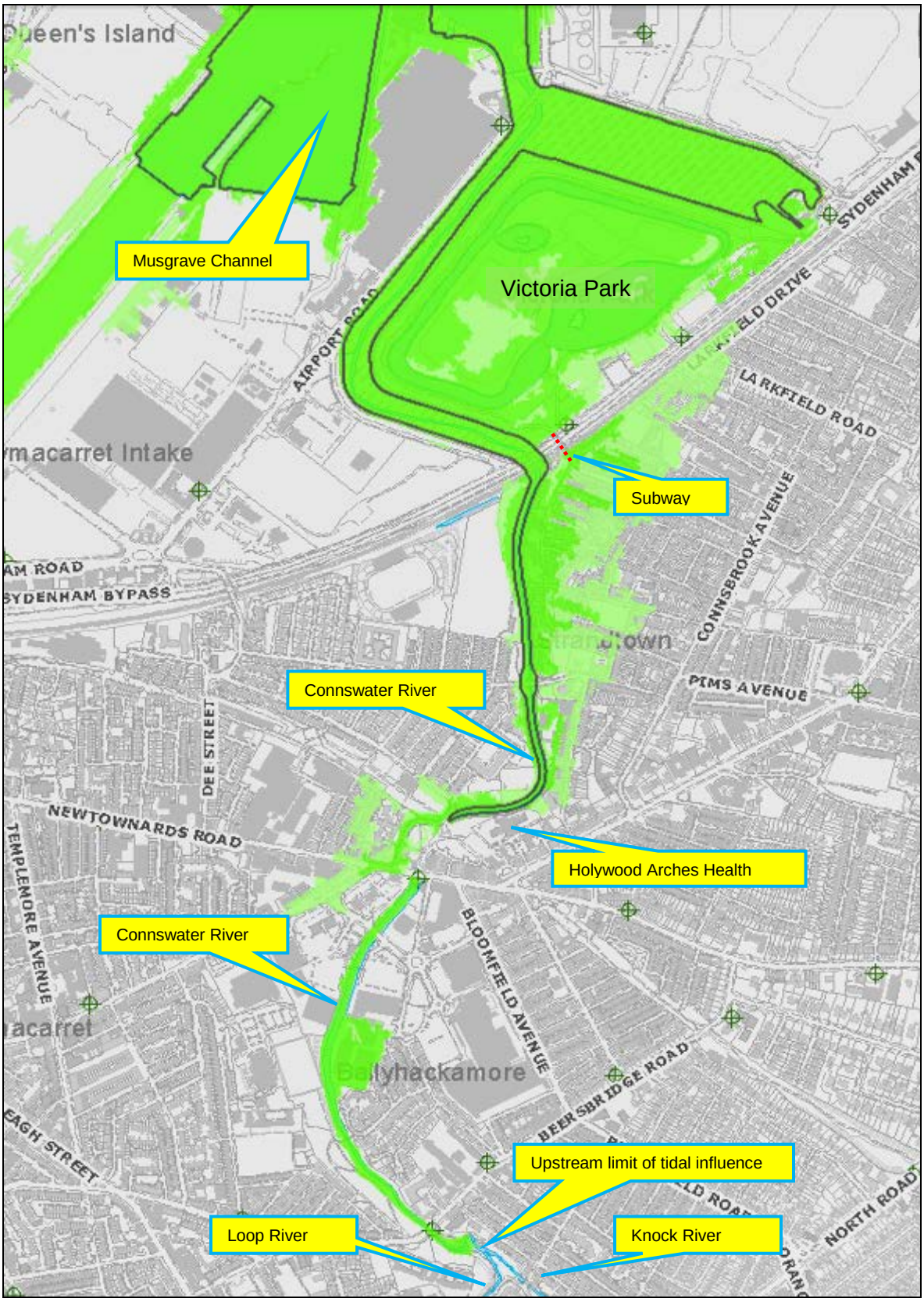

Figure 5.3.4.6 - Belfast SFRA – Tidal Flood Plain (1 in 200 year event) – Sydenham/Strandtown

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Belfast Centre – East Bank

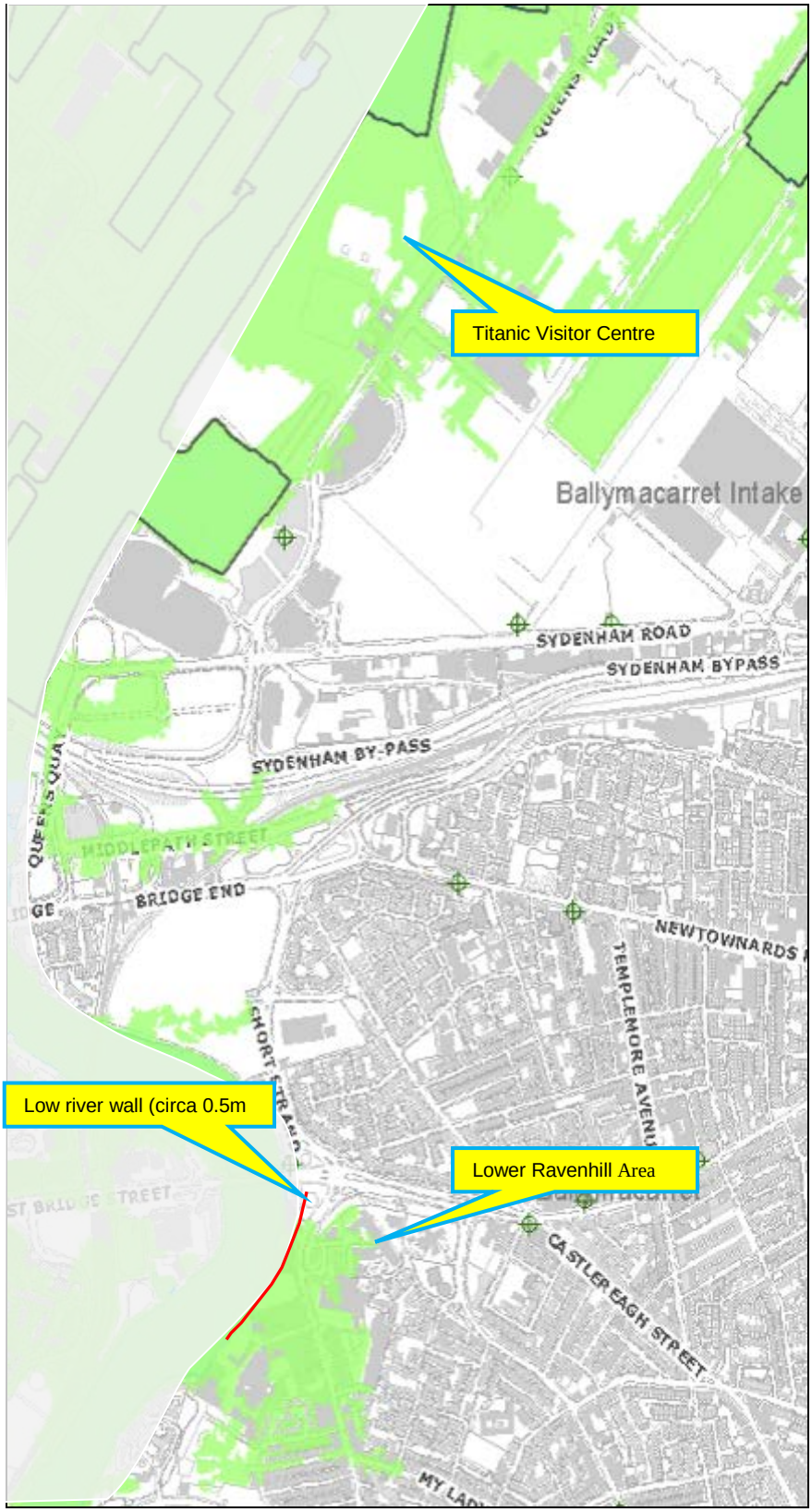

Figure 5.3.4.7 - Belfast SFRA – Tidal Flood Plain (1 in 200 year event) – Belfast Centre, East Bank

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Flooding on the east side of the harbour area and tidal Lagan is limited to Queens Island and the lower Ravenhill Road. Floodwater is predicted to overspill the walls of the various wharfs and quays which fringe the east side of Queen's Island at the 1% AEP (1 in 100 year) tidal event. The flooding, even at the 1 in 200 year event, is predicted to be shallow (less than 300mm deep) and mainly limited to hardstanding areas which are sparsely occupied by warehouses and, perhaps most notably, the Titanic Visitor Centre. The flooding at the lower Ravenhill Road arises from the overtopping of a low section of river wall on the right bank of the River Lagan immediately upstream of the Albert Bridge. It is predicted that floodwater will overspill this wall (which has a height of around 2.5m OD) at the relatively 1 in 50 year event and cause limited shallow depth flooding to the Ravenhill Business Park. At the 1 in 200 year event, the extent of the flood inundation zone is predicted to spread significantly to include a substantial residential area in the vicinity of Ballarat Street. It estimated that 75 homes and 86 non-residential properties are at risk of flooding at the Lower Ravenhill Road and that the cost of the property damages due to potential future floods have a present day value of around £2.22m.

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Table 5.3.4.1	Belfast SFRA		
Potential Adverse Consequences – Coastal Flooding			
Belfast Centre – West Bank			
	Flood Event % AEP		
	10% AEP	0.5% AEP	0.1% AEP
Residential (Nr)	0	621	794
Non Residential (Nr)	13	713	858
Economic Damage (£)	£180k	£74.4m	£128.9m
Annual Average Damage (£)	£968k		
Present Value (£)	£29m		
Connswater – Sydenham/Strandtown			
	Flood Event % AEP		
	10% AEP	0.5% AEP	0.1% AEP
Residential (Nr)	0	525	1226
Non Residential (Nr)	0	50	90
Economic Damage (£)	0	£3.6m	£20.6m
Annual Average Damage (£)	£78,319		
Present Value (£)	£2.35m		
Belfast Centre – East Bank			
	Flood Event % AEP		
	10% AEP	0.5% AEP	0.1% AEP
Residential (Nr)	1	75	132
Non Residential (Nr)	9	86	132
Economic Damage (£)	£306k	£2.25m	£3.77m
Annual Average Damage (£)	£74,060		
Present Value (£)	£2.22m		
Ormeau Embankment			
	Flood Event % AEP		
	10% AEP	0.5% AEP	0.1% AEP
Residential (Nr)	0	272	317
Non Residential (Nr)	0	5	7
Economic Damage (£)	0	£3.58m	£4.57m
Annual Average Damage (£)	£30,615		
Present Value (£)	£918k		
Annadale Embankment			
	Flood Event % AEP		
	10% AEP	0.5% AEP	0.1% AEP
Residential (Nr)	10	41	53
Non Residential (Nr)	4	9	11
Economic Damage (£)	0	£3.58m	£1.05m
Annual Average Damage (£)	£17,724		
Present Value (£)	£532k		

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5.3.5 Proposed Coastal Flooding Mitigation Measures

Tidal Flood Risk Assessment Overview

The detailed digital tidal model for Belfast Lough predicts that a number of areas within the city are potentially at significant risk of flooding. The model simulations show that flooding occurs due to the sea overtopping various sections of the frontage within the Harbour and the lower reaches of the River Lagan and Connswater River. The model estimates that substantive flooding in some areas, such as the city centre, could occur from tidal surge events with return periods in excess of 1 in 50 years. There is degree of uncertainty with the predicted outcomes from all digital models. As it has not been possible to clearly associate extreme tides as the primary cause for any of the major floods which have affected the city in the past, there is always a possibility that the model has over estimated the likelihood of flooding from the sea. However, tide gauges have been installed to measure the sea level within Belfast Lough since 1901 and the near continuous records which they provide show that six out of the seven highest recorded sea levels have occurred in the last 25 years. The latest of these extreme events occurred in January 2014 when a major flood was narrowly averted as the tide peaked a few centimetres below the top of various walls and embankments which are protecting the city. Therefore, on the basis of the model findings, and the regular occurrence of extreme high tides in recent years, there is sound basis upon which to conclude that the tidal risk to Belfast is very real and needs to be managed.

Prevention

As well as managing the existing flood risk to people and properties in Belfast it is important that the flood risk is not increased by new development in areas of known flood risk. Northern Ireland's planning policies adopt a precautionary approach to development that aim to prevent future development that may be at risk of flooding or that may increase the risk of flooding elsewhere.

Reference should be made to Section 4.4 under the headings Planning NI and Local Government regarding the reform and restructuring of the planning system in Northern Ireland. Rivers Agency's Planning Advisory Unit provides advice to Planning NI and Local Councils in relation to the prevention of flooding. In particular Local Councils are advised on Development Plans and at the Planning Application stage. Flood mapping information is used to inform the local Development Plans to ensure, where possible, that new zonings are located outside the identified flood risk areas. In the determination of planning applications any proposed development within a flood risk area will either be advised against or will be further considered if it meets one of the "Exception" rules and is accompanied by a suitable Flood Risk/Drainage Assessment. Applications that relate to "Greenfield" built development in fluvial floodplains are unlikely to be accepted, whereas applications for recreation purposes and amenity open space will usually be accepted.

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Development Plans

In the preparation of new development plans for Belfast Rivers Agency advise against bringing forward sites or the zoning of any land, particularly for built development, that has been identified from the flood maps as being within the 1 in 200 year coastal floodplain area or is susceptible elsewhere to surface water flooding. Rivers Agency shall also review the existing development plan for Belfast with a view to addressing flood risk issues which have only recently been identified as a result of the new flood maps. The main (undeveloped) flooded areas, amongst others, within the Belfast Significant Flood Risk Area are:-

Planning Applications

Rivers Agency shall advise against the development of all sites that are located within the1 in 200 year coastal floodplain, irrespective of whether they are located within a current development plan or as a single site application outside the plan area.

For those sites within the 1 in 100 year fluvial floodplain where the principle of development has been accepted by the Local Council as meeting the 'Exception Test' we will further consider the application through the appraisal of an accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures.

The main existing developed areas, amongst others, at coastal flood risk within Belfast were re-development may be likely to take place are:

- York Street, Duncrue Street and Belfast city centre
- Along the Connswater at Sydenham
- Lower Ravenhill Road

Protection

Although many areas of Belfast are at risk of flooding from the main flood sources, the tidal flood risk to the city centre and surrounding residential areas is of most concern. Initial estimates of the numbers of properties at risk are contained within the Table 5.3.4.1. These estimates, which are based on the Flood Hazard Maps published in December 2013, show that in excess of 1500 residential and 800 non-residential properties may be at risk of flooding from a 1 in 200 year tidal event. It is clear that such an event would cause severe economic damages and result in serious disruption to commerce, the transportation network and the social fabric of the city.

The development of measures to protect the city from tidal flooding have already commenced through the ongoing East Belfast Flood Alleviation Scheme and the completion of the Belfast Tidal Flood Risk Study in late 2015. Details of these projects and their progress are as follows:

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East Belfast Flood Alleviation Scheme

The predicted tidal flooding from the lower reaches of the Connswater River, which affects an extensive and largely residential area at Sydenham/Strandtown, will be mitigated through the delivery of the ongoing Connswater Community Greenway partnership project. This £40 million investment project which has been developed by the East Belfast Partnership and is being delivered through Belfast City Council will create a 9km linear park along the course of the Knock, Loop and Connswater rivers. Rivers Agency is working in partnership with this project to deliver elements of its £11 million East Belfast Flood Alleviation Scheme which shall be integrated within the overall proposals for the linear park. The East Belfast Flood Alleviation Scheme (EBFAS) will prevent the tidal flooding to Sydenham through the construction of steel sheet piled floodwalls and earth embankments/bunds along the banks of the lower Connswater River (from Newtownards Road to Sydenham By-Pass) and by reshaping the landform within Victoria Park to cut off the flow route through the subway under the Sydenham Bypass. The works at Victoria Park were completed in July 2014 and those on Connswater River have commenced and will be completed in 2016. On completion of these elements of the EBFAS, Sydenham, which is one of the areas in Northern Ireland that is most vulnerable to coastal flooding, will become one of the better protected with an estimated 575 properties benefitting from the defences. However, the area will still be at risk to some extent from fluvial and surface water flooding and from any significant escapes that may occur from the NI Water pumping station due to technical failures.

Belfast Tidal Flood Risk Study

In addition to the flood alleviation scheme for the Connswater, Rivers Agency awarded a contract to one of its consultants in December 2014 to undertake the Belfast Tidal Flood Risk Study. This study was commissioned to identify and assess all options for the management of the tidal flood risk in Belfast and produce a long-term mitigation action plan that will guide future investment decisions. The Study report is in the process of being finalised and has identified a preferred option that includes a mixture of permanent flood defence structures and some active elements, such as flood gates and demountable barriers at locations where fixed (passive) defences are not possible. The action plan indicates that an economically viable tidal flood defence solution for Belfast could be delivered by 2018. The capital cost of the preferred solution is estimated to be around £13 million with a healthy benefit verses cost ratio greater than 6 to 1.

Rivers Agency plans to commence the detailed design for the tidal flood defence system in 2016. However, this scheme, like all others, will be placed on a prioritisation list for capital works along with other competing schemes. The position on the list will depend on a set marking criteria, such as the benefit/cost ratio and the overall scheme costs. Subject to the availability of funding and the support of riparian owners, it is aimed to complete the works within the life of this FRMP (i.e. by 2021).

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Preparedness

Coastal flooding has the potential to have a significant impact in terms of risk to life. This is mainly due to the rate of inundation from the sea at the height of the tidal cycle. In light of this, the emergency response to significant coastal flooding with a risk to life, will be led by PSNI and evacuation of potentially affected areas will be a real consideration.

To ensure a coordinated approach local tactical Coastal Flooding Emergency Response plans are being developed for Belfast. This will link to a strategic Coastal Flooding Emergency Response plan.

The Coastal Flood Response plans aim to provide a pre-planned response to a warning of coastal flooding and outline the graduated incident and coordinated inter-agency response to a potential or actual coastal flooding event.

The objectives of the plan are to:-

- Identify activation triggers for responding to a coastal flood warning or incident.
- Document the actions to be taken on receipt of a coastal flood warning.
- Set out the process for a coordinated response including the graduated incident management of a potential or actual coastal flooding event.
- Ensure a common understanding of the potential impacts of a coastal flooding event in each area and act as a reference document for all the agencies involved to provide a pre-planned response at various levels of coastal flood risk.

In addition to assessing the long-term options for the construction of tidal flood defences for Belfast, the recently completed Belfast Tidal Flood Risk Study also examined short term options for the management of flood risks. This includes an emergency plan that highlights the optimum locations for the placement of sand bags, which makes best use of the existing raised structures and landform to cut-off the overland flow paths from the harbour areas to the city centre. The outcomes from this study will inform the development of the coastal emergency response plans until such times as a permanent solution is implemented.

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Photograph 5.3.4.2 - Lower Connswater – Emergency Preparedness

5.3.6 Fluvial/Surface Water Flood Risk Assessment

Modelled Watercourses

Fundamental to the detailed fluvial risk assessment was the development of a hydrodynamic model for each of the main watercourses (and tributaries) within the Belfast SFRA. Figure 5.3.6.1 illustrates the locations of the watercourses within Belfast that have been modelled and the geographical extents of the flood inundation areas predicted by the models for 1% AEP (1 in 100 year) flood event. Figure 5.3.6.2 shows the spread of economic damages that are estimated to occur from river flooding due to a 1 in 100 year event on each of the watercourses. The detailed models indicate that almost 90% of the total numbers of properties that are prone to fluvial flooding are located in clusters within the catchments of the Premier Drive Stream and the Blackstaff and Connswater rivers.

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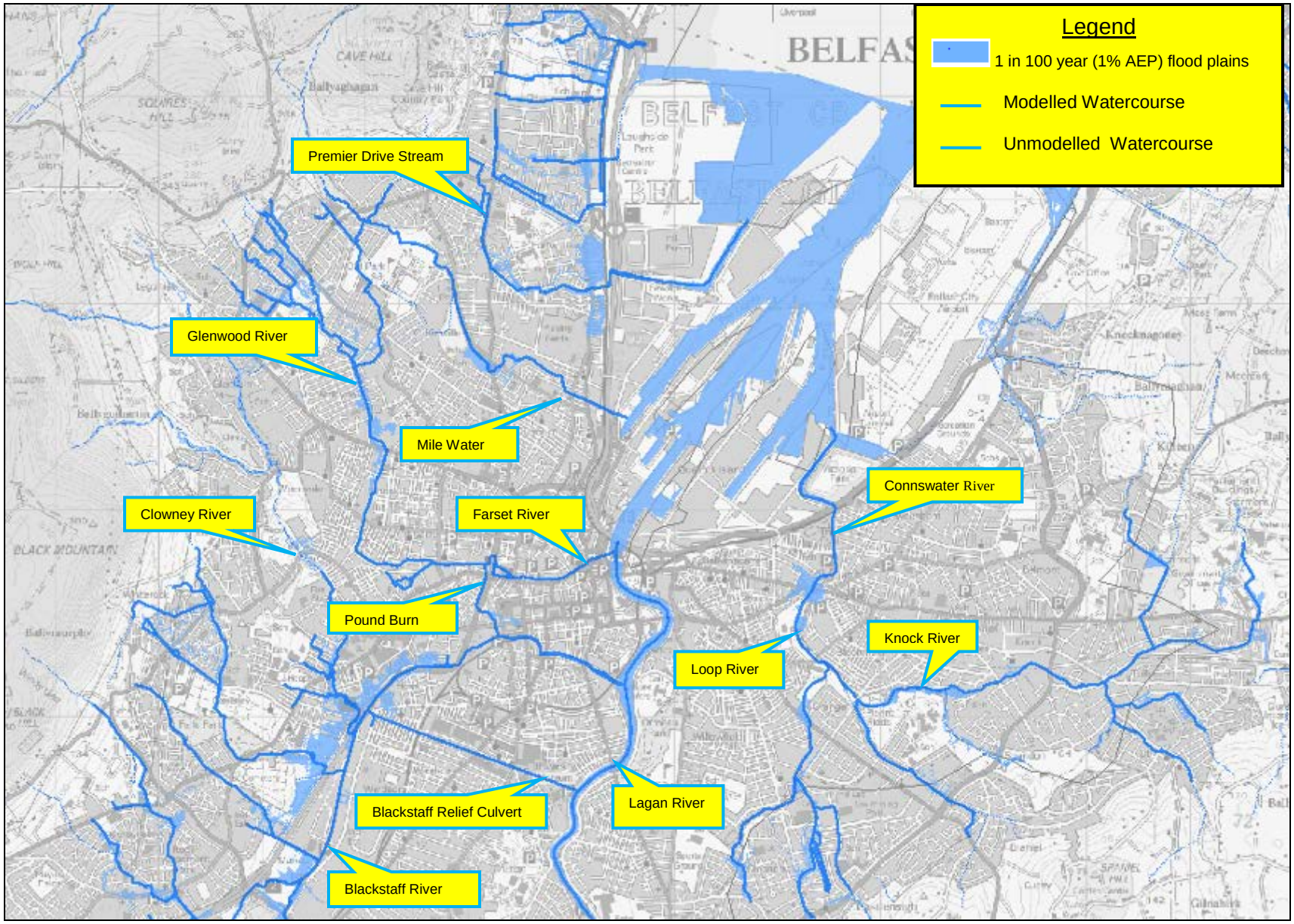

Figure 5.3.6.1 - Belfast SFRA – Modelled watercourse Locations and predicted flood inundation areas for 1% AEP (1 in 100 year) event

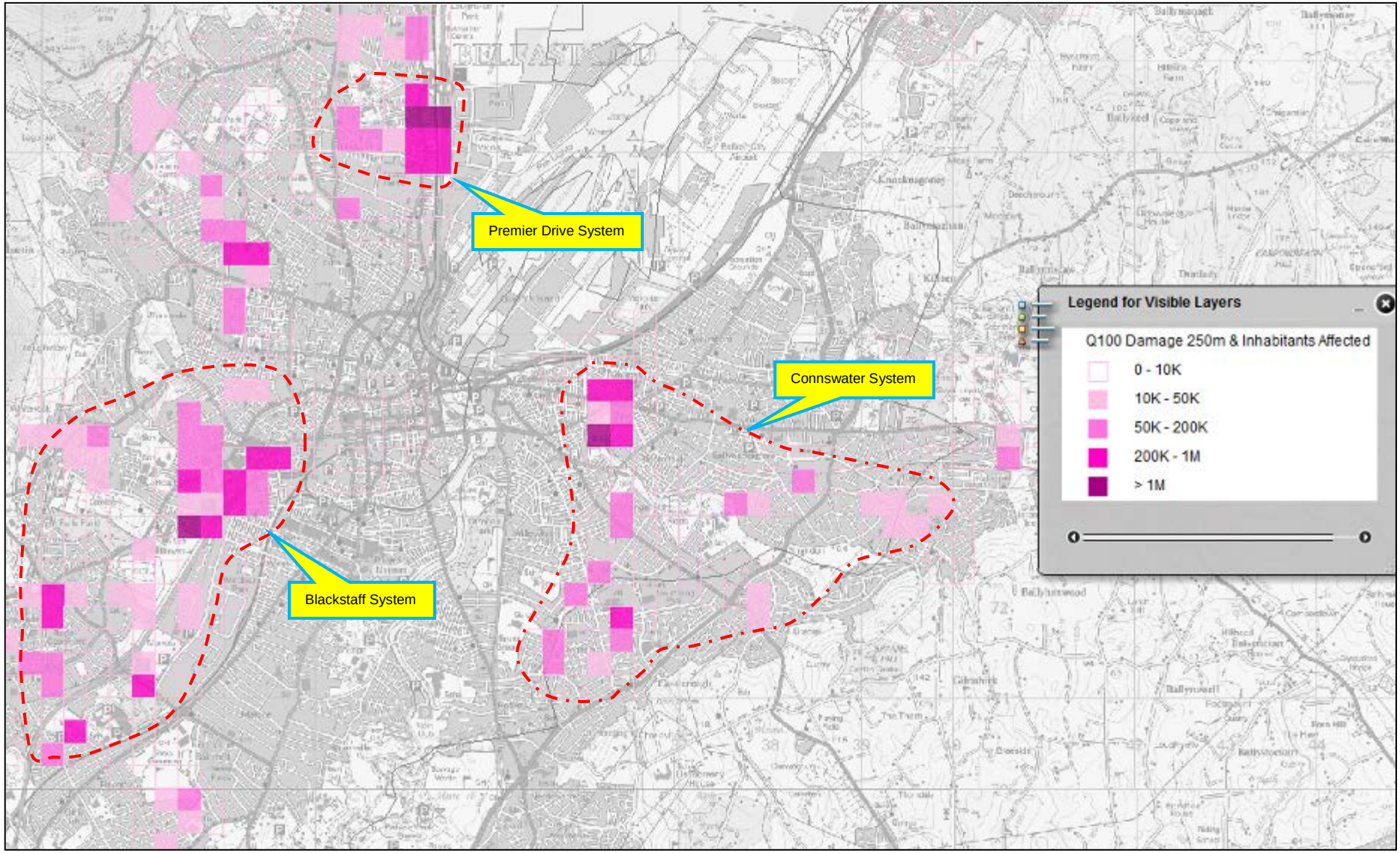

Figure 5.3.6.2 - Belfast SFRA – Locations with very high fluvial flood damages

Belfast – All Watercourses

The models show that across the whole of the Belfast Area, in excess of 5,000 properties are estimated to be located within the areas that are predicted to flood from the various watercourses at the medium probability, 1% AEP (1 in 100 year), flood event. Based on the flood maps it is calculated that the present value of the damage costs from all future fluvial flood events is £63m. These figures are included in the Table 5.3.6.1 below. The majority of properties that estimated to be prone to fluvial flooding (around 90% of the total) are located in the following watercourse systems.

Connswater System

Flooding is predicted to take place in a number of areas throughout the Connswater River catchment. The main flooded areas are indicated at the Newtownards Road and Ballyhackamore on the Connswater; Ladas Drive and Mount Merrion Avenue on the Loop and to areas South of Montgomery Road on the Glenbrook River. The flooding is likely to be due to inadequate capacity in the river culvert and local drainage systems. The model predicted that at the medium probability flood event, 1% AEP (1in 100 year), a total of 694 residential properties and 101 non residential properties are inundated by floodwater. Based on the flood maps it is calculated that the present value of the damage costs from all future flood events is £11m. These figures are included in the Table 5.3.6.2 below.

Blackstaff System

The model predicts significant flooding along the Blackstaff River and its tributaries. The main flooding occurs from the lower reaches of the river at the Village area, along the extents of the West Link and extending past the Broad Meadows to Kennedy Way. There is also flooding indicated along the Clowney River from its outlet to as far up as the Millennium Way crossing. The model shows at the medium probability flood event, 1% AEP (1 in 100 year), a total of 2691 residential properties and 259 non residential properties may be inundated by floodwater. Based on the flood maps it is calculated that the present value of the damage costs from all future flood events is £16.8m. These figures are included in the Table 5.3.6.2 below.

Premier Drive Stream

The model shows significant flooding to the North of Skegoneill Avenue and along Premier Drive. It appears that part of the flood water from the culverted system also flows along the road systems and then collects in the low lying flat areas along the Shore Road and between the Shore Road and the railway line. The model predicts that at the medium probability flood event, 1% AEP (1 in 100 year), that a total of 779 residential properties and 69 non residential properties may be inundated by floodwater. Based on the flood maps it is calculated that the present value of the flood damage costs from all future flood events is £34m. These figures are included in the Table 5.3.6.2 below.

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Table 5.3.6.1 Belfast SFRA – All Watercourses			
Potential Adverse Consequences – Fluvial Flooding			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**1950**	**2488**	**4580**
Non Residential (Nr)	**175**	**237**	**461**
Economic Damage (£)	**£3.75m**	**£5.86m**	**£22.92m**
Annual Average Damage (£)	**£2.1m**		
Present Value (£)	**£63m**		
IPPC sites (Nr)	**0**	**1**	**1**
Community Assets (Nr)	**1**	**2**	**3**
Care Homes	**0**	**0**	**0**
GP Surgery's	**1**	**1**	**1**
Fire stations	**0**	**0**	**0**
Hospitals	**0**	**0**	**0**
Police Stations	**0**	**0**	**0**
Schools	**0**	**1**	**2**
Key Infrastructure (Nr)	**23**	**33**	**57**
NIW Wastewater Treatment Works	**0**	**0**	**0**
NIW Sewage Pumping Stations	**0**	**0**	**3**
NIW Water Treatment Work	**0**	**0**	**0**
NIW Treated Water Pumping Stations	**0**	**0**	**0**
NIE Substation 6to11kV	**20**	**30**	**51**
NIE Substation 33kV	**2**	**2**	**2**
NIE Substation 275kV	**0**	**0**	**0**
NIE Substation 110kV	**0**	**0**	**0**
Road Service - Trunk Road	**1**	**1**	**1**
Environmental Designated sites (Nr)	**0**	**0**	**0**
AONB	**0**	**0**	**0**
ASSI	**0**	**0**	**0**
Environmentally Sensitive Areas	**0**	**0**	**0**
Maritime Nature Reserve	**0**	**0**	**0**
Nature Reserve	**0**	**0**	**0**
RAMSAR	**0**	**0**	**0**
SAC	**0**	**0**	**0**
Sites of Local Nature Conservation Importance	**0**	**0**	**0**
SPA	**0**	**0**	**0**
RSPB Reserve	**0**	**0**	**0**
UWT Nature Reserve	**0**	**0**	**0**
Built Heritage sites (Nr)	**4**	**4**	**8**
National Trust	**0**	**0**	**0**
Listed Buildings	**4**	**4**	**7**
Sites and Monuments Records	**0**	**0**	**1**
Buildings of Special Architectural or Historical Interest	**0**	**0**	**0**
Areas of Significant Archaeological Interest	**0**	**0**	**0**
Historic Gardens	**0**	**0**	**0**

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Table 5.3.6.2 Potential Adverse Consequences – Fluvial Flooding High Consequence Watercourses			
Belfast SFRA – Connswater (and tributaries)			
	Flood Event % AEP		
	10% AEP	4% AEP	1% AEP
Residential (Nr)	246	366	694
Non Residential (Nr)	34	46	101
Economic Damage (£)	£482k	£1.47m	£5.96m
Annual Average Damage (£)	£365k		
Present Value (£)	£11m		
Belfast SFRA – Blackstaff (and tributaries)			
	Flood Event % AEP		
	10% AEP	4% AEP	1% AEP
Residential (Nr)	966	539	2691
Non Residential (Nr)	77	123	259
Economic Damage (£)	£911k	£1.85m	£9.24m
Annual Average Damage (£)	£561k		
Present Value (£)	£17m		
Belfast SFRA – Premier Drive Stream			
	Flood Event % AEP		
	10% AEP	4% AEP	1% AEP
Residential (Nr)	530	539	779
Non Residential (Nr)	47	50	69
Economic Damage (£)	£2.25m	£2.42m	£7.25m
Annual Average Damage (£)	£1.14m		
Present Value (£)	£34m		

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Surface Water Flooding Assessment

Figure 5.3.6.3 is a 'heat map' that highlights the areas where there has been the greatest concentration of flood relief payments awarded to householders since 2007. The heat map of the flood relief payments shows that flooding in the Belfast Area is widespread and extends across large areas that are well outside of the known floodplains of the rivers (see figure for river flood plains). The reason for the broadscale flood pattern is that the vast majority of the flooding in Belfast is caused by surface water and is often related to deficiencies in the sewerage and urban drainage networks. The numbers of properties at risk from surface water within Belfast are difficult to estimate with accuracy as there is no practicable methodology available to produce detailed surface water models at the community level. However, a broad brush estimate, based on the strategic surface water map, is that there are around 3,800 properties at risk of flooding from surface water in Belfast. We also know, based on the award of flood relief payments, that in excess of 2700 properties have flooded in Belfast since 2007 and the majority of these are known to have flooded from surface water. Based on the data available, surface water is clearly a significant source of flooding that requires to be managed.

Photograph 5.3.6.1 - Belfast SFRA – Ardgowan Drive, East Belfast

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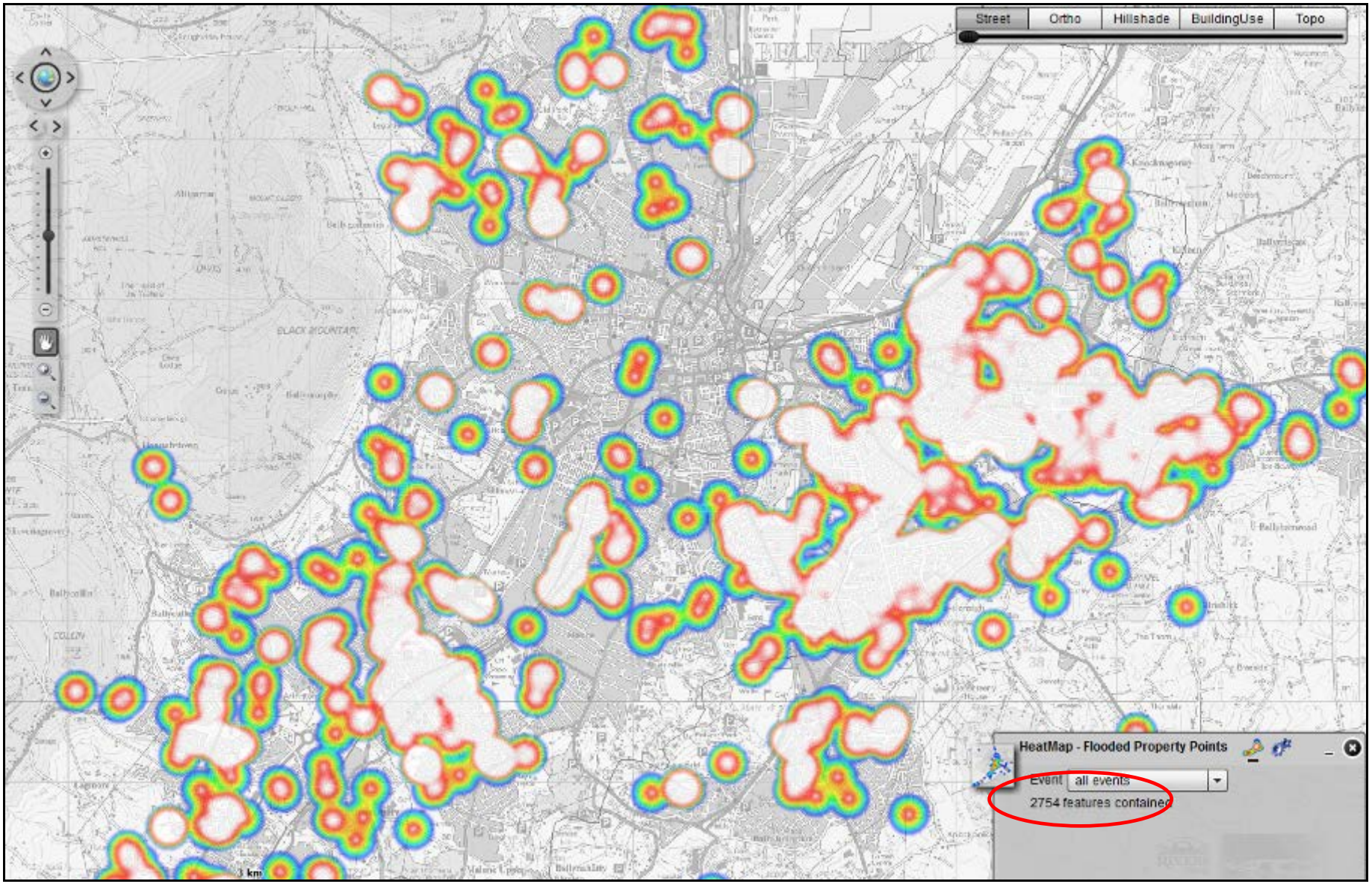

Figure 5.3.6.3 - Belfast SFRA – Flood Relief Payments (Post 2007) – Heat Map

5.3.7 Proposed Fluvial Flooding Mitigation Measures

Prevention

As well as managing the existing flood risk to people and properties in Belfast it is important that the flood risk is not increased by new development in areas of known flood risk. Northern Ireland's planning policies adopt a precautionary approach to development that aim to prevent future development that may be at risk of flooding or that may increase the risk of flooding elsewhere.

Reference should be made to Section 4.4 under the headings Planning NI and Local Government regarding the reform and restructuring of the planning system in Northern Ireland. Rivers Agency's Planning Advisory Unit provides advice to Planning NI and Local Councils in relation to the prevention of flooding. In particular Local Councils are advised on Development Plans and at the Planning Application stage. Flood mapping information is used to inform the local Development Plans to ensure, where possible, that new zonings are located outside the identified flood risk areas. In the determination of planning applications any proposed development within a flood risk area will either be advised against or will be further considered if it meets one of the "Exception" rules and is accompanied by a suitable Flood Risk/Drainage Assessment. Applications that relate to "Greenfield" built development in fluvial floodplains are unlikely to be accepted, whereas applications for recreation purposes and amenity open space will usually be accepted.

Development Plans

In the preparation of new development plans for Belfast Rivers Agency will advise against bringing forward sites or the zoning of any land, particularly for built development, that has been identified from the flood maps as being within the 1 in 100 year fluvial floodplain, reservoir inundation area or is susceptible elsewhere to surface water flooding. Rivers Agency shall also review the existing Development Plan for Belfast (Belfast and Metropolitan Area Plan, 2015) with a view to addressing flood risk issues which have only recently been identified as a result of the new flood maps.

The main (undeveloped) flooded areas, amongst others, within the Belfast Significant Flood Risk Area are:-

- Lagan Valley Regional Park
- Orangefield Park, East Belfast

Planning Applications

Fluvial Areas at Risk

Rivers Agency shall advise against the development of all sites that are located within the1 in 100 year fluvial floodplain, irrespective of whether they are located within a current development plan or as a single site application outside the plan area.

For those sites within the1 in 100 year fluvial floodplain where the principle of development has been accepted by Local Council as meeting the 'Exception Test', Rivers Agency shall further consider the

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application through the appraisal of an accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures.

The main existing developed areas, amongst others, at flood risk within Belfast were re-development may be likely to take place are:-

Premier Drive Stream, North Belfast

- Along Premier Drive/Fortwilliam Parade and to the North of Skegoneill Avenue
- Along York Street/Shore Road and to the West of the railway line.

Blackstaff System, South Belfast

- Along the Blackstaff River, particularly West of the West Link and the Village area,
- Along the Clowney Stream, West Belfast
- Along the Ballymurphy Stream, West Belfast

Connswater System

- Along the Connswater, at the Newtownards Road, East Belfast
- Along the Connswater at Ballyhackamore, East Belfast
- Along the Loop River at the Castlereagh Road, East Belfast
- Along the Loop River, at Ladas Drive and Mount Merrion Avenue, East Belfast
- Along the Glenbrook River between Montgomery Road and the Cregagh Road
- Along the Knock River at Orangefield Park

Areas at Risk of Surface Water Flooding

For those sites outside the 1 in 100 year fluvial floodplain that are located in an area where there is evidence of a history of surface water flooding (identified by flood hardship payments) Rivers Agency will further consider the application through the appraisal of the accompanying Drainage Assessment that will need to demonstrate suitable flood mitigation measures.

Where there is potential for surface water flooding as indicated in the Surface Water Map 'areas highlighted purple' Rivers Agency will advise that the applicant should assess the flood risk and drainage impact to the site and construct in an appropriate manner.

The main areas identified in Belfast Area as being at surface water flood risk are:-

- Sicilly Park Area, Marguerite Park, South Belfast
- Ballynafeigh, Upper Ormeau Road, South Belfast
- Between Mount Merrion Avenue and the Cregagh Road, East Belfast

Areas at Risk of Flood Inundation from Reservoirs

For all development proposals that are located within the potential flood inundation area of a Controlled Reservoir Rivers Agency will further consider the application through the appraisal of the accompanying

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Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures. If it is a new development proposal Rivers Agency will also need the applicant to demonstrate that the condition, management and maintenance regime of the reservoir is appropriate to provide sufficient assurance regarding reservoir safety.

Controlled Reservoirs identified in the Belfast area are as follows:

- Waterworks (Antrim Road)
- Springfield (Mackies)
- Galwally

Protection

Structural measures are still one of the main options in providing flood protection to people and property impacted by the effects of extensive flooding. It is therefore important that we continue to target investment by providing flood defence, culvert alleviation schemes and infrastructure upgrade works to those communities at greatest need.

The alleviation of surface water flooding, in particular, will require input from a number of bodies. The Flood Investment and Planning Group, FIPG, provides a coordinated approach across Government in relation to the investigation of flooding, agreeing responsibilities and identifying collaborative solutions. The group is represented by Rivers Agency, NI Water and Transport NI, amongst others, with flood risk management responsibilities. The draft terms of reference for the FIPG can be found in Appendix G.

There are a number of stages to follow when procuring a flood alleviation scheme. The potential scheme needs to be first subjected to a feasibility study that will also include an economic appraisal. From the detailed Hazard and Risk Maps a 'Flood Risk Metric Tool', FRISM is used in urbanised flooded areas to get an estimate of the likely property damages as a result of a range of flood events. The estimated cost of a scheme is then compared to the total 'damage avoidance benefits' that the scheme will provide to the property over the scheme's design life. If the benefit/cost ratio is greater than 1, then the potential scheme will be referred to Rivers Agency, Capital Procurement Unit for a feasibility study to be undertaken.

If the flooding issue identified is not solely, Rivers Agency's responsibility, or is the responsibility of NI Water or Transport NI, such as a local drainage or road infrastructure issue then it will be referred either to FIPG or directly to the responsible body, for their further consideration.

If a benefit cost analysis identifies a viable scheme, a scheme will then be placed on a prioritisation list for works with other competing schemes. The position on the list will depend on a set marking criteria, such as the benefit/ cost ratio and the overall scheme costs. Depending on the availability of resources it may take anything from between 2 – 5 years for the scheme to progress from the start of the feasibility study to construction works commencing on the ground.

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Fluvial/Surface Water Flood Protection Measures

Within the Belfast area the following ongoing and future planned measures to alleviate the fluvial and/or surface water flood risk have been identified.

Living with Water Programme

Within heavily urbanised zones, most areas of high flood risk have complex drainage arrangements with inter-connected networks of sewers, drains and watercourses that are managed by separate drainage authorities (i.e. NI Water, Transport NI and Rivers Agency) and each design their systems to different standards. This complexity is compounded by the fact that that there are estimated to around 82km of underground drainage assets within Belfast that are not adopted or designated by any of the drainage authorities. The hydraulic capacity and condition of most of these unadopted assets is currently unknown and many could be causing, or contributing to urban flooding problems.

Identification of flooding mechanisms and their solutions, particularly in relation to surface water, requires a detailed understanding of the whole integrated drainage network (including unadopted assets) and cannot be effectively tackled by any of the flood authorities in isolation.

In recognition of the need for a more coordinated approach to the management of flooding in Belfast and to facilitate the development of optimum solutions that reduce flooding and enhance the environment, Government established the Living with Water Programme (LWWP) in July 2014. The LWWP Board brings together all of the key government stakeholders with an interest in flooding and the water environment with the aim of developing a Strategic Drainage Infrastructure Plan (SDIP) for Belfast. For details of the LWWP see section 6.2.2 DRD Water Policy Unit – Living with Water Programme

The LWWP shall consider all aspects of the urban drainage system which contribute to water quality and flooding problems including watercourses, sewers, drains, combined sewer overflows, pumping stations (wastewater and storm water), sewage treatment works and receiving water impacts.

The SDIP is being progressed through 15 interlinked work packages. It is anticipated that the SDIP will be developed by 2018 and early estimates are that future capital investment to deliver the plan may of the order £350M to £750M. It is envisaged that the construction works to deliver the necessary drainage infrastructure improvements identified in the SDIP will commence in 2020 and be completed in 2026.

Although the SDIP will be the overarching mechanism for the delivery of substantive drainage infrastructure investment in Belfast; localised flooding problems which require urgent action and which are clearly the responsibility of a single authority and do not require integrated solutions, may be progressed.

Connswater System – East Belfast Flood Alleviation Scheme

The significant fluvial flood risk to this area is being addressed through the East Belfast Flood Alleviation Scheme. Rivers Agency is investing £11 million to deliver the EBFAS which, when completed in 2016, will reduce the fluvial and coastal flood risk to around 1500 properties. For details of this scheme see Section

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5.3.1 – *'Flood History – East Belfast Flood Alleviation Scheme'*. Whilst the EBFAS will resolve many of the fluvial flooding issues within the inner city parts of the Connswater catchment. There are however further flooding issues to be addressed in the upper catchment, most notably, in the vicinity of the Cregagh Road and Montgomery Road, arising from the Glenbrook River. Rivers Agency plans to commence the design of a flood alleviation scheme for the Glenbrook River in 2016. This scheme will be prioritised, alongside others in Agency's Capital Works Programme and it is likely that the construction works will be completed within the life of the FRMP (i.e. by 2021). With regard to the NI Water pumping station at Sydenham; interim upgrading of the pumping infrastructure has been undertaken, but it may be some years before a new pumping station is built with the necessary capacity and redundancy to fully protect the community from flooding from this source.

Blackstaff System – Living With Water Programme (LWWP)

Management of the flood risk to areas affected by the drainage network within the Blackstaff System will be addressed through the LWWP and has already commenced through its *Work Package 9 – Management of Flood Risk in Belfast the provision of Protection Measures.*

The Upper Falls Drainage Area, which is part of the Blackstaff System, has been selected as a pilot catchment to trial an integrated drainage study approach. This study requires the development of an integrated urban drainage model that will lead to a better understanding of how the various physical components of the drainage system interact and how the different organisations must work together for it to operate effectively. Work on the development of this model has commenced and will help to inform other Work Packages that are considering the approaches that will taken in relation to drainage area planning, unadopted drainage assets and most importantly storm separation.

The results and lessons learned from this pilot catchment study will be used to inform future integrated drainage studies, throughout the Blackstaff System and across the whole of the Belfast Area as necessary.

A specialist consultant shall be appointed to develop the integrated urban drain model in spring 2016 and it is anticipated that the study will be completed in 2017. An aim of this study shall be identify solutions to alleviate flooding from all sources within the pilot catchment area. The drainage improvement works identified through the study will be included in the SDIP and prioritised alongside other capital interventions.

Premier Drive Stream

There are no immediate plans to undertake a specific flood study for the Premier Drive Stream. This drainage system will require an integrated urban drainage study which will be progressed through the LWWP. However, the timing of study is currently unknown as there are many flood prone areas throughout Belfast that will require similar studies and as a consequence a prioritised programme of investigations/studies will developed for the LWWP.

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South Belfast - Flood alleviation measures

In response to repeated flooding of property in the Finaghy/Upper Malone area, most notably in August 2008 and June 2012, NI water carried out surveys and capacity assessments of the private and public underground drainage systems in the area. These surveys revealed extensive structural defects in the culverts, including a number of significant obstructions caused by service intrusions. Urgent repairs and the removal of the service intrusions have been undertaken to maximise the flow carrying capacity of the existing sewers and culverted watercourses to reduce the risk of flooding in the short term. However, the drainage systems may still be overwhelmed by an extreme rainfall event.

In addition, Rivers Agency has designated the Kinnegar Road Stream and Locksley Park Stream as these culverted watercourses were in an unsatisfactory condition and the works to upgrade them was beyond the capability of the individual riparian owners. The Agency plans to carry out a scheme to repair and/or replace significant sections of these culverts. The construction works, which are estimated to cost in excess of £500k, will commence in early 2016 and will reduce the risk of fluvial flooding to around 24 properties.

NI Water has a long term commitment to its Glenmachan Strategic Project which is estimated to cost in the region £85 - £110 million and aims to reduce flooding in South Belfast. NI Water has set aside sufficient development funding in its PC15 Business Plan to progress the feasibility, planning and design of this major project within this FRMP cycle. As part of the overall Glenmachan Project, medium term measures are planned to upgrade the sewerage infrastructure in the Finaghy/Upper Malone area to reduce the risk of flooding. These measures, which are estimated to cost in excess of £10 million, will be undertaken in two phases.

Phase 1a: Sicily Park/Marguerite Park

The design of this project is completed and involves works to impound floodwaters during extreme events within the floodplain of the Taughmonagh Stream. Engagement with riparian owners to conclude agreements for the works are progressing and, given a satisfactory conclusion to these discussions, it is anticipated that these works will be completed in 2016/17.

Phase 2: Greystown/Upper Malone

This project includes works to upgrade the local network of sewers and watercourses and is jointly funded by NI Water and Rivers Agency. It is anticipated that a contractor will be appointed in spring 2016 and that works will be completed in 2016/17.

On completion of the Phase 1 and 2 works and Rivers Agency's culvert improvement works on the Kinnegar Road and Locksley Park Streams, the urban drainage networks within the local area are expected to provide the appropriate standard of flood protection.

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Preparedness

In Belfast it is not possible to prevent or protect against all flooding and even where flood defences exist, it is possible that in an extreme event, they could be over topped and flood the defended area.

Having recognised this fact, considerable effort in recent years has been made by emergency planners in a Government Departments, Councils and the Emergency Services working together and sharing information to ensure a coordinated response.

However, despite these improvements during significant flood events the emergency response of Government Departments and the Emergency Services can become over stretched. This means that not all calls for assistance during a flood event can be responded to in a timely manner. With this in mind it is important that households and communities, subject to a known flood risk, are prepared. The detail of preparedness actions including flood warning and informing activities planned from a regional perspective are provided in Appendix E.

This is not Government withdrawing from any undertaking to respond in emergencies but an additional layer of support to ensure Government Departments and the public work together to reduce the overall impacts of flooding.

From the flood risk assessment there are at least 17 areas in Belfast that have flooded in the recent past that may benefit from the flood warning and informing proposals, outlined in Appendix D.

A pilot project of community engagement to deliver flood warning and informing, held in 2014, identified basic assessment formulae to assess and score areas that could potentially be a focus for flood warning and informing actions. As part of this pilot project, community engagement has been carried out with the community in the Cregagh area. Based on this scoring the following areas could be considered suitable for being included in a programme of community engagement to deliver flood warning and informing initiatives:-

- Clarawood Park area
- Stockmans Lane
- Finaghy Road North area
- Gilnahirk Road / Kingsway Park area
- Greystown Avenue / Finton Gardens area
- York Park / Pittsburg Street area
- Montgomery Road area
- Loopland Park area

Key activities that could be undertaken are:-

- Explaining the potential and limitations of Community Resilience.
- Briefing communities on information available, particulary from the Met Office.
- The facilitation of self-help initiatives, including remote sandbag storage; and

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- Reviewing and validating all elements of the Community Engagement Plan to help the community communicate effectively in an emergency and work together.

The table in Appendix I shows how these community's rank in the overall context of the 20 FRA's in this plan. It should be noted that this is an indicative assessment which may change subject to further information on flood risk becoming available.

The rollout of this work is dependent on funding being available.

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5.4 Downpatrick Significant Flood Risk Area

The core boundary of the Downpatrick SFRA, which has been determined through the PFRA, is located within the Quoile Local Flood Management Area and illustrated in Figure 5.4.1 below.

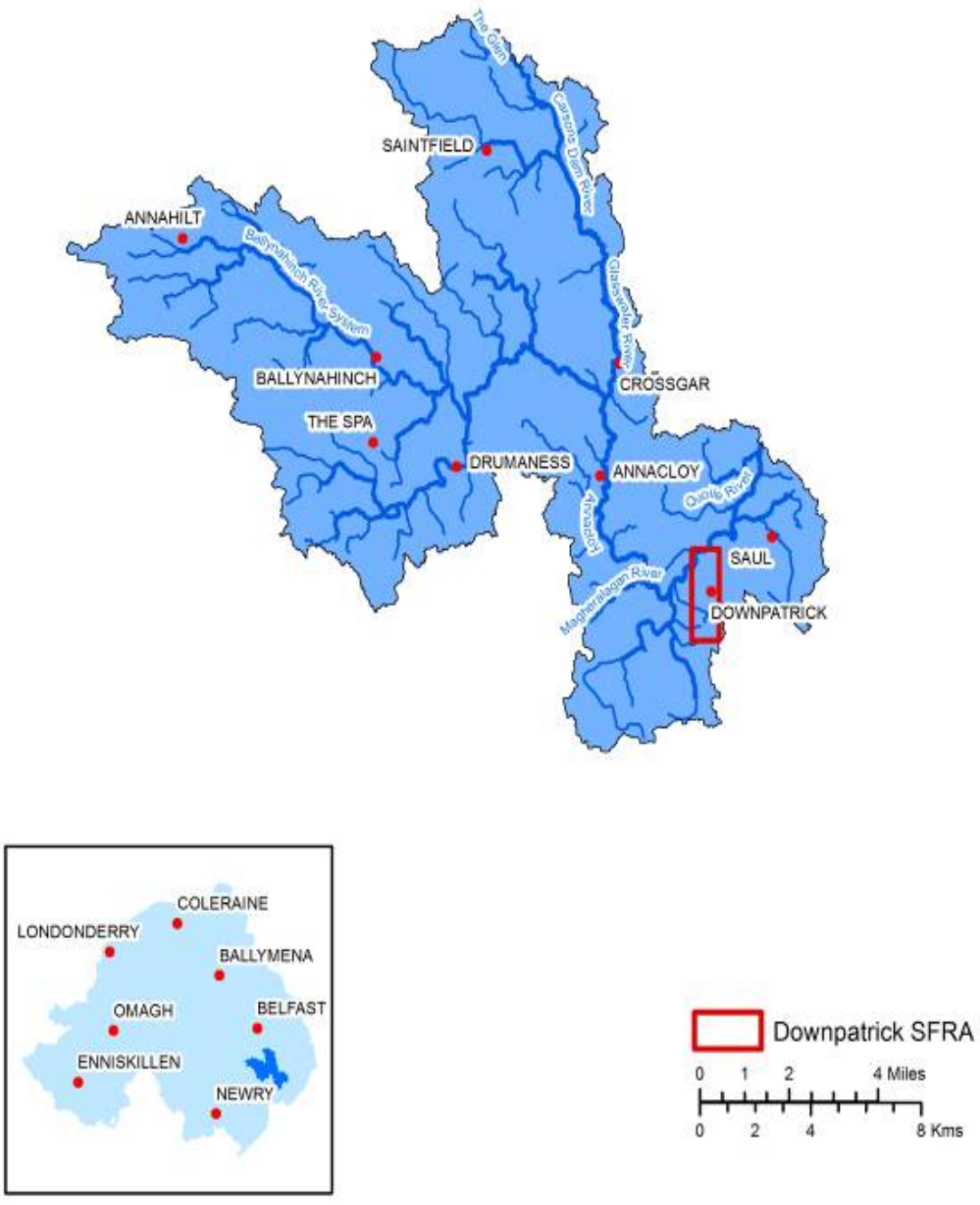

Figure 5.4.1 - Quoile LFMA and Downpatrick SFRA

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5.4.1 Flooding History

There have been numerous instances of flooding to low lying areas of Downpatrick since construction of the Quoile Tidal Barrier in 1957. The details of many of these flooding incidents have been recounted in the local newspapers and more recently, documented in media reports which are available on the internet. There is a continuing theme throughout these reports that points towards a failure of the urban drainage systems, which are unable to vent the runoff arising from heavy rainfall events, particularly at times whenever the water levels in the Quoile Pondage are high. Notable reports of flooding have occurred in 1963, 1966 (see Photo 5.4.1.1 below), 1978 and on a number of occasions within the last decade, most recently on 10th April 2013. The low lying areas of the town most frequently affected by the flooding are in the vicinity of Market Street, Ballyduggan Road and Church Street. Since the introduction of the flooding hardship payment scheme in 2007 there have been no payments issued to homeowners in the Downpatrick SFRA. However, this is because the hardship payment scheme is not open to the owners of flooded business premises, such as those in the Market Street area which have flooded on a number of occasions since 2007.

Photo 5.4.1.1 - Downpatrick's Market Street, May 1966

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5.4.2 PFRA – Identification of Potentially Significant Flood Sources

According to the Preliminary Flood Risk Assessment (Dec 2011) the town of Downpatrick, in terms of the potential adverse consequences of flooding, is ranked eighteenth of the twenty SFRA within Northern Ireland (see Figure 4.1). On the basis of this initial assessment, which was undertaken using the Strategic Flood Maps, the predominant flood risk to the town was considered to arise from tidal inundation and, to a much lesser extent, from fluvial flooding.

It should be noted that the PFRA flagged up the potential for significant tidal inundation at Downpatrick because this national assessment is based on strategic 'undefended' flood models, which ignore the presence of existing flood defence systems such as the Quoile Barrier. Therefore, the assessment is in effect based on the worst-case scenario, as it assumes there is no benefit from the defences. This precautionary approach has been taken because, at the time of the assessment, there was a degree of uncertainty about the level of protection that each of the existing flood defence systems provides. By adopting this approach, the urban areas that are located behind existing flood defence structures were determined to be SFRA by default and consequently, detailed Flood Hazard/Risk Maps had to be prepared in compliance with the requirements of the Directive. This precautionary approach provided the opportunity to undertake the detailed structural assessments and flood modelling necessary to remove the uncertainty and establish the actual level of protection offered by these important defence systems.

To facilitate a more robust assessment of the level of flood risk to Downpatrick from rivers and the sea, Rivers Agency developed detailed predictive flood models for each of these sources. It is considered that the flood hazard maps produced from these models will give a more accurate prediction of the flooded areas which may have been over or under estimated by the strategic flood maps. Details of the models and their output are described in the following sections.

5.4.3 Catchment Characteristics

The Quoile Local Flood Management Area (LMFA) is in the North Eastern River Basin District and covers an area of approximately 245km². The major towns in the Quoile LFMA are Downpatrick, Saintfield, Ballynahinch and Crossgar, with smaller towns including Annahilt and Annacloy. The main land cover is represented by improved grassland, with a small amount of arable horticulture and neutral grass. The area has a range of habitats that have protected status and is a National Nature Reserve. It also supports a range of recreational activities such as bird watching, walking, angling, tourism, canoeing and yachting. The catchment drains two significant river systems, the Glasswater River which rises near Saintfield town, around 18km to the north of Downpatrick and the Ballynahinch River, which rises close to Annahilt, 22km to the northwest. The Ballynahinch River flows southward through Ballynahinch towards its confluence with Glasswater River at Kilmore where it becomes the Annacloy River. The river turns east then north east before reaching Downpatrick where it becomes the Quoile River and flows into the Quoile Pondage.

Up until the middle of the 18th century, Downpatrick was in effect a seaside town. The tidal waters of Strangford Lough extended up to and almost encircled the town. In an effort to reclaim land from the sea,

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the local landowner Edward Southwell erected the first tidal barrage across the estuary of the Quoile River in 1745, at a site near the bridge on the Old Belfast Road. To improve the protection against flooding, a new structure, equipped with self-actuating gates was constructed in 1934 and finally, in 1957 the Quoile Tidal Barrier (pictured below) was constructed at the mouth of the River Quoile at Hare Island.

Photo 5.4.3.1 - Quoile Barrier (sea facing aspect)

The location of the Quoile Barrier at the mouth of the natural estuary of the River Quoile is highlighted in Figure 5.4.3.1 below.

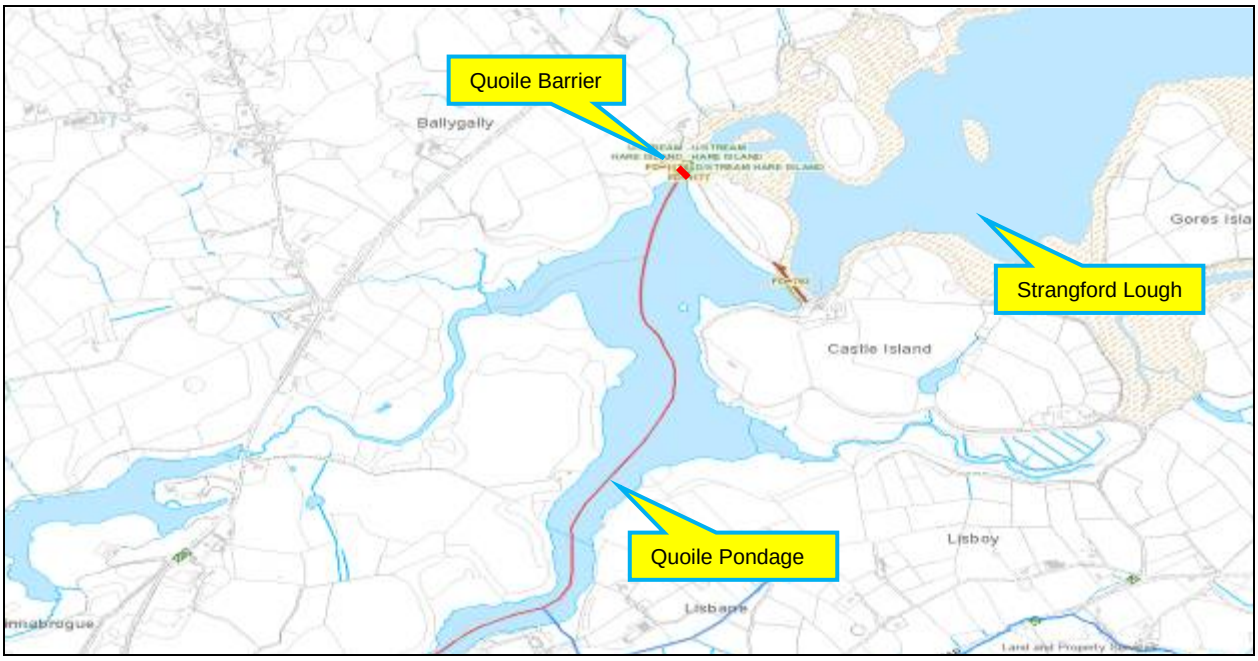

Figure 5.4.3.1 – Location of Quoile Barrier

The lower reach of the Quoile River from the Tidal Barrier upstream to Annacloy, a distance of 14km, has a very shallow gradient with the bed rising marginally to a height of 0.86m AOD. Much of the natural flood plain along this reach is below mean sea level and, as a result, would be inundated on a regular basis during normal high tides, if the tidal barrier was not present. The tidal barrier effectively eliminates the tidal inundation of this stretch and creates a freshwater pondage with more a stable and substantially lower mean water level. The impounded water discharges to Strangford Lough through a series of 16 flap gates in the tidal barrier at stages in the tidal cycle when the sea level is lower than the pondage level. This passive system does not enable levels in the pondage area to be regulated or controlled by Rivers Agency. However, the gated system generally maintains levels within a 1m range (typically -0.7m to 0.5m AOD), but occasional extreme levels outside of this range occur in most years.

5.4.4 Coastal Flood Risk Assessment

For the purposes of producing inundation flood mapping for the overtopping of the Quoile Barrier, extreme sea water levels for a range of return periods were derived using the methodology described in the Rivers Agency's report *Strangford and Belfast Extreme Tides Boundary Condition (August 2009)*. The tidal simulations for Strangford Lough were undertaken using a detailed MIKE 21 HD model which is a sub-model driven by the Irish Surge and Tidal Model that is used to determine extreme sea levels around the non-estuarine coastline of Ireland. Based on the Strangford tidal model the estimated extreme tidal levels at the Quoile Barrier are shown in Table 5.4.4.1 below.

Strangford Lough (Quoile) - Estimated Extreme Sea Levels

	Annual Exceedance Probability - (Return Period)	**Extreme Water Level (m OD)**
Present Day	10% AEP - (1 in 10 year)	2.954
	0.5% AE - (1 in 200 year)	3.202
	0.1% AEP - (1 in 1000 year)	3.445
Year 2030	10% AEP - (1 in 10 year)	3.029
	0.5% AEP - (1 in 200 year)	3.277
	0.1% AEP - (1 in 1000 year)	3.520
Year 2100	10% AEP - (1 in 10 year)	3.706
	0.5% AEP - (1 in 200 year)	3.954
	0.1% AEP - (1 in 1000 year)	4.197

Table 5.4.4.1 – Strangford Lough (Quoile) Estimated Extreme Sea levels

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Coastal Flood Mechanism

As the crest level of the Quoile Barrier is 3.4m OD, which is higher than the estimated extreme level of a 1 in 200 year tidal event at both the Present Day and 2030 yr scenarios (3.20m and 3.28m respectively) there is no significant risk of the sea overtopping this defence in the medium term and consequently no significant risk of coastal flooding to Downpatrick from the sea. However, based on current climate change predictions, it is anticipated that coastal flood risk will increase with time and the model shows that by the year 2100 the annual chance of the sea overtopping the Quoile Barrier may be greater than 10%.

5.4.5 Proposed Coastal Flooding Mitigation Measures

Prevention

As well as managing the existing flood risk to people and properties in Downpatrick it is important that the flood risk is not increased by new development in areas of known flood risk. Northern Ireland's planning policies adopt a precautionary approach to development that aim to prevent future development that may be at risk of flooding or that may increase the risk of flooding elsewhere.

Reference should be made to Section 4.4 under the headings Planning NI and Local Government regarding the reform and restructuring of the planning system in Northern Ireland. Rivers Agency's Planning Advisory Unit provides advice to Planning NI and Local Councils in relation to the prevention of flooding. In particular Local Councils are advised on Development Plans and at the Planning Application stage. Flood mapping information is used to inform the local Development Plans to ensure, where possible, that new zonings are located outside the identified flood risk areas. In the determination of planning applications any proposed development within a flood risk area will either be advised against or will be further considered if it meets one of the "Exception" rules and is accompanied by a suitable Flood Risk/Drainage Assessment. Applications that relate to "Greenfield" built development in fluvial floodplains are unlikely to be accepted, whereas applications for recreation purposes and amenity open space will usually be accepted.

Development Plans

In the preparation of new Development Plans for Downpatrick, Rivers Agency advise against bringing forward sites or the zoning of any land, particularly for built development, that has been identified from the flood maps as being within the 1 in 200 year coastal floodplain.

We shall also review the existing development plan for Downpatrick (Ards and Down Area Plan) with a view to addressing flood risk issues which have only recently been identified as a result of the new flood maps.

The main (undeveloped) coastal flooded areas, within the Downpatrick Significant Flood Risk Area are:-

- along the Quoile River and to the west of the town and in particular those to the north of the town that are closer to the Quoile Barrier.

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Planning Applications - Coastal Areas at risk

Rivers Agency shall advise against the development of all sites that are located within the 1 in 200 year coastal floodplain, irrespective of whether they are located within a current development plan or as a single site application outside the plan area.

For those sites within the 1 in 200 year coastal floodplain, where the principle of development has been accepted by Local Council as meeting the "Exception Test," we will further consider the application through the appraisal of an accompanying Flood Risk Assessment that will be required to demonstrate suitable flood mitigation measures.

The main areas, amongst others, at coastal flood risk within Downpatrick where development may be likely to take place are:-

- the coastal inundation areas along the Quoile River but excluding those 'Greenfield' areas in the proximity of the Quoile Barrier, which may be deemed as being within a defended area.

Protection

Structural measures are still one of the main options in providing flood protection to people and property impacted by the effects of extensive flooding. It is therefore important that we continue to target investment by providing flood defence, culvert alleviation schemes and infrastructure upgrade works to those communities at greatest need.

The alleviation of surface water flooding, in particular, will require input from a number of bodies. The Flood Investment and Planning Group, FIPG, provides a coordinated approach across Government in relation to the investigation of flooding, agreeing responsibilities and identifying collaborative solutions. The group is represented by Rivers Agency, NI Water and Transport NI, amongst others, with flood risk management responsibilities.

There are a number of stages to follow when procuring a flood alleviation scheme. The potential scheme needs to be first subjected to a feasibility study that will also include an economic appraisal. From the detailed Hazard and Risk Maps a Flood Risk Metric Tool (FRISM) is used in urbanised flooded areas to get an estimate of the likely property damages as a result of a range of flood events. The estimated cost of a scheme is then compared to the total "damage avoidance benefits" that the scheme will provide to the property over the scheme's design life. If the benefit/cost ratio is greater than 1 then the potential scheme will be referred to Rivers Agency, Capital Procurement Unit for a feasibility study to be undertaken.

If the flooding issue identified is not solely, Rivers Agency's responsibility, or is the responsibility of NI Water or Transport NI, such as a local drainage or road infrastructure issue then it will be referred either to FIPG or directly to the responsible body, for their further consideration.

If a benefit cost analysis identifies a viable scheme, a scheme will then be placed on a prioritisation list for works with other competing schemes. The position on the list will depend on a set marking criteria, such as

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the benefit/ cost ratio and the overall scheme costs. Depending on the availability of resources it may take anything from between 2 – 5 years for the scheme to progress from the start of the feasibility study to construction works commencing on the ground.

Having conducted a detailed assessment of the coastal flood risk to Downpatrick, Rivers Agency has determined that the Quoile Barrier is currently protecting the town of Downpatrick from extreme tidal surges up to the predicted 1 in 1000 year event which is substantially higher than the normal design standard of 1 in 200 year adopted by Rivers Agency for the construction of sea defences. However, based on current climate change predictions, it is anticipated that coastal flood risk will increase with time and the model shows that by the year 2100 the annual chance of the sea overtopping the Quoile Barrier may be greater than 10%. Then again, due to the high degree of uncertainty associated with climate change predictions it would not be proportionate to commit valuable public resources to undertake a scheme to raise the level of the Quoile Barrier to protect against a potential future flood risk that may not arise. As the coastal flood modelling will be continually updated as new techniques and data become available there will be an opportunity to re-assess the risk to Downpatrick from tidal flooding in future PFRA cycles (i.e. on a six yearly basis). Therefore, based on the information available at this time there is no reason to include additional structural mitigation measures to reduce coastal flood risk in this plan.

Preparedness

The level of coastal flood risk to Downpatrick is extremely low and does not justify a local tactical Coastal Flooding Emergency Response plan.

5.4.6 Fluvial Flood Risk Assessment

Fluvial Model

The hydrodynamic model used for the assessment of fluvial flood risk was developed using Infoworks RS 1d/2d for the largely open watercourse sections which include the Quoile River from Kilmore to the Pondage, the Ballynahinch River from Ballynahinch to Kilmore, the Glasswater River from upstream of Crossgar to Kilmore and the Drumaness River from upstream of Drumaness to its confluence with the Ballynahinch River. Minor urban tributaries within the town of Downpatrick including the Plank Drain, Town Drain, Saul Street Stream, and the Strangford Road Stream which are substantially culverted, were modelled using Infoworks ICM. The location and extents of the watercourses modelled are illustrated in Figure 5.4.6.1

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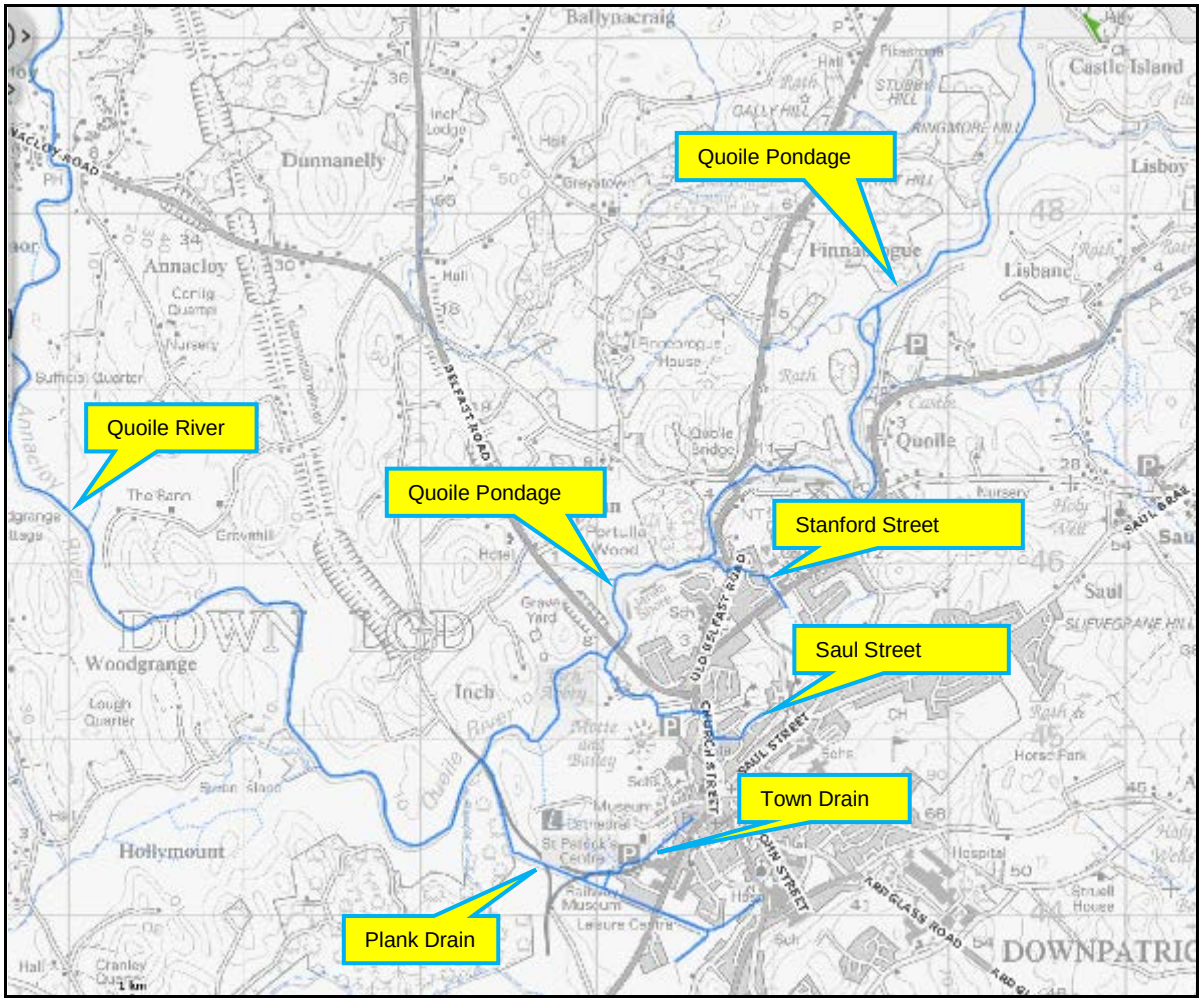

Figure 5.4.6.1 - Downpatrick SFRA - Modelled Watercourses

Modelled Watercourse Descriptions

Quoile Pondage

The water level of the Quoile Pondage and the geographical extent of its inundation area constantly fluctuate in response to the antecedent weather conditions and tidal conditions. These affect the flows from the watercourses which discharge to it, the direct run-off from the surrounding land and the Quoile Barrier's capacity to discharge to Strangford Lough. It proved impossible to produce an acceptable hydrodynamic model that adequately represented the rise and fall of the water level in response to the combined influence of the various factors. Therefore, the water levels of the pondage for extreme events (with a range of return periods) were estimated using a statistical analysis of the continuous 30 year record of water levels within the Pondage that are measured by the Hare's Island Gauging Station. On the basis of this analysis the estimated water levels for the Pondage used within the fluvial model are as follow:

- 10% AEP (1 in 10 year) 1.26m OD
- 1% AEP (1 in 100 year) 1.93m OD
- 0.1% AEP (1 in 1000 year) 2.57m OD

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Quoile River (and main tributaries)

The modelled reach of the Quoile River from Kilmore to the start of the Pondage Area has a length of 13.5km. From Annacloy to the tidal barrier at Hares Island (some 14 km downstream) the channel has a very shallow hydraulic gradient. Much of the flood plain along this stretch is below mean sea level and, where it not for the presence of the tidal barrage, these low lying areas would be inundated on a regular basis during high tides. The barrage eliminates the tidal inundation along this stretch and maintains a fairly constant pondage area between Downpatrick and the structure at Hares Island. Moving upstream from Annacloy, the Quoile River rises substantially to Kilmore where it branches at the convergence of the Ballynahinch and Glasswater rivers.

Minor Urban Tributaries (Downpatrick Centre)

The designated Plank Drain fringes the southern end of Downpatrick's town centre and flows from the east of the town to meet Quoile River just upstream of the railway bridge. The watercourse is open from its confluence with the Quoile to the outskirts of the town at Ballyduggan Road, after which it is largely culverted. The lower section under the playing fields is twin 900mm diameter concrete pipes and has not been structurally graded because the pipes are partially filled with silt and/or standing water due to backflow from the Quoile Pondage. Upstream of the pitches, the Plank Drain receives a small open watercourse (the designated Pemberton Park), at this point the size of the culvert reduces substantially (typically 450mm diameter concrete pipes) and these are in good structural condition apart from one relatively short section near the head of the system.

The Town Drain, which is a sizeable tributary of the Plank Drain, fringes the west side of the town centre and flows south from the rear of the Grove Shopping Centre at Market Street to its confluence with the Plank Drain at the vicinity of the Asda Store. The Town Drain is culverted with concrete pipes (typically 675-750mm diameter) for the whole of its length. The condition of the culvert is generally in poor condition (most sections structural grade 4 or 5) and, as with the Plank Drain, the lower sections have not been inspected due to standing water and/or siltation.

The Saul Street Stream borders the north side of the town. It flows from the Meadowlands housing estate to the Quoile River just upstream of the Belfast Road Bridge at the sewerage treatment works. The watercourse is culverted throughout the Meadowlands estate and along Church Road where it issues to an open section at the west side of New Bridge Street just north of the Downpatrick Business Park. The culverts are typically 675mm to 1350mm diameter concrete pipes with an occasional section of box culvert and are generally in good structural condition.

The Strangford Road Stream is located at the northern side of the town. This designated watercourse is culverted for approximately 400m of its 600m length. The culverted section begins at the upstream side of the Strangford Road, runs throughout the length of the Orchard housing estate and under the Old Belfast Road where it flows to a short open section (approx. 100m in length) that discharges to the Quoile Pondage. The culverts are typically 1350mm diameter and generally in good structural condition.

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Fluvial Flooding Mechanisms

Figure 5.4.6.2 illustrates the predicted extents of the potential fluvial flooding at Downpatrick and details of the potential impact of the flooding on property and key infrastructure is summarised in Table 5.4.6.1. The model shows that at the relatively high frequency 10% AEP flood event, floodwater is predicted to spill from all of the culverted watercourses within the town and that the resulting surface water flow will pond to shallow depths (up to 300mm) in the low lying areas, most notably at Market Street, Church Street and Ballyduggan Road. The main cause of flooding from the watercourses in the Downpatrick area is likely to be related to the fact that, for much of the time, the water level in the Quoile Pondage is substantially higher than the invert levels of the culvert outfalls. The submersion of the outfalls severely limits the flow carrying capacity of the culverts and during extreme events, water from the Quoile Pondage will backflow through the culvert networks and spill onto the surface via manholes in the low lying areas of the town. On the basis of the predictive model it is estimated that at the relatively frequent 10% AEP (1 in 10 year) event, 10 residential and 37 commercial properties could be internally flooded and cause damages in excess of £376k. At the more extreme 1% AEP (1 in 100 year) event the predicted flooding is generally confined to the same locations, although the flood inundation areas are more extensive and deeper (up to 1m deep) particularly in the vicinity of Market Street. Flooding from the 1% AEP event is estimated to affect 63 residential and 113 commercial properties at a cost of around £1.7m. The present day value of the total cost of future flood damages is calculated to be around £3 million.

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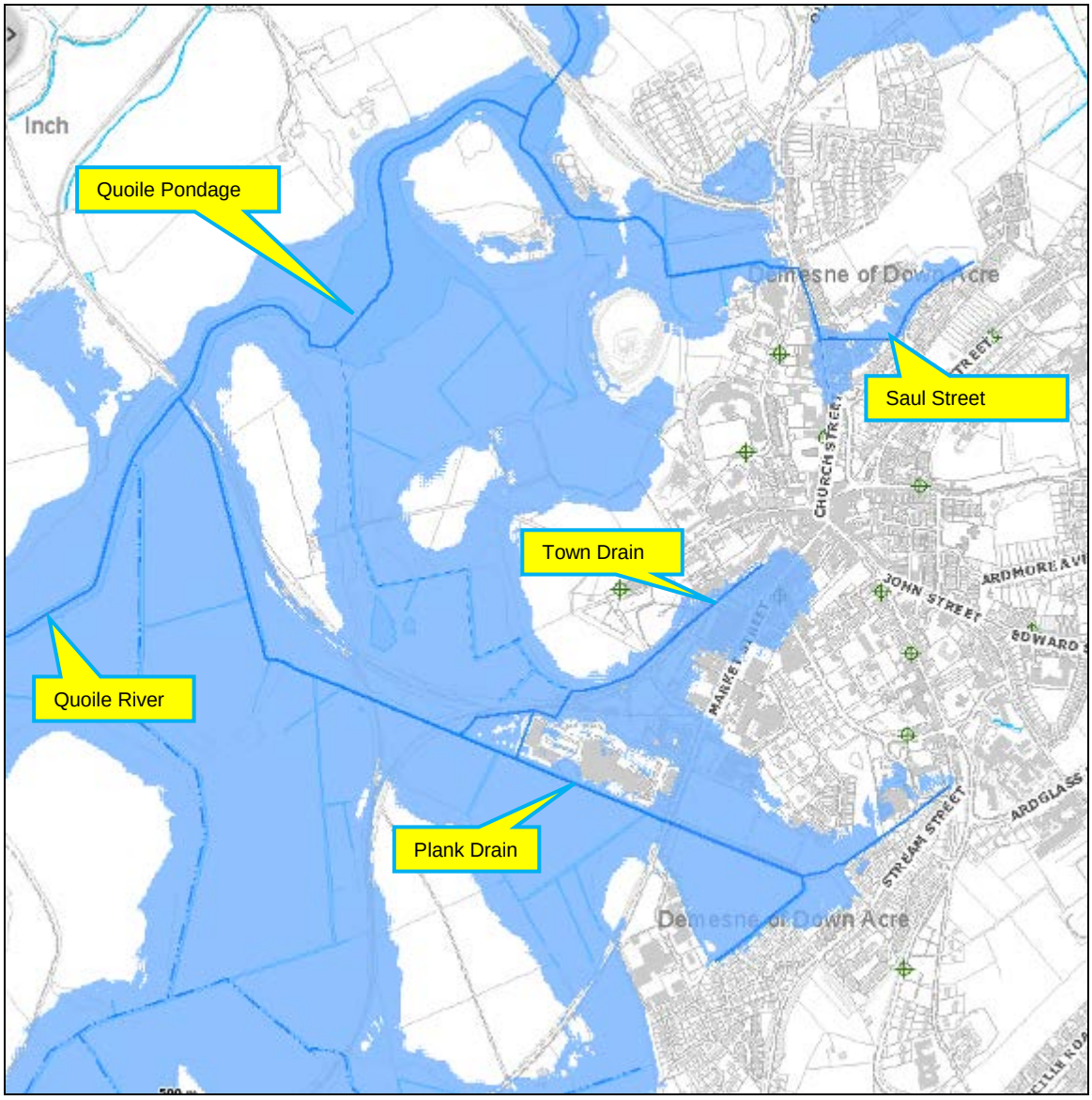

Figure 5.4.6.2 - Downpatrick SFRA – Fluvial Flood Plains 1% AEP (1 in 100 year)

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Table 5.4.6.1 Downpatrick SFRA			
Potential Adverse Consequences – Fluvial Flooding			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**10**	**40**	**63**
Non Residential (Nr)	**37**	**70**	**113**
Economic Damage (£)	**£376k**	**£700k**	**£1.7m**
Annual Average Damage (£)	**£100k**		
Present Value (£)	**£3.0m**		
IPPC sites (Nr)	**0**		**0**
Community Assets (Nr)	**0**		**0**
Care Homes	**0**		**0**
GP Surgery's	**0**		**0**
Fire stations	**0**		**0**
Hospitals	**0**		**0**
Police Stations	**0**		**0**
Schools	**0**		**0**
Key Infrastructure (Nr)	**1**		**13**
NIW Wastewater Treatment Works	**0**		**0**
NIW Sewage Pumping Stations	**0**		**3**
NIW Water Treatment Work	**0**		**0**
NIW Treated Water Pumping Stations	**0**		**0**
NIE Substation 6to11kV	**0**		**7**
NIE Substation 33kV	**0**		**0**
NIE Substation 275kV	**0**		**0**
NIE Substation 110kV	**0**		**0**
Road Service - Trunk Road	**1**		**3**
Environmental Designated sites (Nr)	**10**		**10**
AONB	**1**		**1**
ASSI	**2**		**2**
Environmentally Sensitive Areas	**0**		**0**
Maritime Nature Reserve	**0**		**0**
Nature Reserve	**1**		**1**
RAMSAR	**1**		**1**
SAC	**1**		**1**
Sites of Local Nature Conservation Importance	**3**		**3**
SPA	**1**		**1**
RSPB Reserve	**0**		**0**
UWT Nature Reserve	**0**		**0**
Built Heritage sites (Nr)	**11**		**14**
National Trust	**0**		**0**
Listed Buildings	**0**		**0**
Sites and Monuments Records	**7**		**9**
Buildings of Special Architectural or Historical Interest	**2**		**3**
Areas of Significant Archaeological Interest	**1**		**1**
Historic Gardens	**1**		**1**

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5.4.7 Proposed Fluvial Flood Mitigation Measures

Prevention

As well as managing the existing flood risk to people and properties in Downpatrick it is important that the flood risk is not increased by new development in areas of known flood risk. Northern Ireland's planning policies adopt a precautionary approach to development that aim to prevent future development that may be at risk of flooding or that may increase the risk of flooding elsewhere.

Reference should be made to Section 4.4 under the headings Planning NI and Local Government regarding the reform and restructuring of the planning system in Northern Ireland. Rivers Agency's Planning Advisory Unit provides advice to Planning NI and Local Councils in relation to the prevention of flooding. In particular Local Councils are advised on Development Plans and at the Planning Application stage. Flood mapping information is used to inform the preparation of local Development Plans to ensure, where possible, that new zonings are located outside the identified flood risk areas. In the determination of planning applications any proposed development within a flood risk area will either be advised against or will be further considered if it meets one of the "Exception" rules and is accompanied by a suitable Flood Risk/Drainage Assessment. Applications that relate to "Greenfield" built development in fluvial floodplains are unlikely to be accepted, whereas applications for recreation purposes and amenity open space will usually be accepted.

Development Plans

In the preparation of new Development Plans for Downpatrick, Rivers Agency will advise against bringing forward sites or the zoning of any land, particularly for built development, that has been identified from the flood maps as being within the 1 in 100 year fluvial floodplain, reservoir inundation area or is susceptible elsewhere to surface water flooding.

Rivers Agency shall also review the existing Development Plan for Downpatrick (Ards and Down Area Plan) with a view to addressing flood risk issues which have only recently been identified as a result of the new flood maps.

The main (undeveloped) flooded areas, amongst others, within the Downpatrick Significant Flood Risk Area are:

- West of the town, between the urban fringe and the Quoile River
- South of the town along both sides of Market Street
- North of the town between the urban fringe and the Belfast Road
- North of the town at the Belfast Road and junction with Bridge Street
- Both sides of the Strangford Road near the junction with the Old Belfast Road
- West of the town between Meadowlands and Drumdoon Walk

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Planning Applications

Fluvial Areas at risk

Rivers Agency shall advise against the development of all sites that are located within the 1 in 100 year fluvial floodplain, irrespective of whether they are located within a current development plan or as a single site application outside the plan area.

For those sites within the 1 in 100 year fluvial floodplain where the principle of development has been accepted by Local Council as meeting the 'Exception Test' Rivers Agency will further consider the application through the appraisal of an accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures.

The main existing developed areas, amongst others, at flood risk within Downpatrick where re-development may be likely to take place are in the vicinity of:

- Market Street / St Patrick's Avenue/ Ballydougan Road
- Church Street

Areas at Risk of Surface Water flooding

For those sites outside the 1 in 100 year fluvial floodplain that are located in an area where there is evidence of a history of surface water flooding (identified by flood hardship payments) Rivers Agency will further consider the application through the appraisal of the accompanying Drainage Assessment that will need to demonstrate suitable flood mitigation measures.

Where there is potential for surface water flooding as indicated in the 'purple' predicted areas on the Surface Water Maps, Rivers Agency will advise that the applicant should assess the flood risk and drainage impact to the site and construct in an appropriate manner.

The main areas with a flood history, identified in Downpatrick as being at surface water flood risk are:

- Market Street/ Saul Street
- Church Street
- Playing fields between Ardglass Road and St Dillon's Avenue
- Playing fields east of Ballydougan Road

Areas at Risk of Flood Inundation from Reservoirs

For all development proposals that are located within the potential flood inundation area of a Controlled Reservoir we will further consider the application through the appraisal of the accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures. If it is a new development

proposal Rivers Agency will also need the applicant to demonstrate that the condition, management and maintenance regime of the reservoir is appropriate to provide sufficient assurance regarding reservoir safety. Controlled Reservoirs identified in the Downpatrick area are as follows:

- Finnebrogue Lough

Protection

Structural measures are still one of the main options in providing flood protection to people and property impacted by the effects of extensive flooding. It is therefore important that we continue to target investment by providing flood defence, culvert alleviation schemes and infrastructure upgrade works to those communities at greatest need.

The alleviation of surface water flooding, in particular, will require input from a number of bodies. The Flood Investment and Planning Group, FIPG, provides a coordinated approach across Government in relation to the investigation of flooding, agreeing responsibilities and identifying collaborative solutions. The group is represented by Rivers Agency, NI Water and Transport NI, amongst others, with flood risk management responsibilities.

There are a number of stages to follow when procuring a flood alleviation scheme. The potential scheme needs to be first subjected to a feasibility study that will also include an economic appraisal. From the detailed Hazard and Risk Maps a 'Flood Risk Metric Tool' (FRISM) is used in urbanised flooded areas to get an estimate of the likely property damages as a result of a range of flood events. The estimated cost of a scheme is then compared to the total 'damage avoidance benefits' that the scheme will provide to the property over the scheme's design life. If the benefit/cost ratio is greater than 1 then the potential scheme will be referred to Rivers Agency's Capital Procurement Unit for a feasibility study to be undertaken.

If the flooding issue identified is not solely Rivers Agency's responsibility, or is the responsibility of NI Water or Transport NI, such as a local drainage or road infrastructure issue, it will be referred either to FIPG or directly to the responsible body, for their further consideration.

If a benefit cost analysis identifies a viable scheme, a scheme will be placed on a prioritisation list for works with other competing schemes. The position on the list will depend on a set marking criteria, such as the benefit/ cost ratio and the overall scheme costs. Depending on the availability of resources it may take anything from between 2 – 5 years for the scheme to progress from the start of the feasibility study to construction works commencing on the ground.

Having conducted a detailed assessment of the fluvial flood risk to Downpatrick, Rivers Agency has determined that a potential flood alleviation schemes to reduce the food risk to property arising from all of the minor urban watercourses which discharge to the Quoile Pondage may be justified. Any flood study to identify viable solutions must take into consideration the wider impacts on the urban drainage systems within the town. See below for details.

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Downpatrick Integrated Urban Drainage Study

The predictive flood model used to produce the fluvial flood hazard maps took account of discharges from NI Water's sewerage network using a generalised approach that gives rise to a degree of uncertainty that may impact on the accuracy of the model. NI Water has commenced a major sewerage infrastructure improvement project in Downpatrick that is designed to reduce the risk of out of sewer flooding. Therefore, to ensure that this investment is not compromised River Agency shall cooperate with NI Water to develop a more refined integrated urban drainage model (IUDM) that will examine the potential flood mechanisms arising from the interaction between the various drainage systems i.e. sewerage, watercourses and pondage.

The IUDM will be used to identify any potential improvements that may be required to NI Water's sewerage network to further reduce the risk from out of sewer flooding and as the basis for a detailed flood study, to be undertaken by Rivers Agency, to identify if a publicly funded flood alleviation scheme to reduce the risk of flooding from the pondage and watercourses is cost beneficial.

An initial assessment of the potential options indicates that it highly unlikely that modifications could be made to the Quoile Barrier to affect control over the water level in the Quoile Pondage to the extent that the culvert outfalls will not be drowned out. Therefore, whilst it may be necessary to improve the condition and/or increase the size of the culverts, this of itself would not be an effective solution unless supported by additional measures such fitting flap valves to outfalls, installing back drainage pumping stations and constructing flood banks to contain direct flows from the pondage.

Preparedness

In Downpatrick it is not possible to prevent or protect against all flooding. Indeed even where flood defences exist it is possible in an extreme event that these could be over topped and flooding could still occur.

Having recognised this fact, considerable effort in recent years has been made by emergency planners in a Government Departments, Councils and the Emergency Services working together and sharing information to ensure a coordinated response.

However, despite these improvements during significant flood events the emergency response of Government Departments and the Emergency Services can become over stretched. This means that not all calls for assistance during a flood event may be responded to in a timely manner. With this in mind it is important that households and communities, subject to a known flood risk, are prepared. The detail of preparedness actions, including flood warning and informing activities planned from a regional perspective, are provided in Appendix E.

This is not Government withdrawing from any undertaking to respond in emergencies but an additional layer of support to ensure Government Departments and the public work together to reduce the overall impacts of flooding.

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From the flood risk assessment it would appear that there are 3 main areas within Downpatrick that have flooded before and may benefit from the flood warning and informing proposals outlined in Appendix D.

A pilot project of community engagement to deliver flood warning and informing, held in 2014, identified basic assessment formulae to assess and score areas that could potentially be a focus for flood warning and informing actions. Based on this scoring these areas did not score high enough to be placed within the top 20 communities to be offered a programme of community engagement during the period of this plan. However, if communities want to become more resilient, the Department is committed to providing assistance were possible to develop the consistent approach to resilience. The NI Direct website www.nidirect.gov.uk/ will host further information and advice on what to do in advance of flooding, what to do during flooding and how to recover after flooding. The website will also contain templates for communities wishing to develop their own plan.

5.5 Dundonald Significant Flood Risk Area

The core boundary of the Dundonald SFRA, which has been determined through the PFRA, is located within the Strangford Lough Local Flood Management Area and is illustrated in Figure 5.5.1 below.

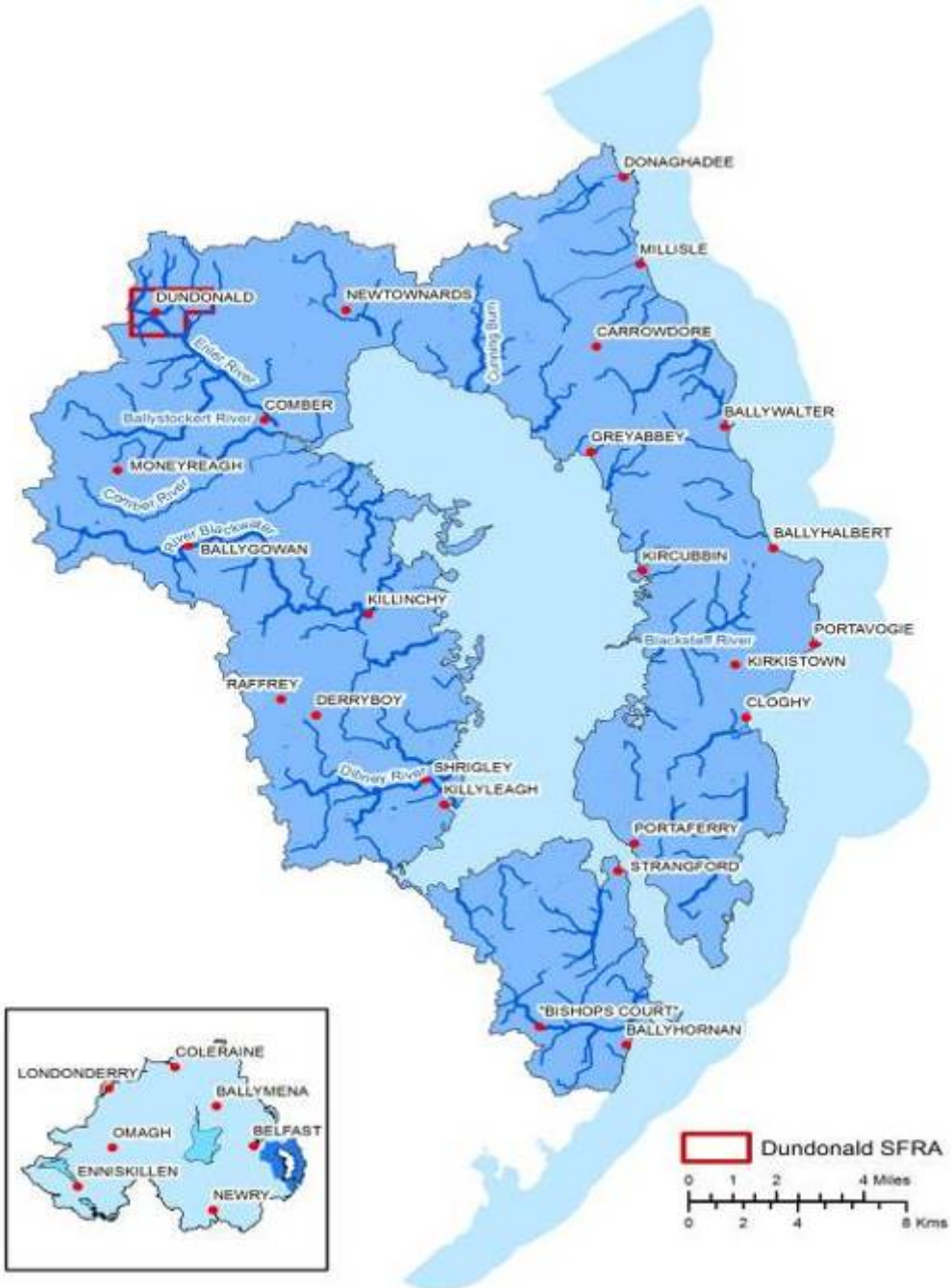

Figure 5.5.1 Strangford Lough Local Flood Management Area and Dundonald SFRA

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5.5.1 Flooding History

A review of the readily available archived historical flood data, including the local and regional newspapers would not suggest that Dundonald is not prone to frequent flooding as it was not possible to identify any major flood events prior to 2007.

Figure 5.5.1.1 - Flooding at Dundonald Ice Bowl, 27 June 2012

Since the introduction of the flooding hardship payment scheme in 2007 there have been 37 payments issued to homeowners in the Dundonald SFRA. The majority of these payments (23 in number) relate to the extreme flooding on 27th June 2012 which affected large parts of the central and to a lesser extent, eastern parts of the province. Most of the flooding that occurred on this day was estimated to have a return period in excess of a 1 in 100 year event. The properties affected during this particular event where mainly clustered in a few localised residential areas, most notably in the vicinity of Dunleady Park/Canberra Park (18 properties), Wanstead Road/Ferndeane Road (5 properties) and Old Dundonald Road (3 properties). Also flooded at this time were the Dundonald Ice Bowl (pictured above) and the DARD's Dundonald House within the Stormont Estate. A previous event in flood event in June 2007 resulted in hardship claims from 6 properties in the Dundonald area. On this occasion the flooded properties were widely scattered, which is reflective of the fact that the flooding was due to a high intensity, short duration rainfall event and most likely related to the overloading of local drainage/sewerage systems.

5.5.2 PFRA – Identification of Potentially Significant Flood Sources

According to the Preliminary Flood Risk Assessment (Dec 2011) the town of Dundonald, in terms of the severity of the potential adverse consequences of flooding, is ranked lowest of the twenty SFRA within Northern Ireland (see Figure 4.1). Although there have been very few records of historical flooding in Dundonald, it is important to recognise that the identification of potentially significant flood risk areas, is

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largely based on predictive flood models as it would be inappropriate to presume that significant flooding will not occur in future because it hasn't occurred in the relatively recent past. The strategic flood models used for the PFRA indicates that within Dundonald there may up to 470 properties located within the floodplains of the River Enler and its tributaries and as a consequence the town was considered to be at potential significant risk from fluvial flooding.

Although the strategic flood maps are suitable for indicating general areas that may be prone to flooding their accuracy is not sufficient is to identify the flood risk to individual properties or as the basis for capital investment decisions for flood alleviation works. Therefore, to facilitate a more robust assessment of the flood risk to Dundonald a detailed flood model was developed for the River Enler and its tributaries. Details of the model and the assessment of the flood risk based on its findings are described below.

5.5.3 Catchment Description

Dundonald is a large settlement in County Down. Located east of Belfast, it is often deemed to be a suburb of the city and includes the large Ballybeen housing estate and many new housing developments which have emerged in the past twenty years. Drainage systems within Dundonald are dominated by the River Enler which rises in the Hollywood and Castlereagh Hills and flows in a south easterly direction for approximately 8km to its tidal outfall at Comber. The catchment of the watercourse extends to an area of around 63km^2. Apart from the urban areas within Dundonald and Comber, which have a combined area less than the 8km^2, the catchment is largely rural in nature. The main channel of the Enler River appears to have been artificially straightened and within the development limits of the town it has a number of tributaries, most of which are substantially culverted and have small heavily urbanised catchments.

5.5.4 Fluvial Flood Risk Assessment

Flood Model

The hydrodynamic model used for the assessment of fluvial flood risk was developed using Infoworks ICM. An existing HEC – RAS model and new survey data were combined to form one composite 1D/2D model of the rural and urban watercourses within the study reach. The study reach for the Enler River model commences from its outlet at Strangford Lough (approx. 1km east of Comber) and extends a distance of around 13km upstream to above the Upper Newtownards Road Culvert in Dundonald. It was decided that the model should cover the entire length of the river from Dundonald to the sea because (based on the strategic flood maps) the town of Comber is also assessed to be at risk of flooding from the Enler River and has been identified as an Area for Further Study. Therefore, by modelling the entire length of the river there was an opportunity to improve the flood hazard mapping for Comber. The modelled extents of the Enler River and the associated tributaries that may impact on the Dundonald settlement are illustrated in Figure 5.5.6.1 below.

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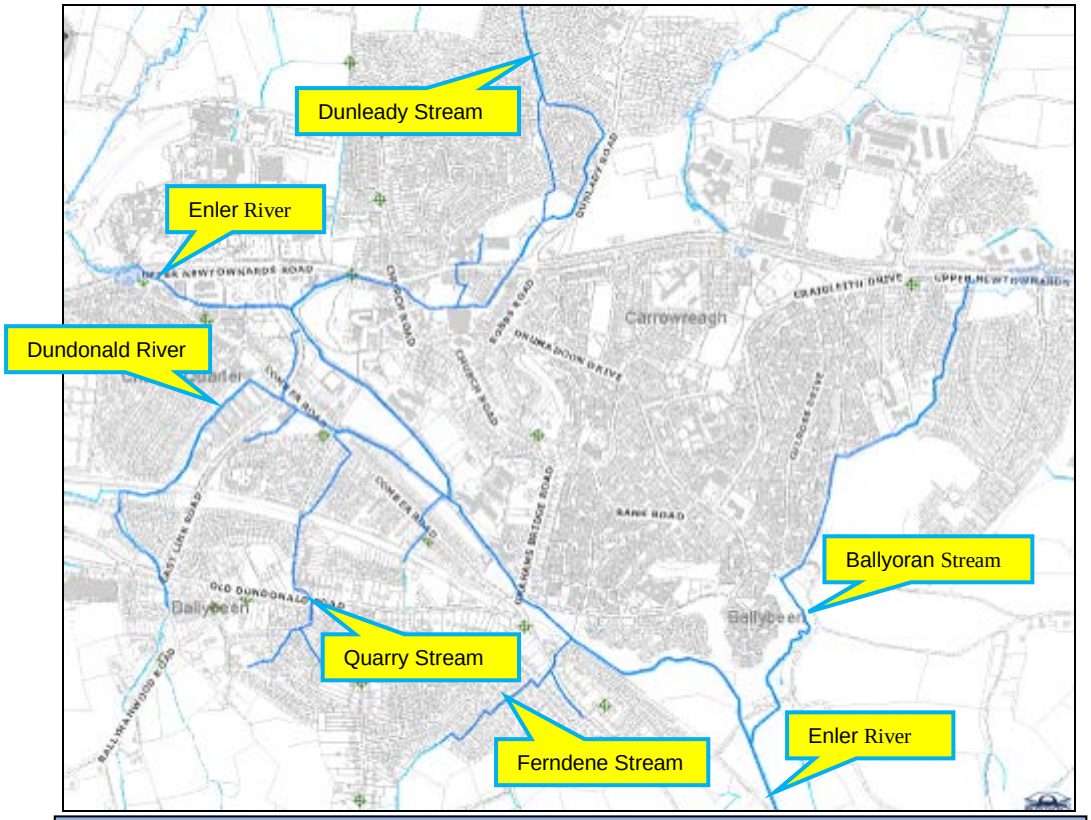

Figure 5.5.6.1 - Dundonald SFRA – Modelled Watercourses (Enler River and tributaries)

As the model predicts that there is virtually no flooding to property from the Dundonald River and no records of historical flooding associated with it, there is no further consideration of this watercourse within the Plan.

Fluvial Flooding Mechanisms

River Enler

The model predicts that the Enler River begins to overspill its right bank in the vicinity of Moat Park at the relatively frequent 50% AEP (1 in 2 year) event. Although at this return period the floodwater does not reach the line of terrace properties at the east side of the Comber Road (between Motte Lodge and Grahams' Bridge road junction) which are some 100m remote from the watercourse. Figure 5.5.6.2 below illustrates the predicted flood extents at the 1 in 10 year (10% AEP) and 1 in 100 year (1% AEP) events. The model indicates that at the 10% AEP event, floodwater skirts the line of properties, mainly causing flooding to gardens, detached garages and possibly shallow depth internal flooding to a few homes. The general ground levels at the property line are such that the extent of the property flooding does not increase markedly at the 1 in 50 year (2% AEP) event.

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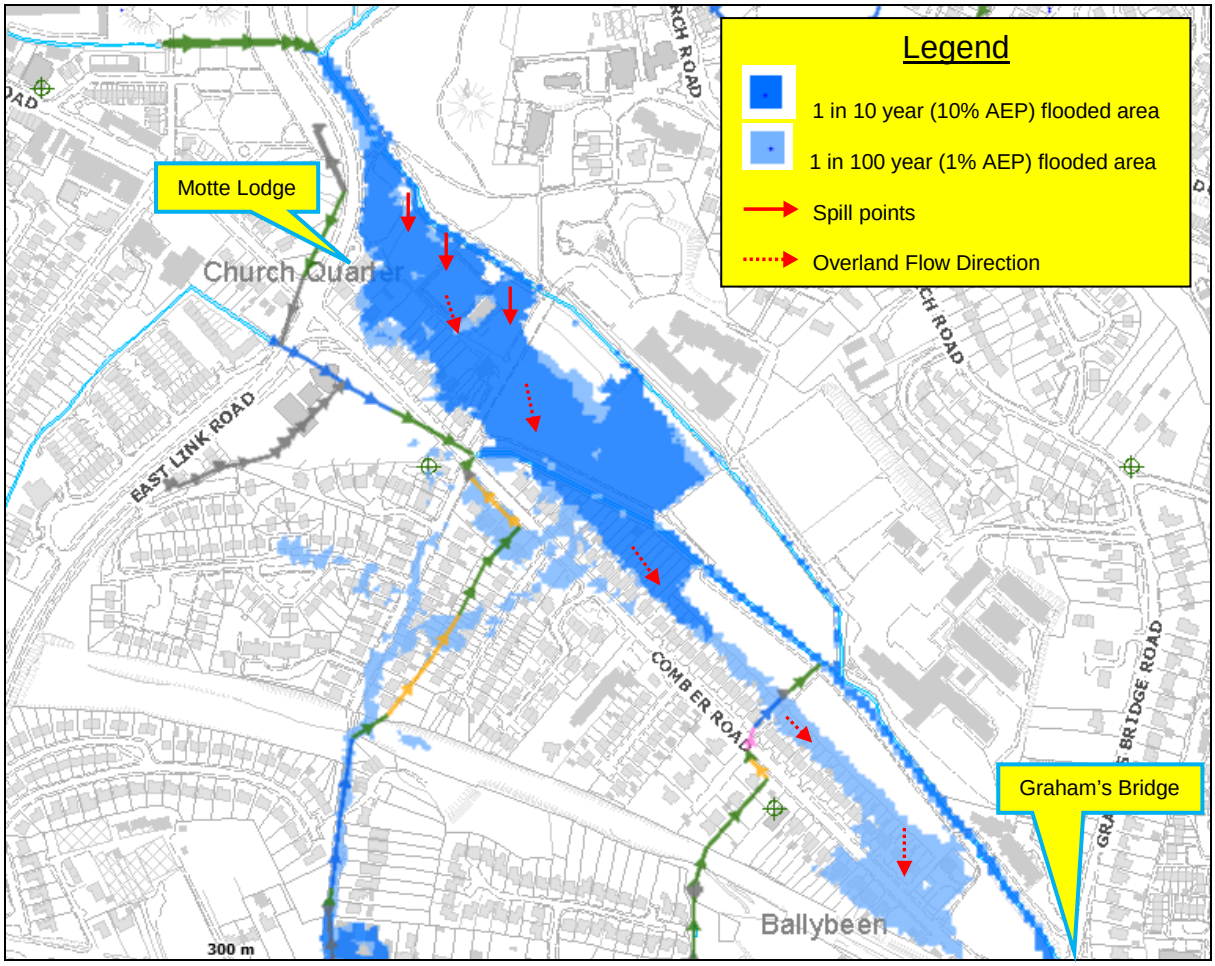

Figure 5.5.6.2 - Dundonald SFRA – Flooding Mechanism at River Enler (main channel)

Even at the at the 1 in 100 year (1% AEP) event the floodwater continues to skirt the majority of the properties along the Comber Road, although in this scenario there are at least 16 properties at Graham's Bridge which are estimated to fall within the increased area inundation area. In addition, floodwater also flows across the Comber Road and inundates a few properties on the south side of the road near Mawhinney Park.

Ballyoran Stream

The model predicts that during a 1 in 100 year flood event on the Ballyoran Stream, floodwater overtops the right bank of a section of open watercourse upstream of the Ballyoran Nursing Home. The floodwater inundates the Nursing Home, Community Centre and around ten residential properties in the adjacent housing development. The overland flow continues southwards via Ardmore Avenue, flooding a couple of properties at Beauly Drive, before returning to the watercourse at the next open section which begins at Millmount Road.

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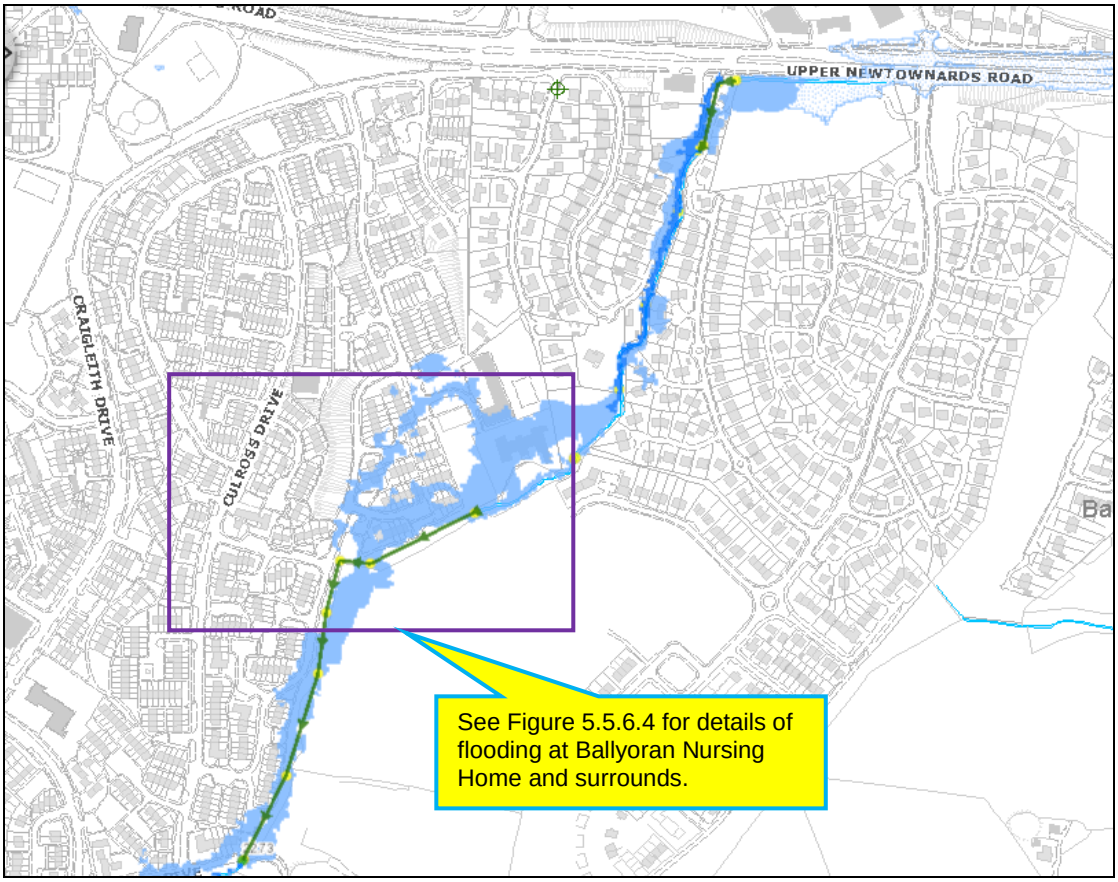

Figure 5.5.6.3 - Dundonald SFRA – Ballyoran Stream, 1% AEP Floodplain

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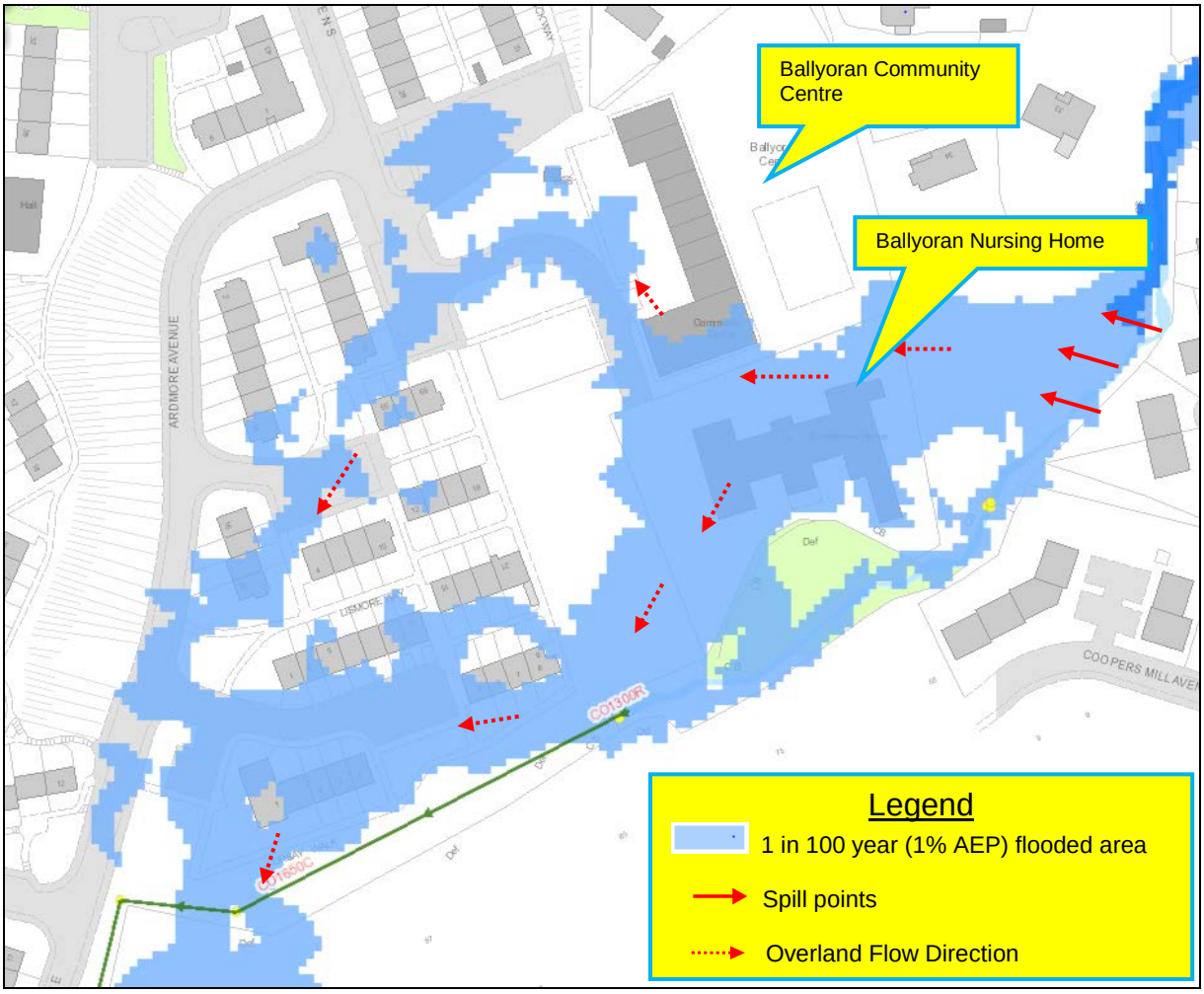

Figure 5.5.6.4 - Dundonald SFRA - Flooding mechanism at Ballyoran Stream (1% AEP)

Quarry Stream

The model indicates that flooding from the Quarry Stream originates from the reach marked A-B on Figure 5.5.6.5. It is predicted that flooding commences at the frequent 1 in 2 year event as floodwater overspills the banks of a short open section and discharges to the surface through a number of surcharged culvert manholes. In this scenario the very shallow flooding is contained within a narrow band following the route of the watercourse from Forthill Close to the Old Dundonald Road and is unlikely to cause internal flooding to property. At the 1 in 10 year (10% AEP) event the flooding is still contained within the same area although it begins to spread and deepen and could result in flooding to around 12 properties. At the 1 in 50 year (2% AEP) event the floodwater is routed beyond the Old Dundonald Road, as it flows steeply downhill via. Quarry Lane, then Grand Prix Park until it finds its way into the open section of the Dundonald River at the Comber Road. The extent of the flooding increases at the 1 in 100 year (1% AEP) event and although it is contained within a fairly narrow band by the steepness of the topography, it estimated to cause internal flooding to in excess of 30 properties. It should be noted that there is very limited historical flood information available for this area and no evidence of actual flooding arising from this watercourse since the introduction of the Flooding Hardship Payment scheme in 2007.

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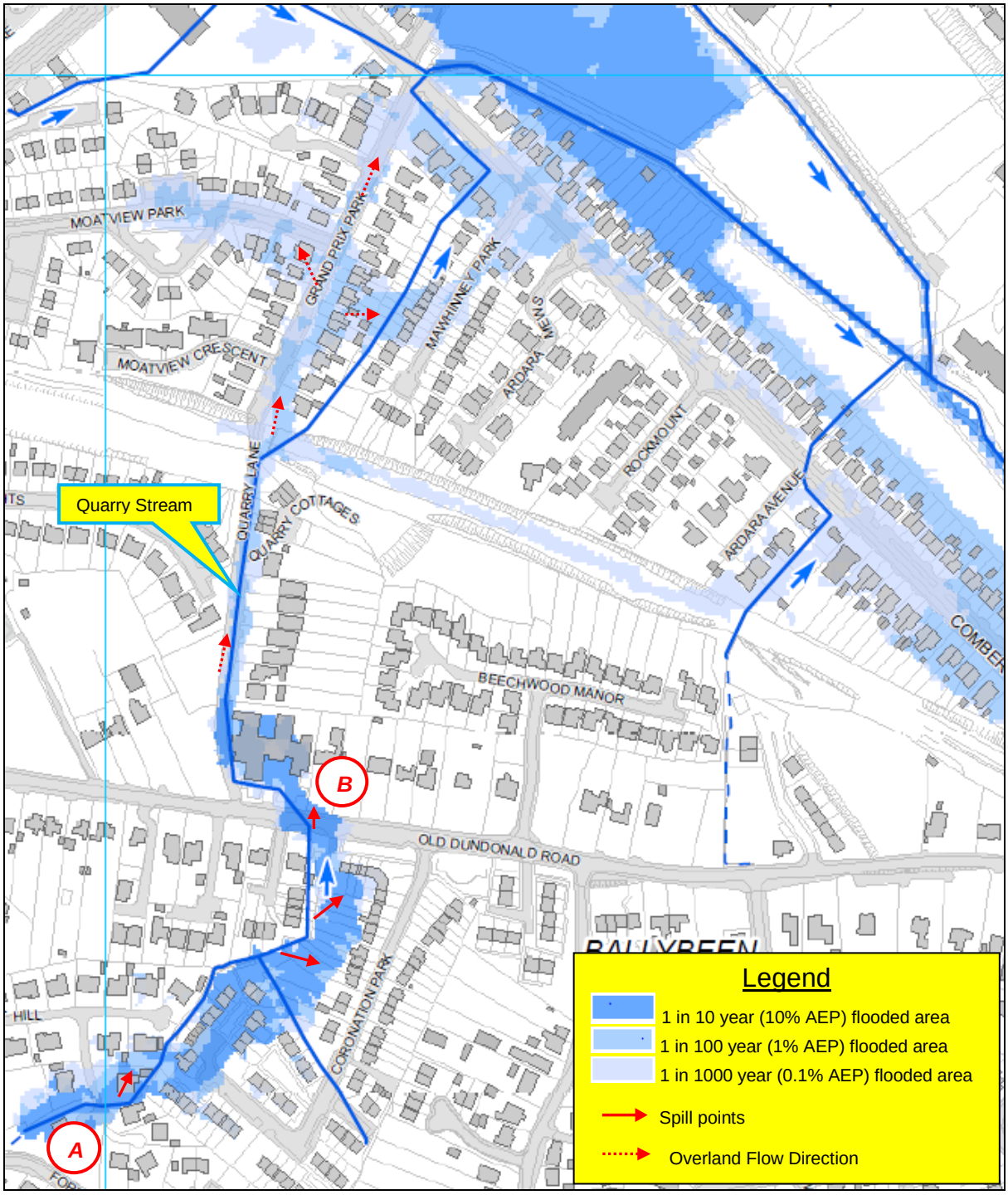

Figure 5.5.6.5 - Dundonald SFRA – Flooding Mechanism at Quarry Stream

Dunleady Stream

The model indicates that there is unlikely to be any out of channel flooding from the Dunleady Stream until the occurrence of 1 in 50 year (2% AEP) event or greater. In this scenario floodwater rises to the surface from surcharged culvert manholes in the gardens of properties at Canberra Park/ Dunleady Park. The floodwater travels overland and is predicted to cause shallow depth flooding to around six properties at Canberra Park. The extent of the flood inundation area increases to include 22 residential properties at the 1 in 100 year event

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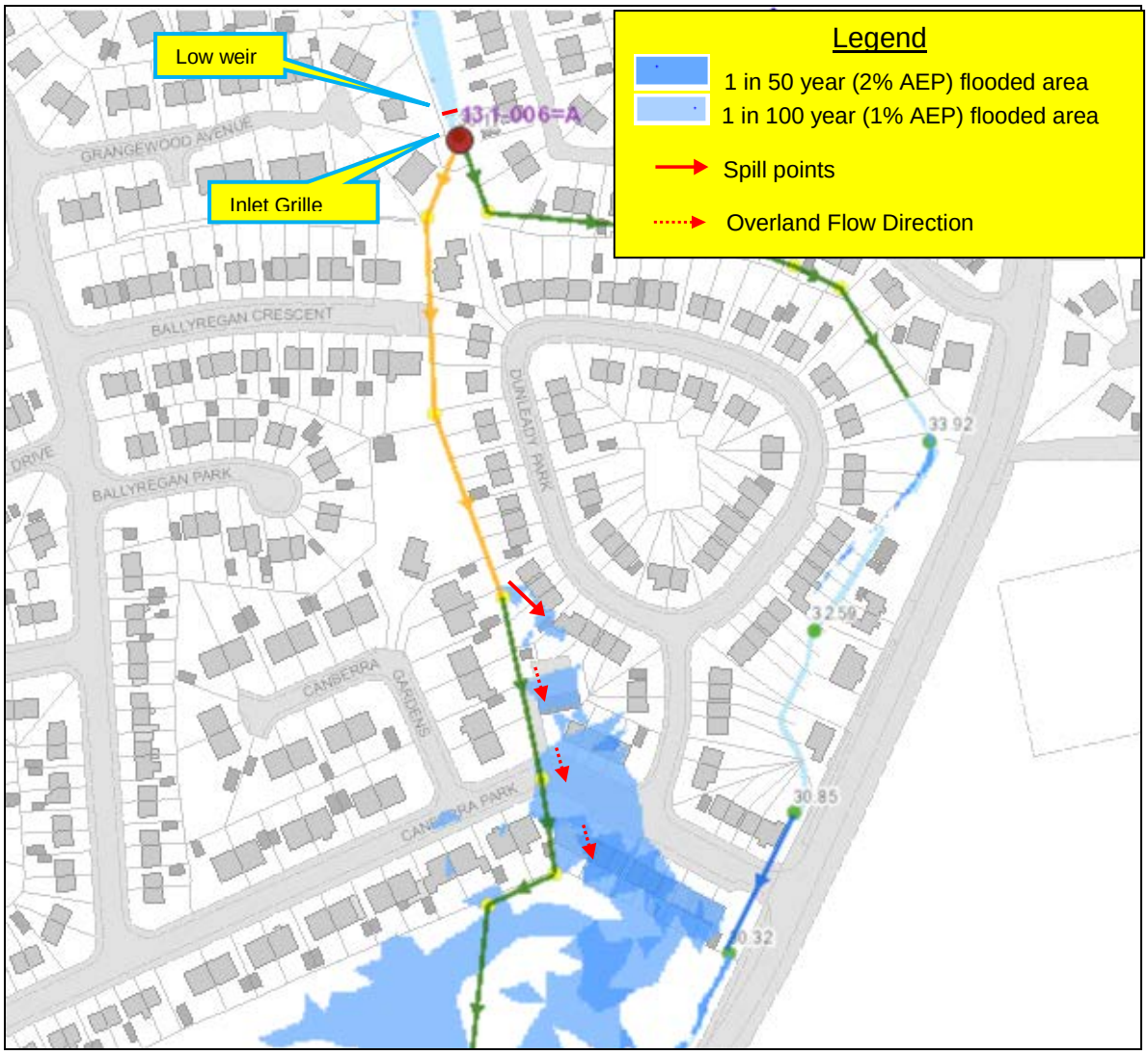

Figure 5.5.6.6 - Dundonald SFRA – Flooding Mechanism at Dunleady Stream

It is known that 18 properties in the vicinity of Dunleady Park and Canberra Park flooded during an extreme flood event in June 2012. A flood investigation report that was carried out by the Rivers Agency's Area Office in the immediate aftermath of the flooding, concluded that the actual peak flow in the river during this event was far in excess of a 1 in 100 year event. On this occasion, the floodwater overtopped the bank of an open section of the watercourse immediately upstream of a culvert inlet structure (see Figure 5.5.6.6), flowed over the surface around the inlet structure and into the Dunleady estate. The Area Report recommended that consideration should be given to the lowering of a small weir which is located approximately 10m upstream of the inlet structure to increase the surcharge capacity and reduce the potential for overtopping at this location in the future. However, based on the findings of the predictive model, if would seem likely that if the watercourse had not overtopped the inlet structure it would have spilled from the manhole a short distance downstream as highlighted in Figure 5.5.6.6.

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Ferndene Stream

The model indicates that there is likely to be no out of channel flooding from the Ferndene Stream at the 1 in 100 year (1% AEP) flood event. Although the model shows that this largely culverted watercourse is considered to be capable of satisfactorily venting the flow from a 1 in 100 year event and it is known to be in good structural condition throughout its length, it did cause flooding to at least 5 properties during the widespread flood event in June 2012. A post flood investigation report that was produced by the Rivers Agency's Area Office concluded that the culverted Ferndene Stream is fit for purpose and does not present a flood risk to property at the 1 in 100 year event. The investigation revealed that the flooding mechanism in this instance was overtopping of the inlet grille at the rear of 17 Ferndene Gardens and was probably caused by a reduction in the capacity at the culvert due to an accumulation of gravel. There is a history of gravel accumulation at this inlet structure (see Photograph 5.5.6.1) and it has been difficult to secure vehicular access to the grille for maintenance as it involves travelling across the lawns of adjacent properties. Consequently, the removal of gravel is an onerous undertaking as it has to be carried out by hand. It is recommended in the Area Report that the Agency should consider the installation of at least three separate gravel traps in a more accessible section of the watercourse, located 200m to 300m upstream of the offending grille.

Photograph 5.5.6.1 - Ongoing problem with gravel accumulation at Ferndene Stream

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Table 5.5.6.1 Dundonald SFRA – Enler River & tributaries			
Potential Adverse Consequences – Fluvial Flooding			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**37**	**72**	**191**
Non Residential (Nr)	**3**	**4**	**10**
Economic Damage (£)	**£58k**	**£88k**	**£599k**
Annual Average Damage (£)	**£40k**		
Present Value (£)	**£1.2m**		
IPPC sites (Nr)	**0**	**0**	**0**
Community Assets (Nr)	**0**	**1**	**2**
Care Homes	**0**	**1**	**2**
GP Surgery's	**0**	**0**	**0**
Fire stations	**0**	**0**	**0**
Hospitals	**0**	**0**	**0**
Police Stations	**0**	**0**	**0**
Schools	**0**	**0**	**0**
Key Infrastructure (Nr)	**0**	**1**	**8**
NIW Wastewater Treatment Works	**0**	**0**	**0**
NIW Sewage Pumping Stations	**0**	**0**	**2**
NIW Water Treatment Work	**0**	**0**	**0**
NIW Treated Water Pumping Stations	**0**	**0**	**0**
NIE Substation 6to11kV	**0**	**0**	**2**
NIE Substation 33kV	**0**	**0**	**0**
NIE Substation 275kV	**0**	**0**	**0**
NIE Substation 110kV	**0**	**0**	**0**
Road Service - Trunk Road		**1**	**4**
Environmental Designated sites (Nr)	**0**	**1**	**1**
AONB	**0**	**0**	**0**
ASSI	**0**	**0**	**0**
Environmentally Sensitive Areas	**0**	**0**	**0**
Maritime Nature Reserve	**0**	**0**	**0**
Nature Reserve	**0**	**0**	**0**
RAMSAR	**0**	**0**	**0**
SAC	**0**	**0**	**0**
Sites of Local Nature Conservation Importance	**0**	**1**	**1**
SPA	**0**	**0**	**0**
RSPB Reserve	**0**	**0**	**0**
UWT Nature Reserve	**0**	**0**	**0**
Built Heritage sites (Nr)	**0**	**0**	**0**
National Trust	**0**	**0**	**0**
Listed Buildings	**0**	**0**	**0**
Sites and Monuments Records	**0**	**0**	**0**
Buildings of Special Architectural or Historical Interest	**0**	**0**	**0**
Areas of Significant Archaeological Interest	**0**	**0**	**0**
Historic Gardens	**0**	**0**	**0**

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5.5.5 Proposed Fluvial Flood Mitigation Measures

Prevention

As well as managing the existing flood risk to people and properties in Dundonald it is important that the flood risk is not increased by new development in areas of known flood risk. Northern Ireland's planning policies adopt a precautionary approach to development that aim to prevent future development that may be at risk of flooding or that may increase the risk of flooding elsewhere.

Reference should be made to Section 4.4 under the headings Planning NI and Local Government regarding the reform and restructuring of the planning system in Northern Ireland. Rivers Agency's Planning Advisory Unit provides advice to Planning NI and Local Councils in relation to the prevention of flooding. In particular Local Councils are advised on Development Plans and at the Planning Application stage. Flood mapping information is used to inform the local preparation of Development Plans to ensure, where possible, that new zonings are located outside the identified flood risk areas. In the determination of planning applications any proposed development within a flood risk area will either be advised against or will be further considered if it meets one of the "Exception" rules and is accompanied by a suitable Flood Risk/Drainage Assessment. Applications that relate to "Greenfield" built development in fluvial floodplains are unlikely to be accepted, whereas applications for recreation purposes and amenity open space will usually be accepted.

Development Plans

In the preparation of new Development Plans for Dundonald, Rivers Agency will advise against bringing forward sites or the zoning of any land, particularly for built development, that has been identified from the flood maps as being within the 1 in 100 year fluvial floodplain, reservoir inundation area or is susceptible elsewhere to surface water flooding.

Rivers Agency shall also review the existing Development Plan for Dundonald (Belfast Metropolitan Area Plan 2015) with a view to addressing flood risk issues which have only recently been identified as a result of the new flood maps.

The main (undeveloped) flooded areas within Dundonald are:

- Both sides of the Dunleady Stream & Canberra Park Stream to the north of the Upper Newtownards Road.
- South of the Enler River and behind property along the Comber Road and opposite Mawhinney Park
- West of the Ballyoran Stream at Beauly Drive
- Along the Quarry Stream to the immediate north of the old Dundonald Road in the vicinity of Coronation Park.
- Along the Quarry Stream between Grand Prix Park and Mahwinney Park
- East of Canberra Park Stream alongside Canberra Park.

Planning Applications

Fluvial Areas at risk

Rivers Agency shall advise against the development of all sites that are located within the 1 in 100 year fluvial floodplain, irrespective of whether they are located within a current development plan or as a single site application outside the plan area.

For those sites within the 1 in 100 year fluvial floodplain where the principle of development has been accepted by Local Council as meeting the 'Exception Test', Rivers Agency will further consider the application through the appraisal of an accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures.

The main existing developed areas, amongst others, at flood risk within Dundonald were re-development may be likely to take place are located to the:

- South of the Enler River along the Comber Road between East Link Road and Graham's Bridge Road.
- North of the Ballyronan Steam at Lismore Way and Ballyoran Nursing Home.

Areas at Risk of Surface Water flooding

For those sites outside the 1 in 100 year fluvial floodplain that are located in an area where there is evidence of a history of surface water flooding (identified by flood hardship payments) Rivers Agency will further consider the application through the appraisal of the accompanying Drainage Assessment that will need to demonstrate suitable flood mitigation measures.

Where there is potential for surface water flooding as indicated in the predicted areas on the Surface Water Maps (highlighted purple) we will advise that the applicant should assess the flood risk and drainage impact to the site and construct in an appropriate manner.

The main areas with a flood history, identified in Dundonald as being at surface water flood risk are at:

- Dunleady Park and Canberra Park Area
- Old Dundonald Road near Hanwood Farm
- Ferndene Gardens and Wanstead Road.

Areas at Risk of Flood Inundation from Reservoirs

For all development proposals that are located within the potential flood inundation area of a controlled reservoir we will further consider the application through the appraisal of the accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures. If it is a new development proposal, Rivers Agency will also need the applicant to demonstrate that the condition, management and maintenance regime of the reservoir is appropriate to provide sufficient assurance regarding reservoir safety.
The controlled reservoirs identified in the Dundonald area are as follows:-

- NONE

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Protection

Structural measures are still one of the main options in providing flood protection to people and property impacted by the effects of extensive flooding. It is therefore important that we continue to target investment by providing flood defences, culvert alleviation schemes and infrastructure upgrade works to those communities at greatest need.

The alleviation of surface water flooding, in particular, will require input from a number of bodies. The Flood Investment and Planning Group, FIPG, provides a coordinated approach across Government in relation to the investigation of flooding, agreeing responsibilities and identifying collaborative solutions. The group is represented by Rivers Agency, NI Water and Transport NI, amongst others, with flood risk management responsibilities.

There are a number of stages to follow when procuring a flood alleviation scheme. The potential scheme needs to be first subjected to a feasibility study that will also include an economic appraisal. From the detailed Hazard and Risk Maps a Flood Risk Metric Tool' (FRISM) is used in urbanised flooded areas to get an estimate of the likely property damages as a result of a range of flood events. The estimated cost of a scheme is then compared to the total 'damage avoidance benefits' that the scheme will provide to property over the scheme's design life. If the benefit/cost ratio is greater than 1, then the potential scheme will be referred to Rivers Agency's Capital Procurement Unit for a feasibility study to be undertaken.

If the flooding issue identified is not solely Rivers Agency's responsibility, or is the responsibility of NI Water or Transport NI such as a local drainage or road infrastructure issue, then it will be referred either to FIPG or directly to the responsible body, for their further consideration.

If a cost benefit analysis identifies a viable scheme, it will be placed on a prioritisation list and progressed alongside other competing schemes. The position on the list will depend on a set marking criteria, such as the benefit/ cost ratio and the overall scheme costs. Depending on the availability of resources it may take anything from between 2 – 5 years for the scheme to progress from the start of the feasibility study to construction works commencing on the ground.

Having conducted a detailed assessment of the fluvial flood risk to the Dundonald SFRA, Rivers Agency has determined that a potential flood alleviation scheme may be justified for the River Enler and that localised improvement works should be considered for the Dunleady Stream and Ferndene Stream. For details of the proposed measures see below.

River Enler (and tributaries) Flood Study

Based on the detailed fluvial model, there are predicted to be substantial clusters of properties at risk of flooding from the 'main channel' of the Enler River and all of its tributaries except the Ferndene Stream and Dundonald River. In total there are estimated to be 72 homes and 4 non-residential properties at risk from the relatively frequent 1 in 25 year event, rising to 191 homes and 10 non-residential properties (which

includes two care homes) at the more extreme 1 in 100 year event. It is calculated the present value of the total cost of flood damages from potential future floods is £1.2 million. As the flooding is of a disparate nature and not focused at a particular location from a single watercourse, it has been determined that a broad scale flood study of the River Enler and its tributaries is required to establish if structural flood alleviation solutions are likely to be economically viable. Accordingly, Rivers Agency shall undertake a feasibility study for a potential flood alleviation scheme on the River Enler and tributaries. The timing for the commencement of this flood study will depend on its priority with the Flood Study Programme and will subject to the future resources available to Rivers Agency.

Localised watercourse improvement works

Dunleady Stream – Remove low weir located approximately 10m upstream of the inlet grille at the rear of No. 22 Grangewood Avenue. On removal of the weir regrade the channel invert of the open channel for a distance of approx 30m.

Ferndene Stream – Reconstruct inlet grill at No.17 Ferndene Gardens to meet Rivers Agency's specification, install gravel traps upstream of inlet grille and, if possible, identify source of gravel and undertake works necessary to prevent its entry to watercourse.

Preparedness

In Dundonald it is not possible to prevent or protect against all flooding. Indeed even where flood defences exist it is possible in an extreme event that these could be over topped and flooding could still occur.

Having recognised this fact, considerable effort in recent years has been made by emergency planners in a Government Departments, Councils and the Emergency Services working together and sharing information to ensure a coordinated response.

However, despite these improvements during significant flood events the emergency response of Government Departments and the Emergency Services can become over stretched. This means that not all calls for assistance during a flood event may be responded to in a timely manner. With this in mind it is important that households and communities, subject to a known flood risk, are prepared. The detail of preparedness actions, including flood warning and informing activities planned from a regional perspective, are provided in Appendix E.

This is not Government withdrawing from any undertaking to respond in emergencies but an additional layer of support to ensure Government Departments and the public work together to reduce the overall impacts of flooding.

From the flood risk assessment there are 4 main areas within Dundonald that have flooded in the recent past that may benefit from the flood warning and informing proposals, outlined in Appendix D.

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A pilot project of community engagement to deliver flood warning and informing, held in 2014, identified basic assessment formulae to assess and score areas that could potentially be a focus for flood warning and informing actions. Based on this scoring the following area could be considered suitable for inclusion in a programme of community engagement to deliver flood warning and informing initiatives:-

- Dunleady Park / Canberra Park area.

Key activities that could be undertaken are:

- Explaining the potential and limitations of Community Resilience;
- Briefing communities on information available, particularly from the Met Office;
- The facilitation of self-help initiatives, including remote sandbag storage; and
- Reviewing and validating all elements of the Community Engagement Plan to help the community communicate effectively in an emergency and work together.

The table in Appendix I shows how this community's rank in the overall context of the 20 SFRA's in this Plan. It should be noted that this is an indicative assessment which may change subject to further information on flood risk becoming available.

The rollout of this work is dependent on funding being available.

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5.6 Bangor Significant Flood Risk Area

The core boundary of the Bangor SFRA, which has been determined through the PFRA, is located within the Belfast Lough and Tidal Lagan local Flood Management Area and is illustrated in Figure 5.6.1 below.

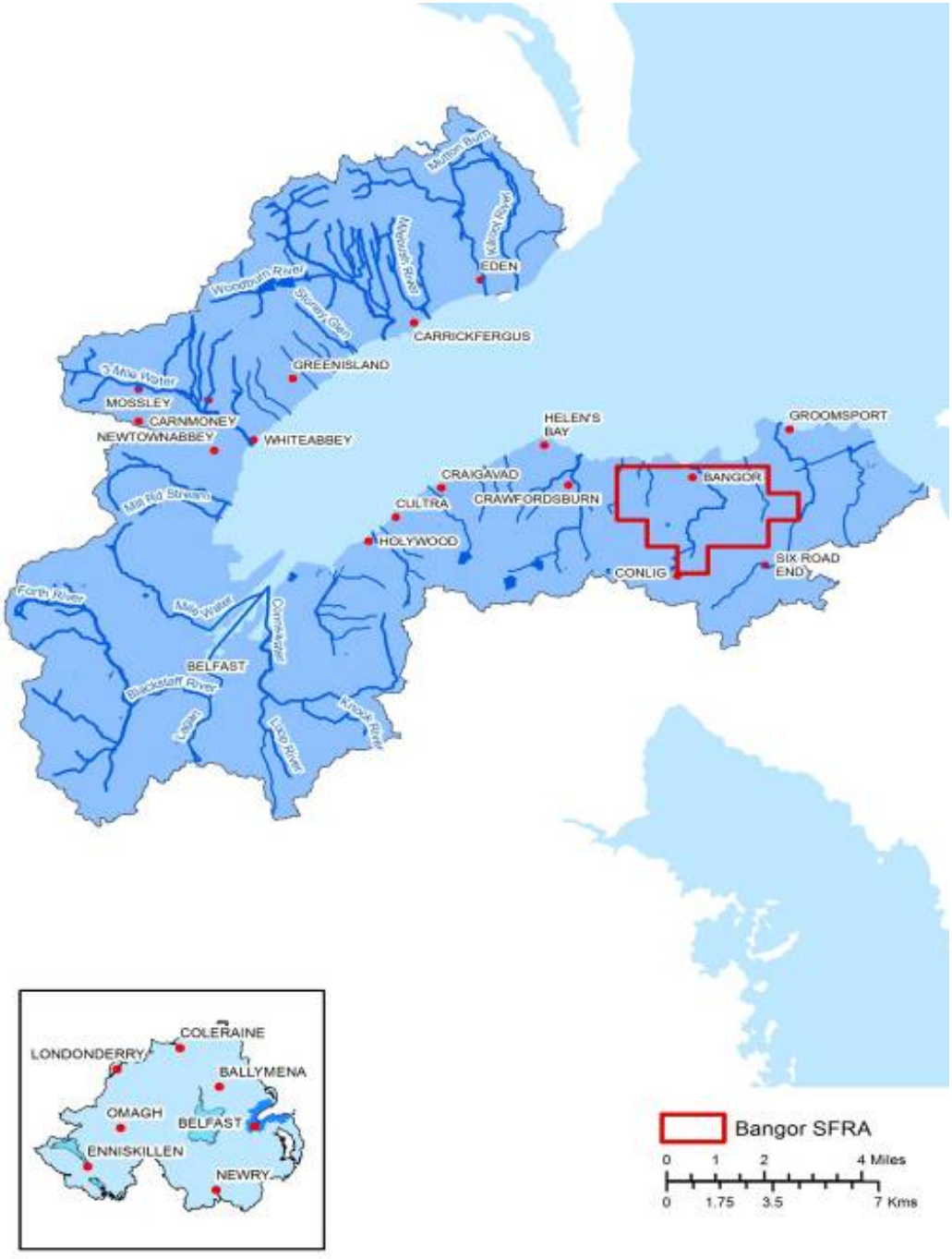

Figure 5.6.1 - Belfast Lough & Tidal Lagan Local Flood Management Area and Bangor SFRA

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5.6.1 Flooding History

The historical records would indicate that very few properties have been inundated with floodwater in the Bangor Area in recent years. Since the introduction of the Flood Relief Payments Scheme in 2007 there have been only 6 payments issued to householders, 2 in June 2007 and 4 in August 2008. The locations of the properties that are known to have flooded are shown in Figure 5.6.1.1. To put this into perspective there have been in excess of 2700 payments issued to householders in the Belfast area during the same period. The lack of flooding may be attributed to the fact that major improvement schemes to the urban watercourses in Bangor were undertaken by Rivers Agency in the early 1990s and in addition the fairly steeply sloping landform acts to prevent surface water flooding.

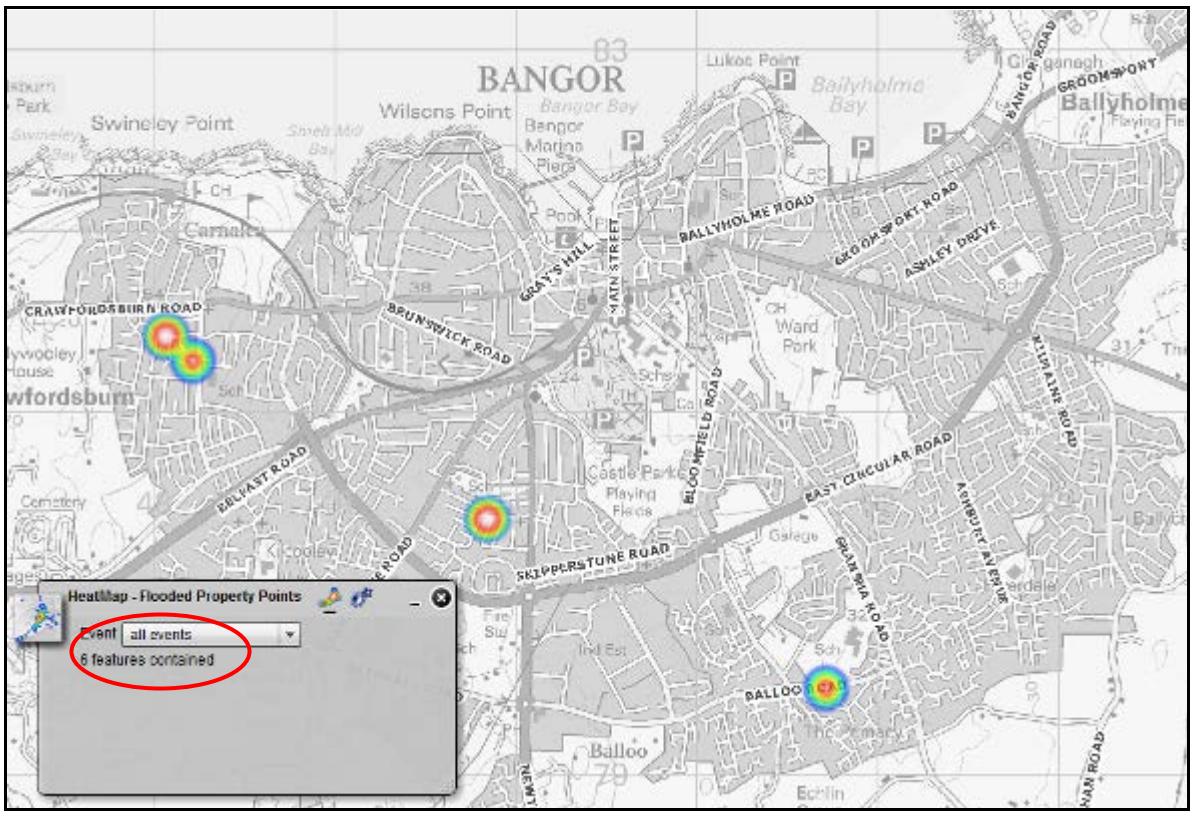

Figure 5.6.1.1 - Bangor SFRA – Flood Relief Payments since 2007

5.6.2 PFRA – Identification of Potentially Significant Flood Sources

According to the Preliminary Flood Risk Assessment (Dec 2011) the town of Bangor, in terms of the potential adverse consequences of flooding, is ranked seventh of the twenty SFRA within Northern Ireland (see Figure 4.1). On the basis of this initial assessment, which was undertaken using the Strategic Flood Maps, the town is considered to be at significant risk from fluvial flooding only. Although a coastal town, the coastal fringe is generally well elevated above sea level and as a consequence significant tidal inundation of the town is unlikely, even in the most extreme tidal events. During the recent extreme tidal event that affected the east coast in January 2014 there were only two seaside properties that suffered minor flood damage.

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It should be noted that the PFRA was based on the Strategic Flood Map (NI) Rivers & Sea which, at the time of this assessment, was the best available information upon which to identify the general areas throughout Northern Ireland that may be prone to flooding from rivers and the sea. However, due to the onerous requirement to produce flood maps that cover the whole of the province, it was necessary to develop the strategic flood models using a broad-scale modelling methodology that had clear limitations. The extents of the floodplains predicted by the Strategic Flood Maps are illustrated in Figure 5.6.2.1 below.

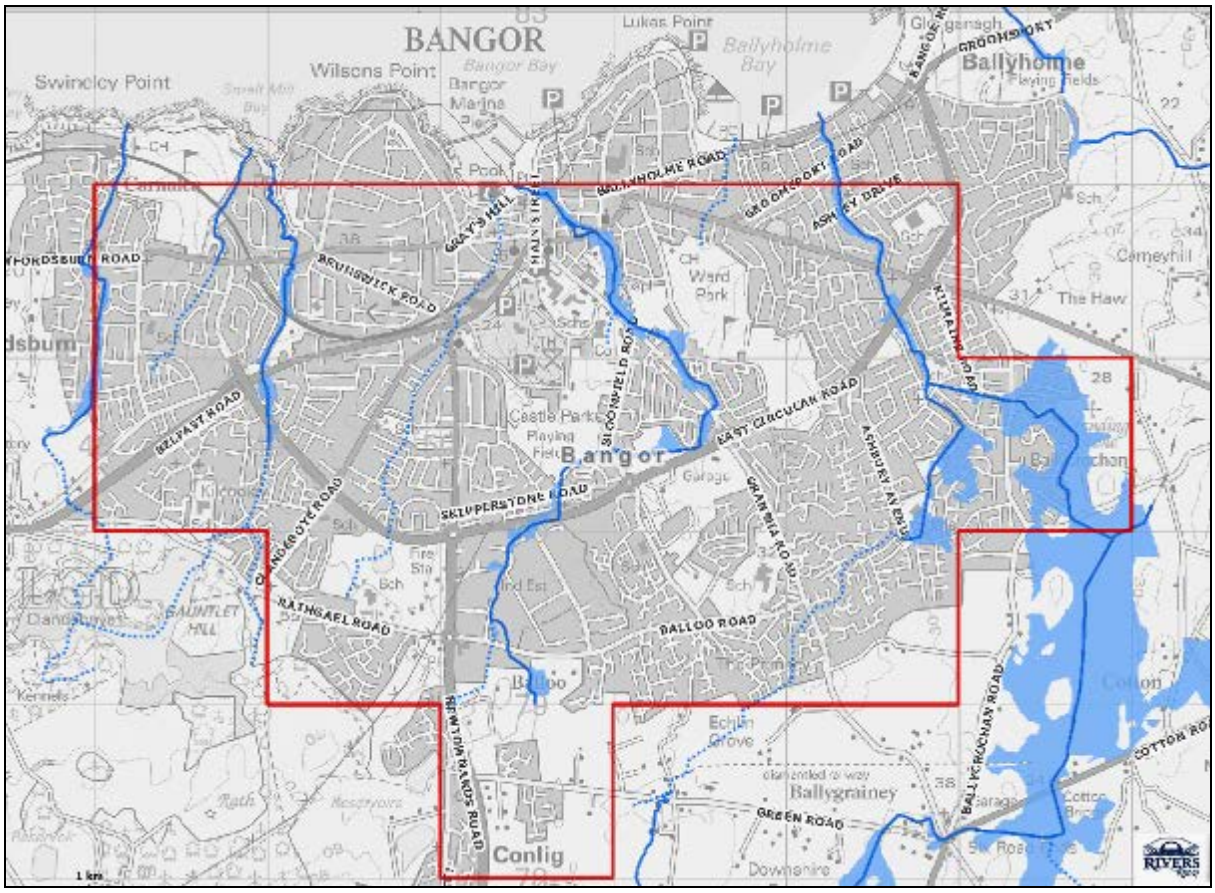

Figure 5.6.2.1 - Bangor SFRA – Undefended Fluvial Flood Plains, Strategic 1% AEP (1 in 100 yr) event

Although the PFRA estimated that there may be in excess of 900 properties in Bangor at risk of flooding from rivers, it was acknowledged that there was a high degree of uncertainty with this figure as it was based on the Strategic Flood Maps. To reduce this uncertainty and facilitate a more robust assessment of the level of fluvial flood risk to Bangor, Rivers Agency developed detailed predictive flood models for each of the watercourses within the town. The Flood Hazard Maps produced using the detailed flood models are more accurate than the strategic maps which may be over estimating or under estimating the number of properties at risk of flooding. Details of the models and their output are described in the following sections.

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5.6.3 Catchment Description

Bangor is a coastal town which is located on the southern shore at the mouth of Belfast Lough. The coastline fringing the town is generally a steep rock face with the exception of a sandy bay to the east at Ballyholme. There are 6 substantial watercourses that flow through the urban footprint. The watercourses all flow in a northerly direction from the Gauntlet Hills to their individual sea outfalls at various locations along the shoreline from Swinely Point at the west side of town to Ballyholme Bay in the east. Four of the watercourses (Carnrea Stream, Rathmore Stream, Bryan's Burn and Clandeboye Stream) have small predominantly urban catchments with an area less than 5km^2. Ballyholme Stream has a catchment area in excess of 19km^2 and is largely rural and the Ward Park Stream has the largest catchment, which exceeds 26km^2 and is about 50% rural.

5.6.4 Fluvial Flood Risk Assessment

Fluvial Model

Fundamental to the detailed fluvial risk assessment was the development of an Infoworks ICM 1D/2D hydrodynamic model for each of the six main watercourses (and tributaries) which have the potential to adversely impact the urbanised area of Bangor. The names, location and extents of the watercourses which were modelled in detail are indicated in Figure 5.6.4.1 below.

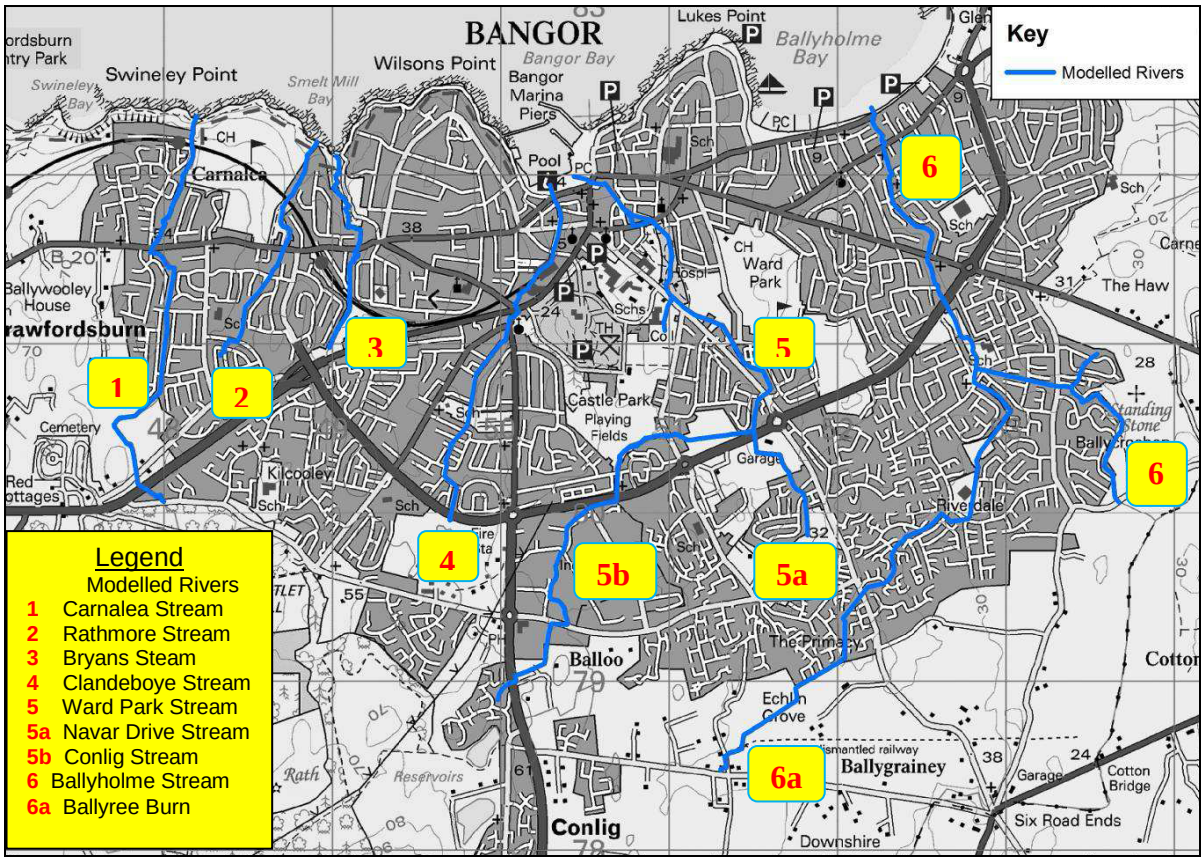

Figure 5.6.4.1 - Bangor SFRA – Modelled Watercourses

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Fluvial Flooding Mechanisms

The 'Flood Hazard Maps' produced using the detailed flood maps (and available through Flood Maps NI) show that for two of the six watercourses within the urban footprint, the Clandeboye Stream and the Bryan's Burn, there is no risk to property from floods up to and including the 1% AEP (1 in 100 year) event. Consequently, the flooding from these watercourses is considered no further within the plan. The flood risk from the other four watercourses is assessed below.

Carnalea Stream

The modelled reach of designated Carnalea Stream (U3505) starts at the Rathgael Road, flows through the western side of town (usually within the confines of the rear gardens of residential properties) and skirts around the western edge of the Carnalea Golf Course before discharging to the sea near Swinely Point. The length of this modelled section is around 2.8km and flows within an open channel for most of its length with occasional short sections of culverts at road and railway crossings. The sizes of the culverts are generally around 1200mm diameter with an 1800mm x 1500mm concrete box culvert under the Belfast Road Dual Carriageway. All culverts are assessed to be in good structural condition.

The developed areas that are prone to flooding within the Carnalea Stream, together with a the flooding mechanisms are described below.

The model predicts that at the relatively frequent 10% AEP event, floodwater spills from a section of open watercourse at localised dips on its right bank to the rear of 48 Rathmore Crescent and at the inlet to the culvert located behind 13 Wandsworth Park (see Figure 5.6.4.2). However, in this scenario the impact is likely to be limited to shallow depth internal flooding of a couple of properties. The extent of the flooding is predicted to increase substantially at the more extreme (and less frequent) events, potentially inundating up to around 30 properties at the 1 in 100 year event. It is calculated that the present value of the total damages to properties from potential future floods is around £94k. Considering the number of properties affected, the value of the damage appears quite low, but this reflects the very shallow depth of the predicted flooding. There are flood records to indicate that at least two properties have flooded at this location in recent years. In addition, Rivers Agency has received dozens of calls for assistance from residents over the past twenty years who were fearful that rising floodwater in their gardens may reach their property.

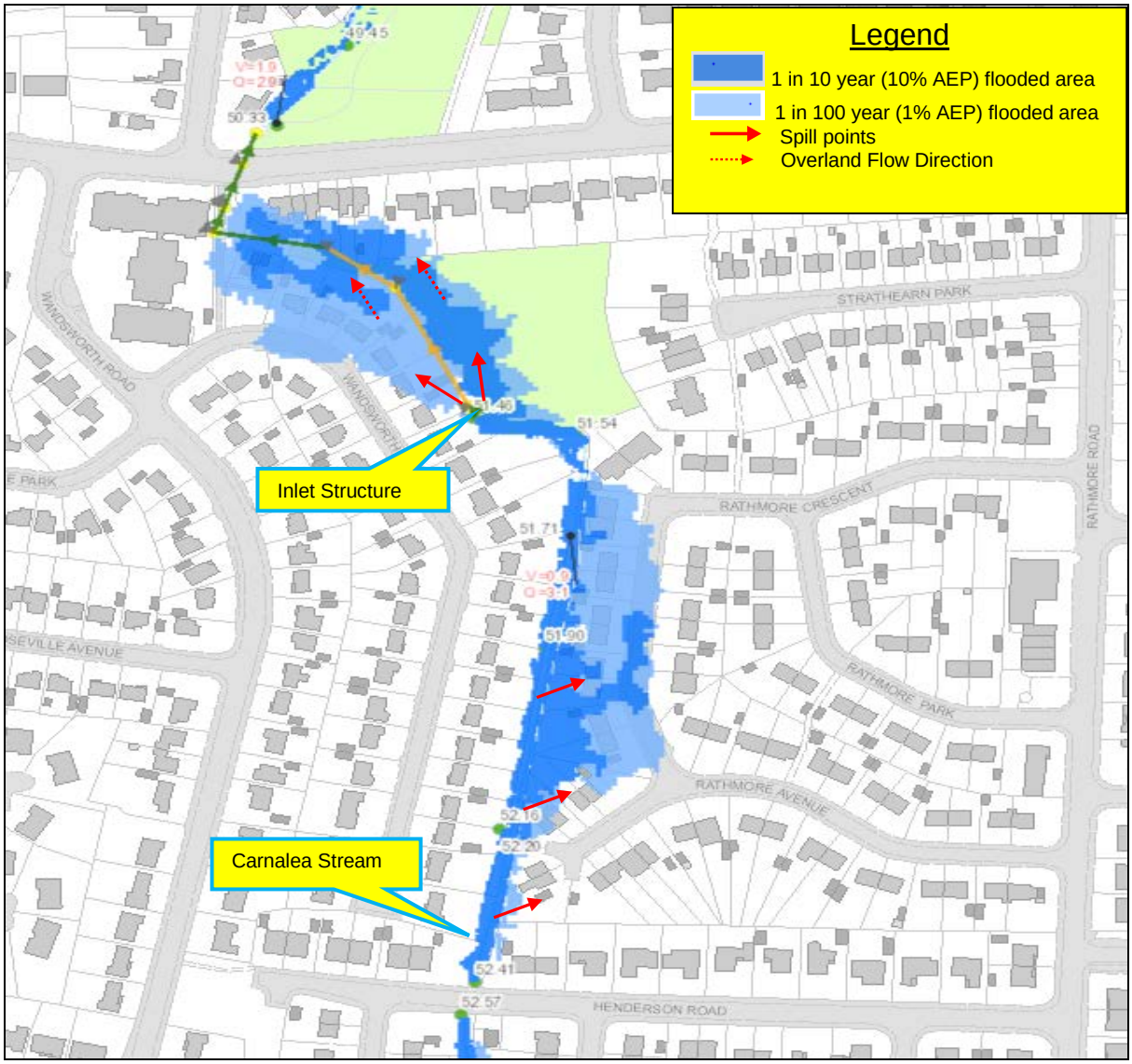

Figure 5.6.4.2 - Bangor SFRA – Carnalea Stream (1% AEP)

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Figure 5.6.4.1 Bangor SFRA – Carnalea Stream			
Potential Adverse Consequences – Fluvial Flooding			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**13**	**20**	**36**
Non Residential (Nr)	**1**	**1**	**1**
Economic Damage (£)	**£10k**	**£23k**	**£120k**
Annual Average Damage (£)	**£3.1k**		
Present Value (£)	**£94k**		
IPPC sites (Nr)	**0**	**0**	**0**
Community Assets (Nr)	**0**	**0**	**0**
Care Homes	**0**	**0**	**0**
GP Surgery's	**0**	**0**	**0**
Fire stations	**0**	**0**	**0**
Hospitals	**0**	**0**	**0**
Police Stations	**0**	**0**	**0**
Schools	**0**	**0**	**0**
Key Infrastructure (Nr)	**2**	**2**	**3**
NIW Wastewater Treatment Works	**0**	**0**	**0**
NIW Sewage Pumping Stations	**1**	**1**	**1**
NIW Water Treatment Work	**0**	**0**	**0**
NIW Treated Water Pumping Stations	**0**	**0**	**0**
NIE Substation 6to11kV	**1**	**1**	**2**
NIE Substation 33kV	**0**	**0**	**0**
NIE Substation 275kV	**0**	**0**	**0**
NIE Substation 110kV	**0**	**0**	**0**
Road Service - Trunk Road	**0**	**0**	**0**
Environmental Designated sites (Nr)			
AONB	**0**	**0**	**0**
ASSI	**0**	**0**	**0**
Environmentally Sensitive Areas	**0**	**0**	**0**
Maritime Nature Reserve	**0**	**0**	**0**
Nature Reserve	**0**	**0**	**0**
RAMSAR	**0**	**0**	**0**
SAC	**0**	**0**	**0**
Sites of Local Nature Conservation Importance	**1**	**1**	**1**
SPA	**0**	**0**	**0**
RSPB Reserve	**0**	**0**	**0**
UWT Nature Reserve	**0**	**0**	**0**
Built Heritage sites (Nr)			
National Trust	**0**	**0**	**0**
Listed Buildings	**0**	**0**	**0**
Sites and Monuments Records	**0**	**0**	**0**
Buildings of Special Architectural or Historical Interest	**0**	**0**	**0**
Areas of Significant Archaeological Interest	**0**	**0**	**0**
Historic Gardens	**0**	**0**	**0**

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Rathmore Stream

The modelled reach of the Rathmore Stream (designated watercourse U3504) extends to a length of around 1.6km. It flows in a northerly direction, commencing in the heart of the Belmont housing development in Bangor West and is culverted through dense residential areas for a distance of around 850m until it crosses the Crawfordsburn Road. Downstream of the Crawfordsburn Road the watercourse flows within an open channel, forming a boundary between Carnalea Golf Course and Bryansglen housing development before discharging to the sea at Ballyvarnet. The diameter of the culverts are in the range 450mm to 1250mm and all of the culverts, except for a couple of shorts section of small diameter pipes with a combined length of around 60m, are in good structural condition.

The developed areas that are prone to flooding within the Rathmore Stream, together with a description of the flooding mechanisms are as follows.

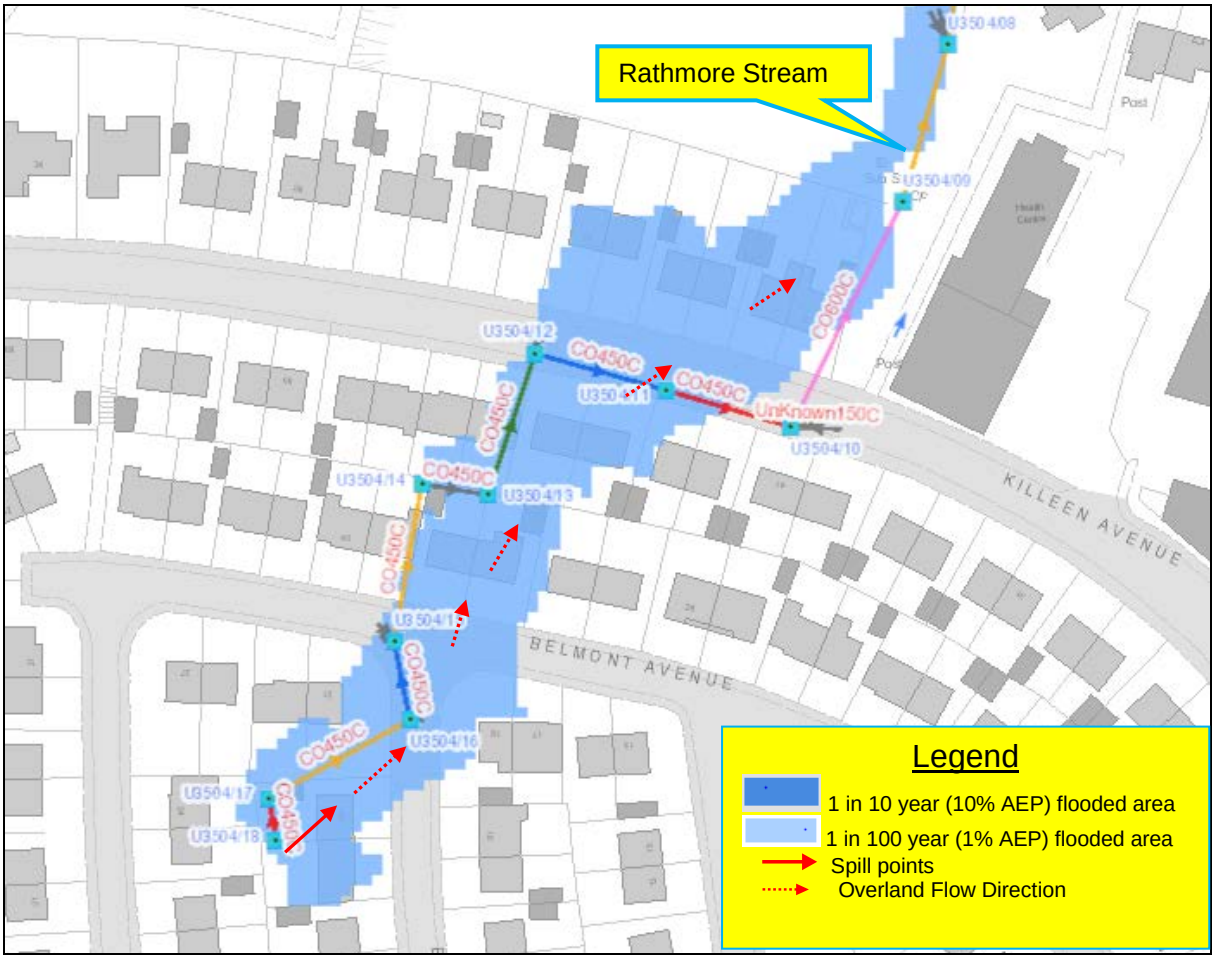

Figure 5.6.4.3 - Bangor SFRA – Rathmore Stream (1% AEP)

The model predicts that flooding to property from Rathmore Stream will be limited in scale and very infrequent as there is no indication of flooding to property until the very extreme 1 in 100 year event. In this scenario, the model shows that a 450mm diameter culvert, located in the rear garden of 19 Belmont Road, surcharges at the 1 in 100 year event and results in a spill from a manhole that could cause shallow depth

flooding (less than 300mm) to around 12 properties. However, there is no record of historical flooding at this location and Rivers Agency has received no phone calls to the emergency Floodline from members of the public to alert them of any concerns in relation to flows from manholes or flooding generally.

The level of flood risk from the Rathmore Stream has been determined to be so low that a 'Potential Adverse Consequences' table has not been prepared.

Ward Park Stream (and tributary Conlig Stream)

The modelled reach of the watercourse commences at Rathgael House where a short section of culverted watercourse known as the Beechill Stream (U3G350) crosses the Newtownards Road. The watercourse continues within an open channel, through the Balloo Industrial Estate and crosses the South Circular Road at Lisbreen Presbyterian Church. At this point the name of the watercourse changes to the Conlig Stream. The Conlig Stream continues in an easterly direction as an open watercourse, through the Skipperstown Glen and Bloomfield Playing Fields, to the Gransha Road Roundabout where it meets the Navar Drive Stream and forms the Ward Park Stream (designated watercourse U3513). The Ward Park Stream turns to flow in a north westerly directly and runs in a culvert through the rear gardens of properties on the Gransha Road. Beyond this point it reverts to an open watercourse, which is impounded by a series of weirs to form ponds as it passes through Ward Park. Downstream of Ward Park the watercourse is culverted and runs under the Flagship Centre to its sea outfall at the Bangor Marina. All of the culverted sections of the watercourse are in a satisfactory structural condition, except for a short (20m) length of masonry arch culvert at the Flagship Centre under Mill Row which is assessed to be Grade 2 (poor).

The developed areas that are to prone flooding within the Ward Park Stream and its tributaries (Conlig Stream and Navar Drive Stream), together with a description of the flooding mechanisms are as follows.

Ward Park Stream and tributaries

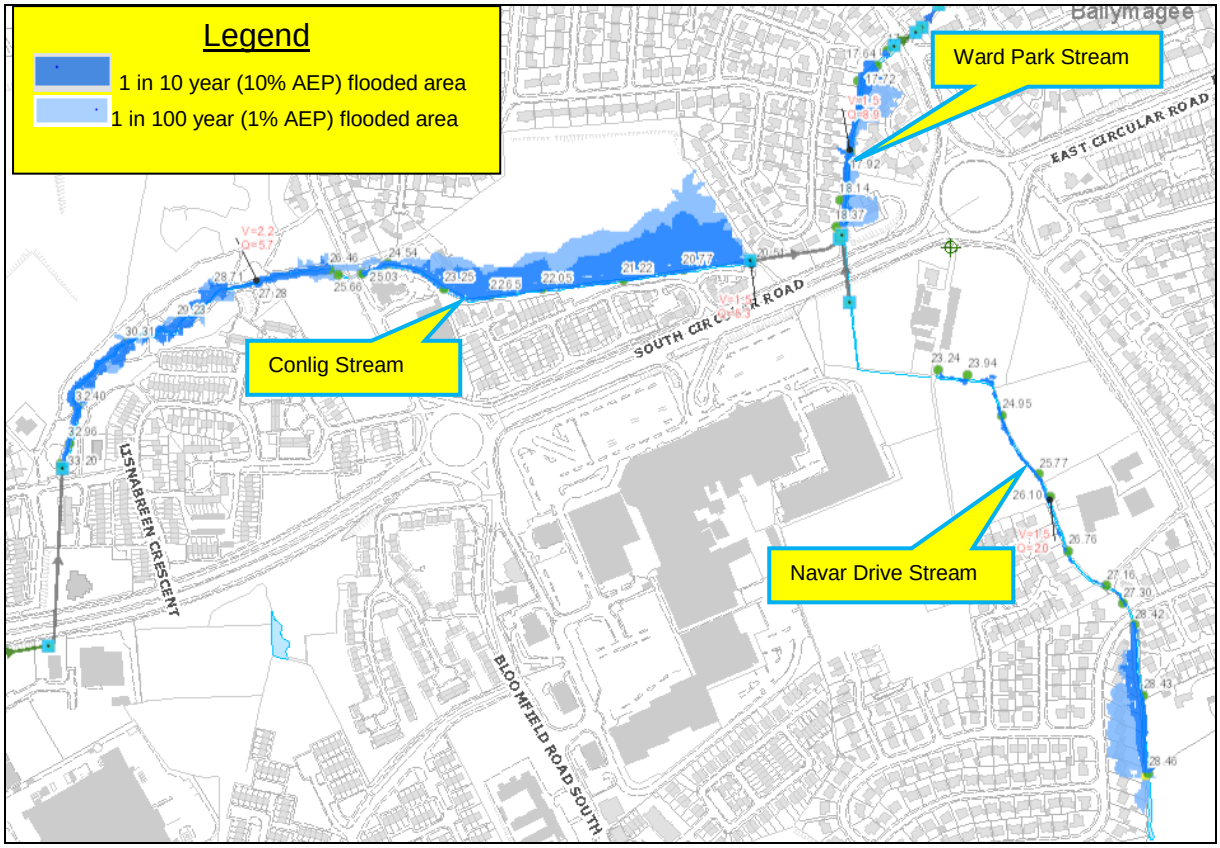

Figure 5.6.4.4 - Bangor SFRA – Ward Park Stream and tributaries (1% AEP)

The model predicts a relatively low risk of flooding to property from the Ward Park Stream and its tributaries the Conlig Stream and the Navar Drive Stream. In the case of the Conlig Stream there is one substantial flood inundation area at the South Circular Road. However, the land predicted to flood is grassland with only one non-residential property located on the fringe of the floodplain.

There are two predicted flood inundation zones arising from flooding related to the main channel of the Ward Park Stream (see Figure 7.6.4.4). The larger of these areas is located within the confines of the Ward Park recreational area and presents no risk to property. The other flood inundation area, which does present a risk to a small number of properties, is situated near the Gransha Road Roundabout and the flood mechanism for this is described below and illustrated in Figure 5.6.4.5.

On the Navar Drive Stream, the only notable flood zone impacts a residential area at Navar Court and the flood mechanism for this is described below and illustrated at Figure 5.6.4.6.

The predicted adverse consequence arising from the whole of the Ward Park Stream (and its tributaries) are listed in Table 5.6.4.2. This shows that across the whole of this drainage system, there are estimated to be only 12 homes and 9 non-residential properties at risk of flooding from the 1% AEP (1 in 100 year) event. It

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is calculated that the present day value of the property damage costs arising from potential future floods is £66k, which is not sufficiently high to justify any substantive structural works to mitigate the risk.

Ward Park Stream

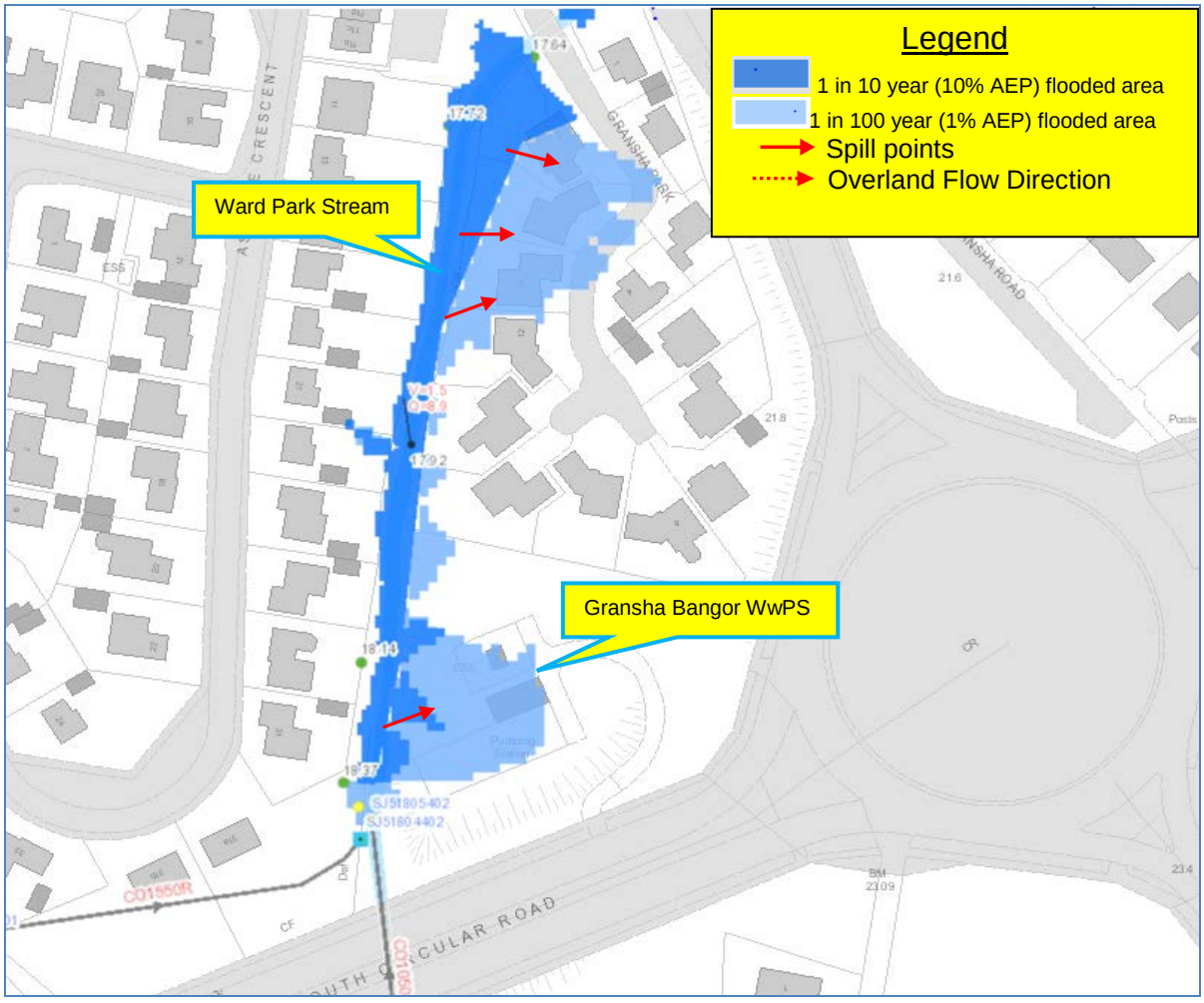

Figure 5.6.4.5 - Bangor SFRA – Ward Park Stream (1% AEP)

The model predicts flooding from a short section of open watercourse that is sandwiched between road culverts under the South Circular Road and the Gransha Park access road. Although floodwater over spills the right bank at the relatively frequent 10% AEP (1 in 10 year) event, it is unlikely to present a risk to property in this scenario. Even at the 1% AEP (1 IN 100 year) event, damage is predicted to be restricted to shallow depth flooding (<300mm) to 4 large residential properties and the Gransha Bangor Wastewater Pumping Station. There is some evidence of past flooding at this location and it is recorded in Rivers Agency's Flood Reporting Database that three properties were flooded internally in June 2007 due to a badly blocked culvert inlet grill at a time of high flows in the watercourse. Two other flood calls are recorded (2005 & 2008) and both of these were from homeowners fearful that their properties may flood due to rising river levels and on both occasions this was attributable to partial blockage of the inlet grille.

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Navar Drive Stream

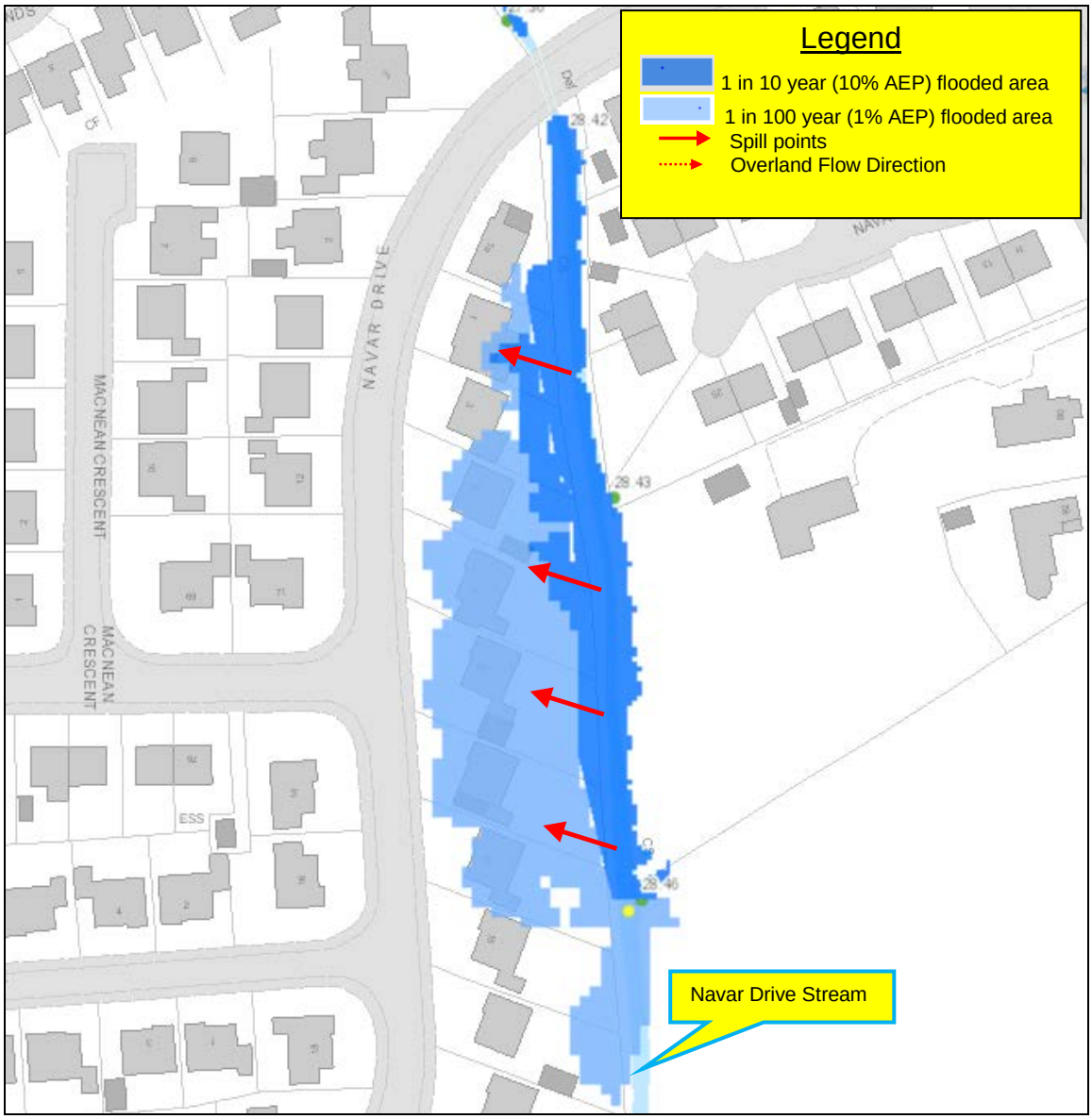

Figure 5.6.4.6 Bangor SFRA – Navar Drive Stream (1% AEP)

The model predicts flooding to property from an open section of watercourse which runs along the rear of residential properties at Navar Drive. It indicates that at the relatively frequent 10% AEP (1 in 10 year) event, floodwater can spill from the open channel at a localised dip in the left bank behind 5 Navar Drive. However, in this scenario there is unlikely to be internal flooding to any properties. At the 1% AEP (1 in 100 year) event, the predicted flooded area increases to include 7 residential properties, some of which may be inundated to a depth of 1m. Although there is no historical evidence of internal property flooding at this location, the Rivers Agency's Flooding Reports Database shows it responded to calls for assistance from homeowners in the area in 1986 and 1987. On both occasions properties were close to flooding from the watercourse, which at that time was undesignated and clearly in need of maintenance. Rivers Agency designated the watercourse in 1995 for the purposes of maintenance and there have been no flooding concerns since that time.

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Table 5.6.4.2 Bangor SFRA – Ward Park Stream (and tributaries)			
Potential Adverse Consequences – Fluvial Flooding			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**2**	**4**	**12**
Non Residential (Nr)	**6**	**6**	**9**
Economic Damage (£)	**£9k**	**£15k**	**£84k**
Annual Average Damage (£)	**£2.2k**		
Present Value (£)	**£66K**		
IPPC sites (Nr)	**0**	**0**	**0**
Community Assets (Nr)	**0**	**0**	**0**
Care Homes	**0**	**0**	**0**
GP Surgery's	**0**	**0**	**0**
Fire stations	**0**	**0**	**0**
Hospitals	**0**	**0**	**0**
Police Stations	**0**	**0**	**0**
Schools	**0**	**0**	**0**
Key Infrastructure (Nr)	**0**	**0**	**2**
NIW Wastewater Treatment Works	**0**	**0**	**0**
NIW Sewage Pumping Stations	**0**	**0**	1
NIW Water Treatment Work	**0**	**0**	**0**
NIW Treated Water Pumping Stations	**0**	**0**	**0**
NIE Substation 6to11kV	**0**	**0**	1
NIE Substation 33kV	**0**	**0**	**0**
NIE Substation 275kV	**0**	**0**	**0**
NIE Substation 110kV	**0**	**0**	**0**
Road Service - Trunk Road	**0**	**0**	**0**
Environmental Designated sites (Nr)			
AONB	**0**	**0**	**0**
ASSI	**0**	**0**	**0**
Environmentally Sensitive Areas	**0**	**0**	**0**
Maritime Nature Reserve	**0**	**0**	**0**
Nature Reserve	**0**	**0**	**0**
RAMSAR	**0**	**0**	**0**
SAC	**0**	**0**	**0**
Sites of Local Nature Conservation Importance	**0**	**0**	**0**
SPA	**0**	**0**	**0**
RSPB Reserve	**0**	**0**	**0**
UWT Nature Reserve	**0**	**0**	**0**
Built Heritage sites (Nr)			
National Trust	**0**	**0**	**0**
Listed Buildings	**0**	**0**	**0**
Sites and Monuments Records	**0**	**0**	**0**
Buildings of Special Architectural or Historical Interest	**0**	**0**	**0**
Areas of Significant Archaeological Interest	**0**	**0**	**0**
Historic Gardens	**0**	**0**	**0**

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Ballyholme Stream and Ballyree Burn

The modelled reach of the Ballyholme Stream (designated watercourse MW3604) extends to a length of around 3.2km. It starts at the Hawe Road and flows in a northerly direction, through a dense residential area at the east side of town, to its outlet to the sea at Ballyholme Bay. Apart from the occasional culverted section at road crossings, the watercourse flows within an open channel for the whole of its length. Around 800m of the watercourse is located within open spaces and park land, with the remainder running alongside the boundaries of the rear gardens of residential properties. The Ballyree Burn is a tributary of the Ballyholme Stream. The modelled reach of this watercourse commences outside of the town's urban area at the upstream side of the Green Road. It flows in a north easterly direction for around 3.6km to it confluence with the Ballyholme Stream at the Silverbirch Road near the Kilmaine Primary School. Apart from a couple of culverted road crossing, the upper 1.5km section of the watercourse, from the Green Road to the Gransha Road, flows within an open channel. After the Gransha Road, the watercourse alternates from culverted to open sections until it reaches Albany Road at Ballymagee Primary School, some 1km downstream. Thereafter, the watercourse reverts to an open watercourse, which flows through a linear park for most of its length, until it meets the Ballyholme Stream. The culverts in these watercourses are typically 1350mm diameter concrete pipes and have been assessed to be in a satisfactory structural condition.

The developed areas that are prone to flooding within the Ballyholme Stream and its tributaries the Ballyree Burn, together with a description of the flooding mechanisms, are as follows.

The model predicts substantial flooding at numerous discrete locations throughout the length of the Ballyholme Stream and its tributary the Ballyree Burn. However, at most locations the areas inundated are undeveloped (or lightly developed) and present no substantial risk to property.

Along the main channel of the Ballyholme Stream, the flooding to property is largely (although not exclusively) limited to the lower reaches of the watercourse between the Donaghadee Road and the tidal outfall at the Ballyholme Esplanade. The flooding mechanism at this section of the Ballyholme Stream and the potential adverse consequences are described below and illustrated in Figure 5.6.4.7.

Flooding to property from the Ballyree Burn is mainly restricted to two residential areas on either side of the Gransha Road. One area is to the east side of Gransha Road in proximity to Bexley Road and the other on the west side, near Rockfield Glen. The flood mechanisms at these sections are described below and illustrated on Figure 5.6.4.8 and Figure 5.6.4.9.

In addition to the main areas of flooding from the Ballyholme Stream and the Ballyree Burn that are described in detail, there are a number of small clusters of properties located at various locations including for example, Greenhill Road, Pinehill Road and Marlo Heights.

Ballyholme Stream (main channel)

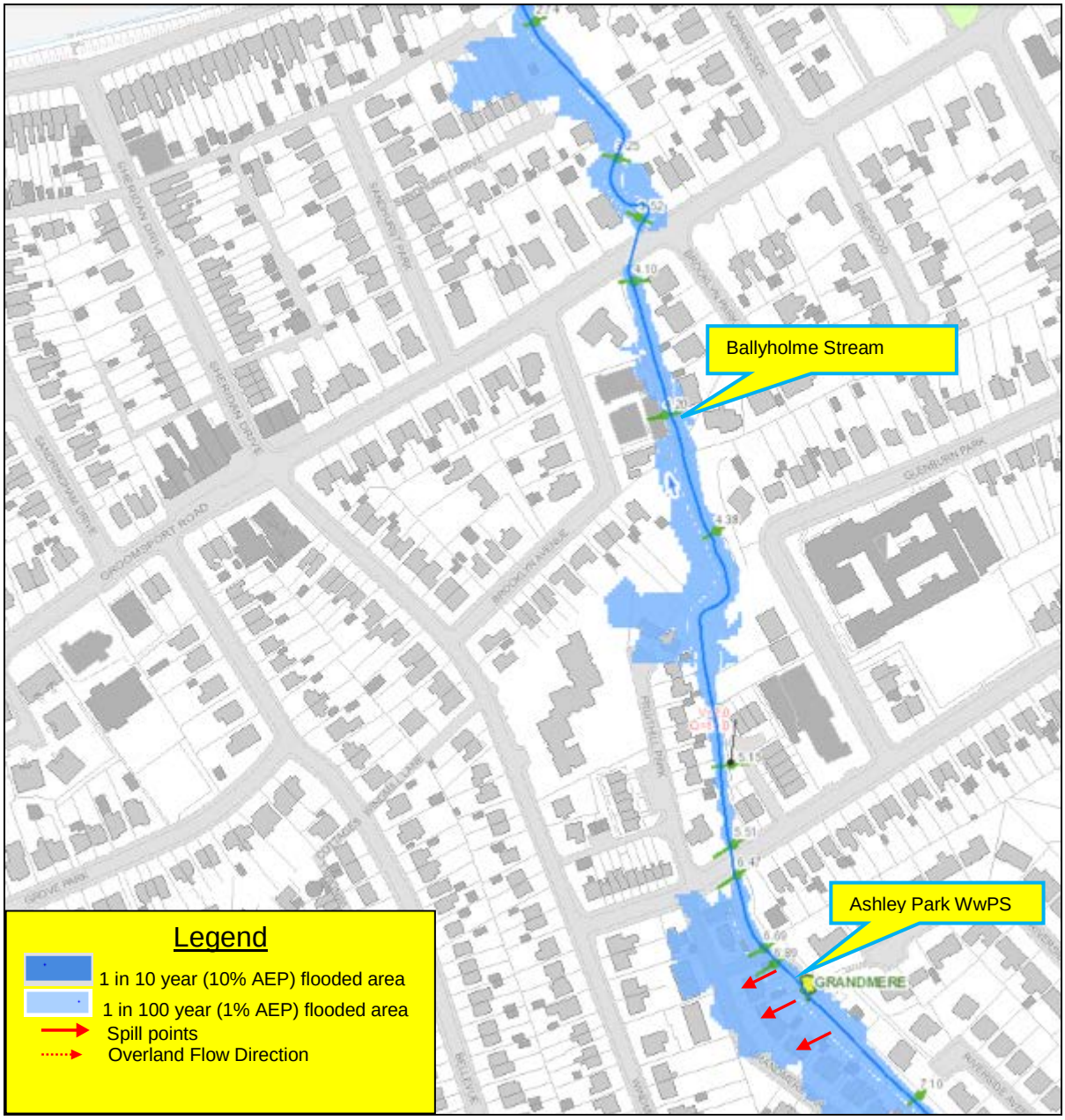

Figure 5.6.4.7 - Bangor SFRA –Ballyholme Stream (1% AEP)

The model predicts that floodwater overspills the left bank of a section of open watercourse which is immediately upstream of the culvert laid under the lane leading from Grandmere Park to the Ashley Park Sewerage Pumping Station. At the relatively frequent 10% AEP (1 in 10 year) event, floodwater is predicted to overspill at a localised dip in the bank to the rear of numbers 2 and 5 Grandmere Park. In this scenario, the extent of the flooding is largely limited to the grounds of around ten properties and, as the depth of flooding is shallow (less than 300mm), substantial internal flood damage to many of these may not occur. At the more extreme 1 in 100 year event, the flood level in the watercourse exceeds the height of a substantial section of the left bank from the culvert inlet, upstream for a distance of around 140m, and in this case at

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least 20 properties are likely to be flooded to depths of around 0.5m. Further downstream, it is predicted that at the 1 in 100 year event, a small numbers of properties, around 14 in total, are predicted to flood at two separate location in the vicinity of Fruithill Park and at Sandhurst Drive. Although few, if any, of these properties are expected to flood at the more frequent 1 in 10 year event. Despite the findings of the detailed model, there is very little historical evidence of flooding to property at any of these locations. The only flood call which was made to the emergency Floodline was back in 1986 and this was to alert Rivers Agency that debris was blocking the grille on the culvert inlet at Grandmere Park.

Ballyree Burn (1)

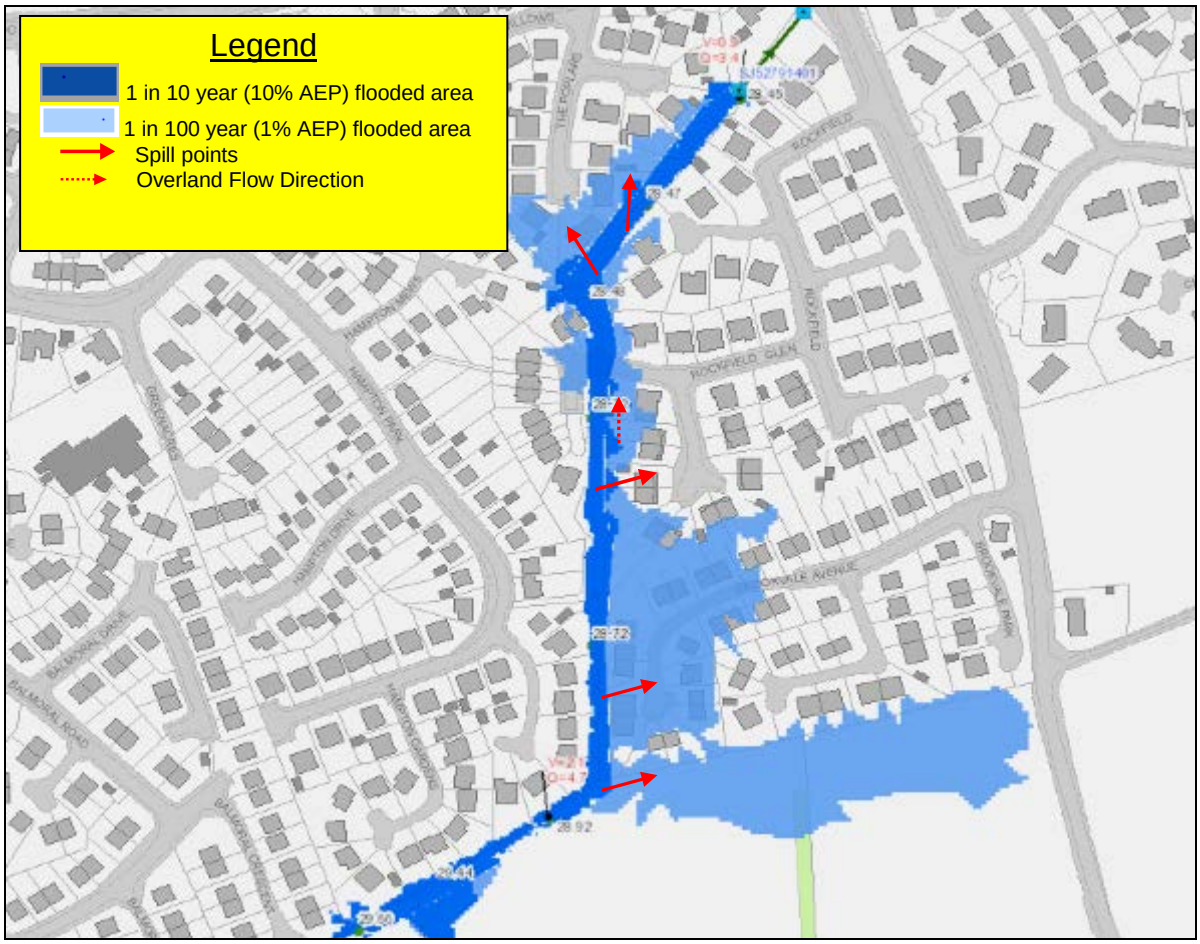

Figure 5.6.4.8 - Bangor SFRA – Ballyree Burn (1% AEP)

The model predicts that there is a likelihood of flooding to property from an open section of the Ballyree Burn which starts at the point at which the watercourse enters the urban zone in the vicinity of Brookvale Avenue and ends some 180m downstream, when it flows into a third party culvert which was laid under the access road to the recently constructed Rockfield Close development. Although the model predicts that floodwater begins to overspill the banks of the open channel at the relatively frequent 1 in 10 year event, the flood inundation area produced is very narrow and is limited to the gardens of the many residential properties which line its banks. However, the height of the right bank throughout the whole of this section is substantially lower than the estimated water level for a 1 in 100 year event by between 0.4m to 1.0m. In this scenario the inundation area increases substantially and as many as 30 properties in vicinity of Brookvale

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Crescent and Rockfied Glen are estimated to flood. Also, as the floodwater rises in the open channel, it flows across the carriageway surface at Rockfield Road to rejoin the open watercourse downstream of the road culvert and contributes to the flooding of a further 6 properties at the Poplars. As the predicted depth of flooding in the immediate vicinity of most of the properties is predicted to be less than 300mm deep, some of the properties may escape internal flooding doe to the height of their thresholds. It is notable that there is no historical evidence of flooding to property at this location.

Ballyree Burn (2)

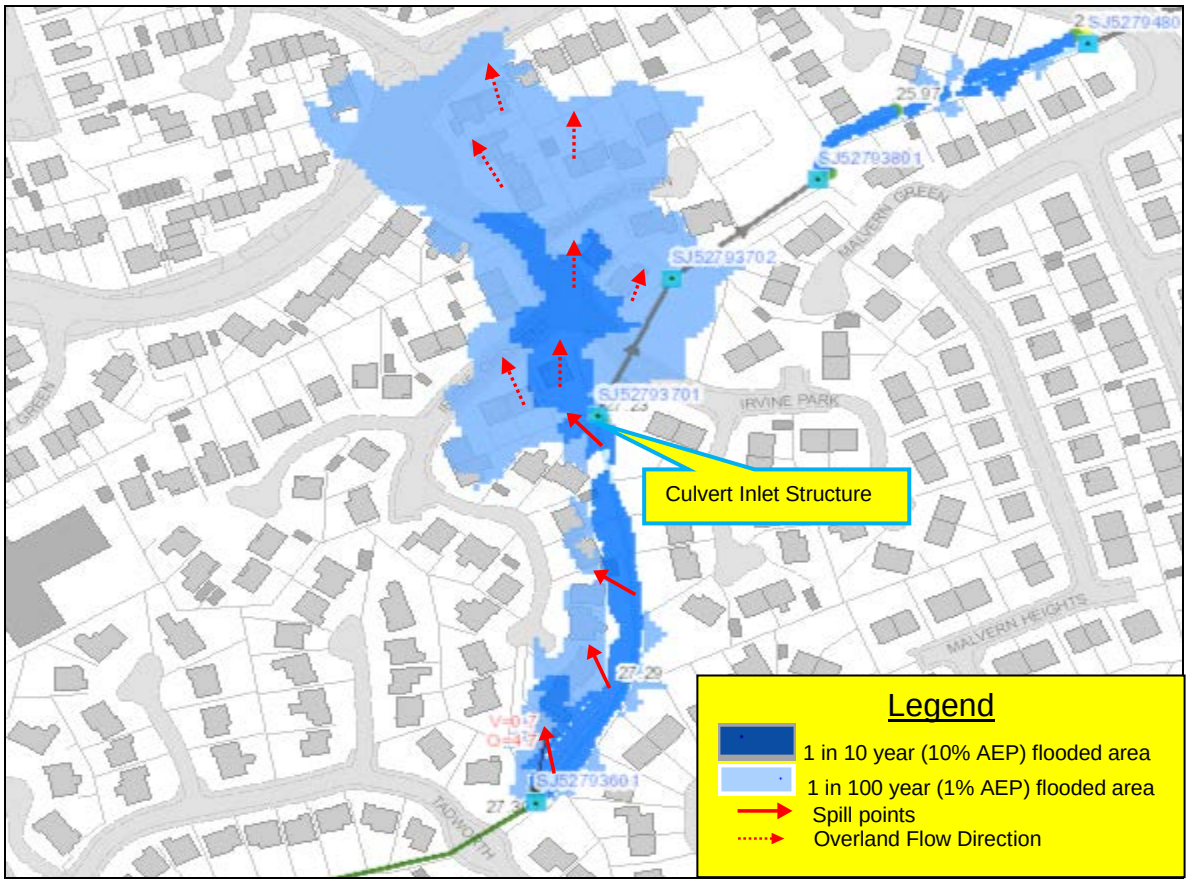

Figure 5.6.4.9 - Bangor SFRA – Ballyree Burn (1% AEP)

The model predicts flooding from an open reach of the Ballyree Burn which issues from a culvert section at Tadworth Road. This watercourse runs along the rear of properties in Irvine Crescent, before flowing into a 1350mm diameter culvert some 150m downstream at the rear of 6 Irvine Park. Flooding is estimated to occur at the frequent 1 in 10 year event as flooding rises from the open channel into the gardens of the houses in Irvine Crescent and could cause shallow depth internal flooding to one or two of the properties. At the downstream limit, floodwater can flow around the culvert inlet structure, across the Irvine Park carriageway to the Shamrock Glen housing development and may cause shallow depth flooding to another property in Irvine Park. At the more extreme 1 in 100 year flood event, the area inundated by flood water increases substantially and is estimated to cause flooding up to 1m deep to as many as 30 homes located in

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and around Irvine Crescent, Irvine Park and Shamrock Glen. There is no historical evidence of flooding at this location. The only relevant flood call received by Rivers Agency from the public was in 1994 and this was to report a debris blockage at the culvert inlet grille.

Across the whole of this watercourse drainage system there are predicted to be 28 residential and 7 non-residential properties at risk from a 1 in 10 year flood event, increasing to 139 homes and 8 non-residential properties at the more extreme 1 in 100 year event. It is calculated that the present day value of the cost of the damages to property from potential future floods is £840k.

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Table 5.6.4.3 Bangor SFRA – Ballyholme Stream and tributaries			
Potential Adverse Consequences – Fluvial Flooding			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**28**	**60**	**139**
Non Residential (Nr)	**7**	**7**	**8**
Economic Damage (£)	**£35k**	**£268k**	**£973k**
Annual Average Damage (£)	**£28k**		
Present Value (£)	**£840k**		
IPPC sites (Nr)	**0**	**0**	**0**
Community Assets (Nr)	**0**	**0**	**0**
Care Homes	**0**	**0**	**0**
GP Surgery's	**0**	**0**	**0**
Fire stations	**0**	**0**	**0**
Hospitals	**0**	**0**	**0**
Police Stations	**0**	**0**	**0**
Schools	**0**	**0**	**0**
Key Infrastructure (Nr)	**4**	**4**	**6**
NIW Wastewater Treatment Works	**0**	**0**	**0**
NIW Sewage Pumping Stations	1	1	2
NIW Water Treatment Work	**0**	**0**	**0**
NIW Treated Water Pumping Stations	**0**	**0**	**0**
NIE Substation 6to11kV	**3**	**3**	**3**
NIE Substation 33kV	**0**	**0**	1
NIE Substation 275kV	**0**	**0**	**0**
NIE Substation 110kV	**0**	**0**	**0**
Road Service - Trunk Road	**0**	**0**	**0**
Environmental Designated sites (Nr)	**2**	**2**	**3**
AONB	**0**	**0**	**0**
ASSI	**0**	**0**	**0**
Environmentally Sensitive Areas	**1**	**1**	**1**
Maritime Nature Reserve	**0**	**0**	**0**
Nature Reserve	**0**	**0**	**0**
RAMSAR	**0**	**0**	**1**
SAC	**0**	**0**	**0**
Sites of Local Nature Conservation Importance	**0**	**0**	**0**
SPA	**1**	**1**	**1**
RSPB Reserve	**0**	**0**	**0**
UWT Nature Reserve	**0**	**0**	**0**
Built Heritage sites (Nr)	**0**	**0**	**0**
National Trust	**0**	**0**	**0**
Listed Buildings	**0**	**0**	**0**
Sites and Monuments Records	**0**	**0**	**0**
Buildings of Special Architectural or Historical Interest	**0**	**0**	**0**
Areas of Significant Archaeological Interest	**0**	**0**	**0**
Historic Gardens	**0**	**0**	**0**
	0	**0**	**0**

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5.6.5 Proposed Fluvial Flood Mitigation Measures

Prevention

As well as managing the existing flood risk to people and properties in Bangor it is important that the flood risk is not increased by new development in areas of known flood risk. Northern Ireland's planning policies adopt a precautionary approach to development that aim to prevent future development that may be at risk of flooding or that may increase the risk of flooding elsewhere.

Reference should be made to Section 4.4 under the headings Planning NI and Local Government regarding the reform and restructuring of the planning system in Northern Ireland. Rivers Agency's Planning Advisory Unit provides advice to Planning NI and Local Councils in relation to the prevention of flooding. In particular Local Councils are advised on Development Plans and at the Planning Application stage. Flood mapping information is used to inform the local Development Plans to ensure, where possible, that new zonings are located outside the identified flood risk areas. In the determination of planning applications any proposed development within a flood risk area will either be advised against or will be further considered if it meets one of the "Exception" rules and is accompanied by a suitable Flood Risk/Drainage Assessment. Applications that relate to "Greenfield" built development in fluvial floodplains are unlikely to be accepted, whereas applications for recreation purposes and amenity open space will usually be accepted.

Development Plans

In the preparation of new Development Plans for Bangor, Rivers Agency will advise against bringing forward sites or the zoning of any land, particularly for built development, that has been identified from the flood maps as being within the 1 in 100 year fluvial floodplain, reservoir inundation area or is susceptible elsewhere to surface water flooding.

Rivers Agency will also review the existing Development Plan for Bangor (Belfast Metropolitan Area Plan, 2015) with a view to addressing flood risk issues which have only recently been identified as a result of the new flood maps.

The main (undeveloped) flooded areas, amongst others, within the Bangor Significant Flood Risk Area are:

Conlig Stream

- North of the watercourse alongside Bloomfield Playing Pitches

Carnalea Stream

- East of the stream in field behind Wandsworth Park
- East of the stream and south of the Crawfordsburn Road at Rathmore Avenue.
- West of the stream and south of the Crawfordsburn Road along Wandsworth Avenue

Rathmore Stream

- West of the stream at Killen Avenue

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- East of the stream at Belmont Avenue
- West of the stream to the north of Innisfoyle Drive
- Both sides of the river at the south of Innisfoyle Drive

Ward Park Stream

- West of the stream along Gransha Park

Navar Drive Stream

- West of the stream along Navar Drive

Ballyholme Stream / Ballyree Burn

- East of the stream at Brookvale Avenue
- West of the stream at the Poplars
- West of the Stream at Shamrock Glen, Irvine Park and Irvine Crescent
- West of the stream at Grandmere Park
- West of the stream at Sandhurst Drive

Planning Applications

Fluvial Areas at risk

Rivers Agency shall advise against the development of all sites that are located within the 1 in 100 year fluvial floodplain, irrespective of whether they are located within a current development plan or as a single site application outside the plan area.

For those sites within the 1 in 100 year fluvial floodplain where the principle of development has been accepted by Local Council as meeting the 'Exception Test', Rivers Agency will further consider the application through the appraisal of an accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures.

Areas at Risk of Surface Water flooding

For those sites outside the 1 in 100 year fluvial floodplain that are located in an area where there is evidence of a history of surface water flooding (identified by flood hardship payments) we will further consider the application through the appraisal of the accompanying Drainage Assessment that will need to demonstrate suitable flood mitigation measures.

Where there is potential for surface water flooding as indicated in the 'purple' predicted areas on the Surface Water Maps we will advise that the applicant should assess the flood risk and drainage impact to the site and construct in an appropriate manner.

Areas at Risk of Flood Inundation from Reservoirs

For all development proposals that are located within the potential flood inundation area of a controlled reservoir we will further consider the application through the appraisal of the accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures. If it is a new development proposal we will also need the applicant to demonstrate that the condition, management and maintenance regime of the reservoir is appropriate to provide sufficient assurance regarding reservoir safety.

The Controlled Reservoirs identified in the Bangor area are:

- **Clandeboye Lake**
- **Conlig Upper & Conlig Lower**
- **Clandeboye Reservoir**

Protection

Structural measures are still one of the main options in providing flood protection to people and property impacted by the effects of extensive flooding. It is therefore important that we continue to target investment by providing flood defences, culvert alleviation schemes and infrastructure upgrade works to those communities at greatest need.

The alleviation of surface water flooding, in particular, will require input from a number of bodies. The Flood Investment and Planning Group, FIPG, provides a coordinated approach across Government in relation to the investigation of flooding, agreeing responsibilities and identifying collaborative solutions. The group is represented by Rivers Agency, NI Water and Transport NI, amongst others, with flood risk management responsibilities.

There are a number of stages to follow when procuring a flood alleviation scheme. The potential scheme needs to be first subjected to a feasibility study that will also include an economic appraisal. From the detailed Hazard and Risk Maps a Flood Risk Metric Tool' (FRISM) is used in urbanised flooded areas to get an estimate of the likely property damages as a result of a range of flood events. The estimated cost of a scheme is then compared to the total 'damage avoidance benefits' that the scheme will provide to property over the scheme's design life. If the benefit/cost ratio is greater than 1, then the potential scheme will be referred to Rivers Agency's Capital Procurement Unit for a feasibility study to be undertaken.

If the flooding issue identified is not solely Rivers Agency's responsibility, or is the responsibility of NI Water or Transport NI such as a local drainage or road infrastructure issue, then it will be referred either to FIPG or directly to the responsible body, for their further consideration.

If a cost benefit analysis identifies a viable scheme, it will be placed on a prioritisation list and progressed alongside other competing schemes. The position on the list will depend on a set marking criteria, such as the benefit/ cost ratio and the overall scheme costs. Depending on the availability of resources it may take

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anything from between 2 – 5 years for the scheme to progress from the start of the feasibility study to construction works commencing on the ground.

Having conducted a detailed assessment of the fluvial flood risk to the Bangor SFRA, Rivers Agency has determined that within the national context, only the flooding from one of the of the six main watercourses which drain the urban area could be described as potentially significant. See below for details.

The detailed fluvial flood models predict that two of the six watercourses, which include the Bryan's Burn and the Clandeboye Stream, present no tangible flood risk to property. The models also show that for three of the others, the Ward Park Stream, Rathmore Stream and Carnalea Stream, the numbers of properties that are estimated to be at risk are relatively low.

There is however, considered to be a substantial risk of flooding to property from the Ballyholme Stream and its tributaries where it is estimated that up to 139 homes and 8 non-residential properties are at risk from the 1 in 100 year event. It is calculated that the present day value of the cost of property damages from potential future floods is around £1 million and therefore a potential flood alleviation scheme to mitigate the flood risk may be economically viable. Accordingly, Rivers Agency shall undertake a feasibility study for a potential flood alleviation scheme on the Ballyholme Stream. The timing for the commencement of this flood study will depend on its priority within the Flood Study Programme and will subject to the future resources available to Rivers Agency.

It should also be noted that the available historical records would indicate that the watercourses have caused nothing other than minor flooding to very small numbers of properties in the recent past and on each occasion debris blockage of a culvert inlet grille was a contributing factor. The lack of flooding in recent year may be attributable to the fact that in the early 1990s Rivers Agency undertook studies to identify deficiencies in the urban watercourse systems within the Bangor area and carried out major improvement schemes to address the deficiencies and alleviate potential future flood risk, most notably on sections of the Ward Park Stream and Carnalea Stream.

Preparedness

In Bangor it is not possible to prevent or protect against all flooding. Indeed even where flood defences exist it is possible in an extreme event that these could be over topped and flooding could still occur.

Having recognised this fact, considerable effort in recent years has been made by emergency planners in a Government Departments, Councils and the Emergency Services working together and sharing information to ensure a coordinated response.

However, despite these improvements during significant flood events the emergency response of Government Departments and the Emergency Services can become over stretched. This means that not all

calls for assistance during a flood event may be responded to in a timely manner. With this in mind it is important that households and communities, subject to a known flood risk, are prepared. The detail of preparedness actions including flood warning and informing activities planned from a regional perspective are notes in Appendix E.

This is not Government withdrawing from any undertaking to respond in emergencies but an additional layer of support to ensure Government Departments and the public work together to reduce the overall impacts of flooding.

From the flood risk assessment it would appear that there are 8 main areas within Bangor that have flooded in the recent past that may benefit from the flood warning and informing proposals, outlined in Appendix D.

A pilot project of community engagement to deliver flood warning and informing, held in 2014, identified basic assessment formulae to assess and score areas that could potentially be a focus for flood warning and informing actions. Based on this scoring these areas did not score high enough to be placed within the top 20 communities to be offered a programme of community engagement during the period of this plan. However, if communities want to become more resilient, the Department is committed to providing assistance were possible to develop the consistent approach to resilience. The NI Direct website www.nidirect.gov.uk/ will host further information and advice on what to do in advance of flooding, what to do during flooding and how to recover after flooding. The website will also contain templates for communities wishing to develop their own plan.

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5.7 Newcastle Significant Flood Risk Area

The core boundary of the Newcastle SFRA, which has been determined through the PFRA, is located within the South Down Local Flood Management Area and is illustrated in Figure 5.7.1 below.

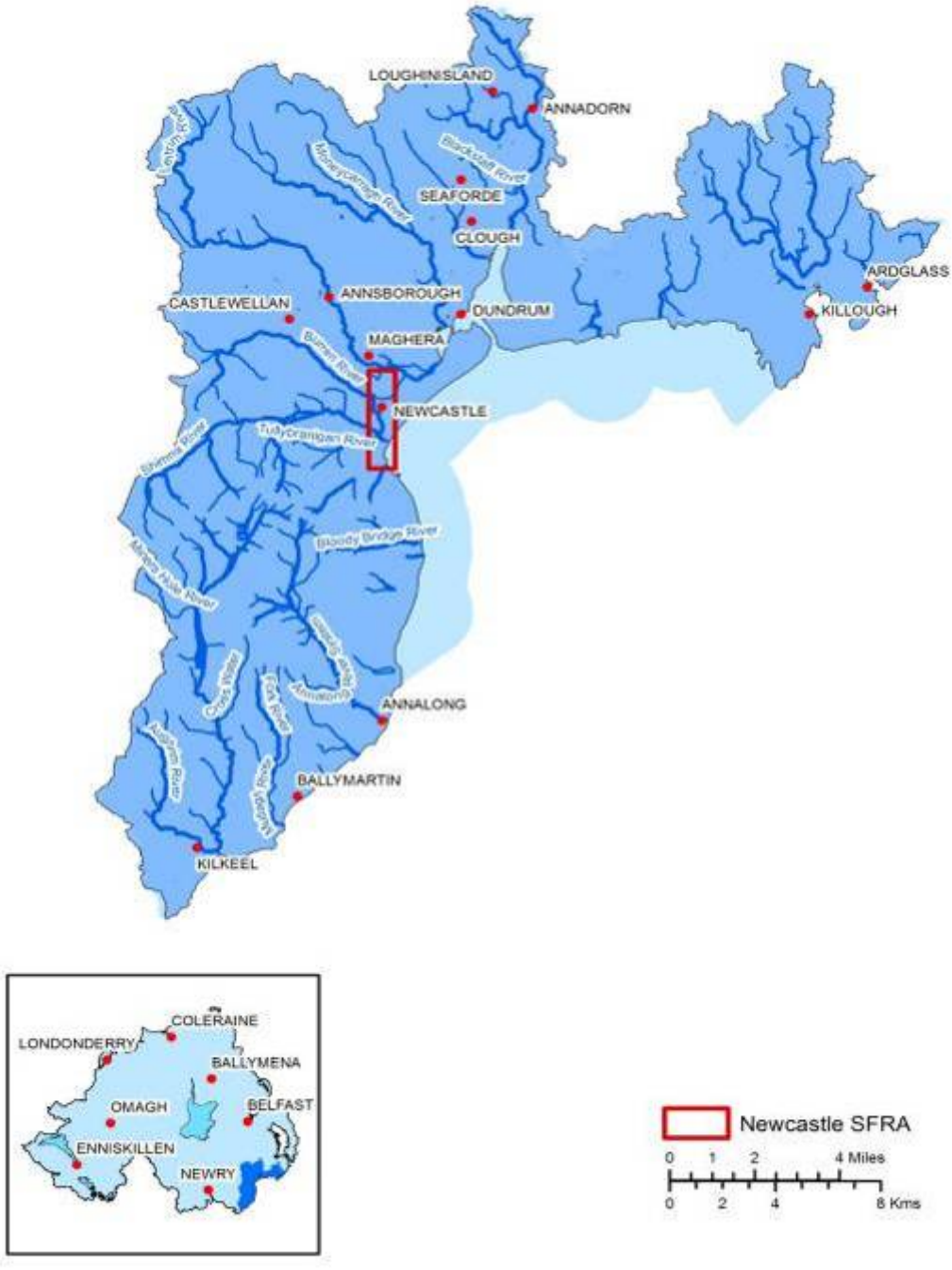

Figure 5.7.1 - South Down Local Flood Management Area and Newcastle SFRA

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5.7.1 Flooding History

Flooding to Newcastle from both the Shimna River and Burren River has happened on many occasions in the past. A report produced by Rivers Agency in 2003 titled *Newcastle Urban Area Assessment of the Flood Levels* contains references to newspaper reports of flood events in 1968, 1978, 1978, 1987, 1988 and 1994 and in addition, other significant events are known to have occurred in 1982, 1986, 1990 and 1997. Much of this historical flooding has emanated from the Burren River and, as consequence, Rivers Agency undertook the Burren flood alleviation scheme in 2007. The scheme involved the construction of flood walls along both sides of the lower reach of the river which extend from its confluence with the Shimna River for a distance 2km upstream (see Photograph 5.7.1.1).

Photograph 5.7.1.1 - Newcastle, Burren River flood defences.

Following completion of the Burren Flood Alleviation Scheme, another major flood event occurred in Newcastle on 16th August 2008. On this occasion, the flooding largely emanated from the Shimna River and caused flood damage to around 40 properties mostly located in and around Bryansford Avenue and Shimna Road. Unfortunately, on this occasion floodwater from the Shimna River 'jumped its catchment' and spilled into an area behind the recently constructed flood defences on the Burren River. This was a particular disappointment to the owners of flooded properties in Shimna Road and Shimna Vale who, understandably, believed that they would be protected from flooding by the Burren River defences.

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Since the introduction of the flooding hardship payment scheme in 2007, there have been in excess of 70 payments issued to homeowners in the Newcastle SFRA. The majority of the payments (53) relate to properties that flooded during the August 2008 event described above. A further 13 of the payments relate to an extreme rainfall flood event in June 2012 which overwhelmed the urban drainage systems and led to the flooding of properties in and around the Mourneview housing development. Many similar flood events have occurred in this area prior to the introduction of the 2007 scheme and this area is listed in the inter-agency Flood Liaison Group's 'Flooding Hotspots' register. The cause of this repeated flooding is due to the ineffectiveness of the existing sewerage systems that were laid by the developer of the housing estates in the 1970s. Measures to address the significant surface water flooding at Mourneview are outlined in the protection section.

Photograph 5.7.1.2 - Flooding at Mourneview and Burrendale housing developments – 5th July 2012

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5.7.2 PFRA – Identification of Potentially Significant Flood Sources

According to the Preliminary Flood Risk Assessment (Dec 2011) the town of Newcastle, in terms of the potential adverse consequences of flooding, is ranked eighth of the twenty SFRA within Northern Ireland (see Figure 4.1). On the basis of this initial assessment, which was undertaken using the Strategic Flood Maps, the flood risk to the town was considered to arise almost exclusively from fluvial flooding with in excess of 1300 properties estimated to fall within the predicted 1 in 100 year strategic flood plain outlines. Although Newcastle is a seaside town, it is not considered to be at significant risk from tidal inundation as there is nothing more than the toilet block in Castle Park exposed to flooding at a 1 in 200 yr event.

To facilitate a more robust assessment of the fluvial flood risk to Newcastle, Rivers Agency developed detailed predictive flood models for the Shimna River and its tributaries; the Leitrim River and its tributaries and the Glen River. The Flood Hazard Maps, produced using the detailed flood models, are more accurate than the strategic maps which may be over estimating or under estimating the number of properties at risk of flooding. Details of the models and their output are described in the following sections.

5.7.3 Catchment Description

The Shimna River rises in the Mourne Mountains and flows for approximately 11km in an easterly direction through the Tullymore Forest Park to the sea at Newcastle. Within the town of Newcastle the Shimna River is joined by the Burren River at Islands Park and, less than 100m downstream, it is joined by the Tullybranigan River (in the vicinity of the Castle Park boating lake) before discharging to the sea at the Castle Bridge. The upper catchment of the Shimna falls quite steeply from the mountains through a narrow valley which flattens abruptly in the vicinity of Island Park before being joined by its main tributaries. The lower sections of the rivers are tidally influenced which adds to the risk by damping the capacity of the river to discharge to the sea during high tides.

5.7.4 Fluvial Flood Risk Assessment

Fluvial Model

Following the August 2008 flood event, Rivers Agency has undertaken a number of flood studies for Newcastle. The most recent, the Newcastle Modelling & Flood Mapping Study, was completed in October 2013. The output from this modelling study has been used to produce the detailed Flood Hazard Maps and Flood Risk Maps required by the Directive and available through Rivers Agency's website in Flood Maps NI. Fundamental to this study was the development of a single Infoworks ICM model which is capable of simulating the flood mechanisms, taking account of the interactions between the various watercourses located within the urban area. This combined hydrodynamic model includes the Shimna River, Burren River, Tullybranigan River, Glen River and Shanslieve Drive Stream. In addition, a separate Infoworks RS 1D/2D hydrodynamic model was developed for the Leitrim River and its tributary the Murlough Drain which skirt the north side of the town. The location and extent of the rivers that were modelled are illustrated in Figure 5.7.4.1 below.

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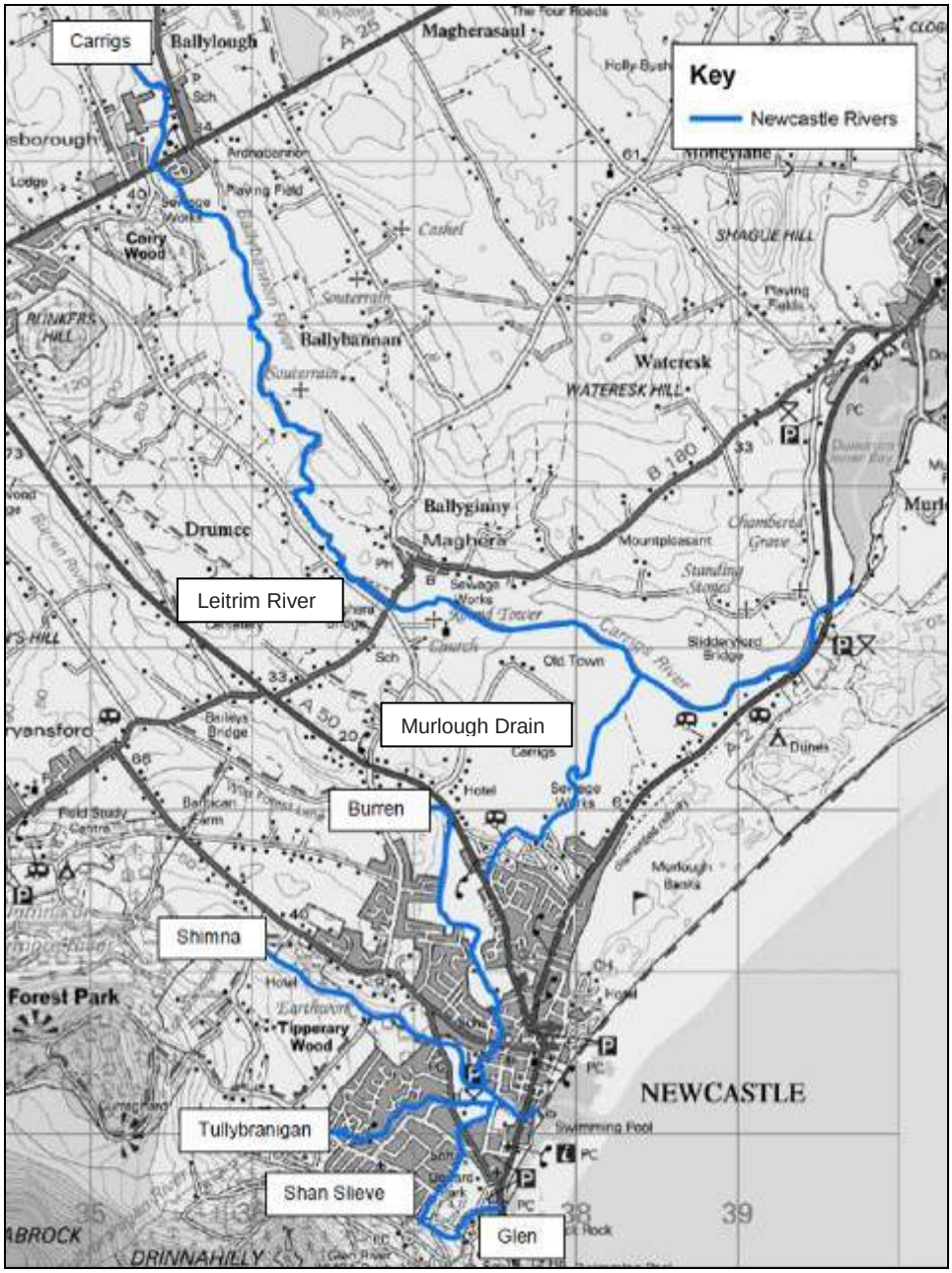

Figure 5.7.4.1 - Newcastle SFRA – Modelled Watercourses

Flooding Mechanisms

Shimna River (and tributaries)

The upper limit of the modelled reach of the Shimna River is at the outskirts of the Newcastle urban limits. Above this point the upstream catchment is mountainous in nature and predominantly rural with no properties located in areas that likely to be affected by flooding. The Shimna discharges to the Irish Sea at Castle Bridge. The lower section of the Shimna River is tidally influenced and therefore, for purposes of modelling this scenario, the 1 in 2 year tidal level predicted by the Irish Surge and Tidal Model was used for the downstream boundary condition.

The modelled reach of the Burren River begins at the confluence with the Shimna River at the Islands Park and extends upstream to a location near the Burrendale Hotel (at Castlewellan Road). Upstream of this position the catchment is essentially rural with very few properties estimated to be located in or near the floodplain.

Flowing from the Tullybranigan Hill and Shan Slieve, the upstream catchment of the Tullybranigan River is entirely mountainous. The Tullybranigan was modelled through the urban reach which flows through the southwest of the town from Bonny's Caravan Park to its outlet at the boating pond in Castle Park. Immediately upstream of the boating pond, the Tullybranigan River is linked to the Shimna River by a channel that runs along the upstream face of the Shimna Bridge.

The upper catchment of the Shan Slieve Drive Stream which flows through Donard Wood is entirely mountainous. The upstream limit of the model begins at the outskirts of the town to the rear of houses at Slieve Shannagh Park and extends to its convergence with the Tullybranigan River at the Shimna Bridge. A 200m section of the watercourse is culverted from the bottom of Shan Slieve Drive to the Bryansford Road with pipes (typically 450mm to 600mm in diameter) and a short 60m section of the pipeline has been assessed as Grade 4 defective. Historically, the majority of the flow from the Shan Slieve has been diverted to the Glen River via the Shan Slieve Diversion Channel and consequently, the channel of the Shan Slieve Drive Stream is dry except in times of heavy rainfall, when some local drainage discharges to it. For the purposes of the model, the flows from the Shan Slieve are included in the Glen River.

The developed areas that are prone to flooding from the Shimna River and its tributaries (Burren River and Tullybranigan River), together with a description of the flooding mechanisms, are as follows.

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Shimna River (and tributaries)

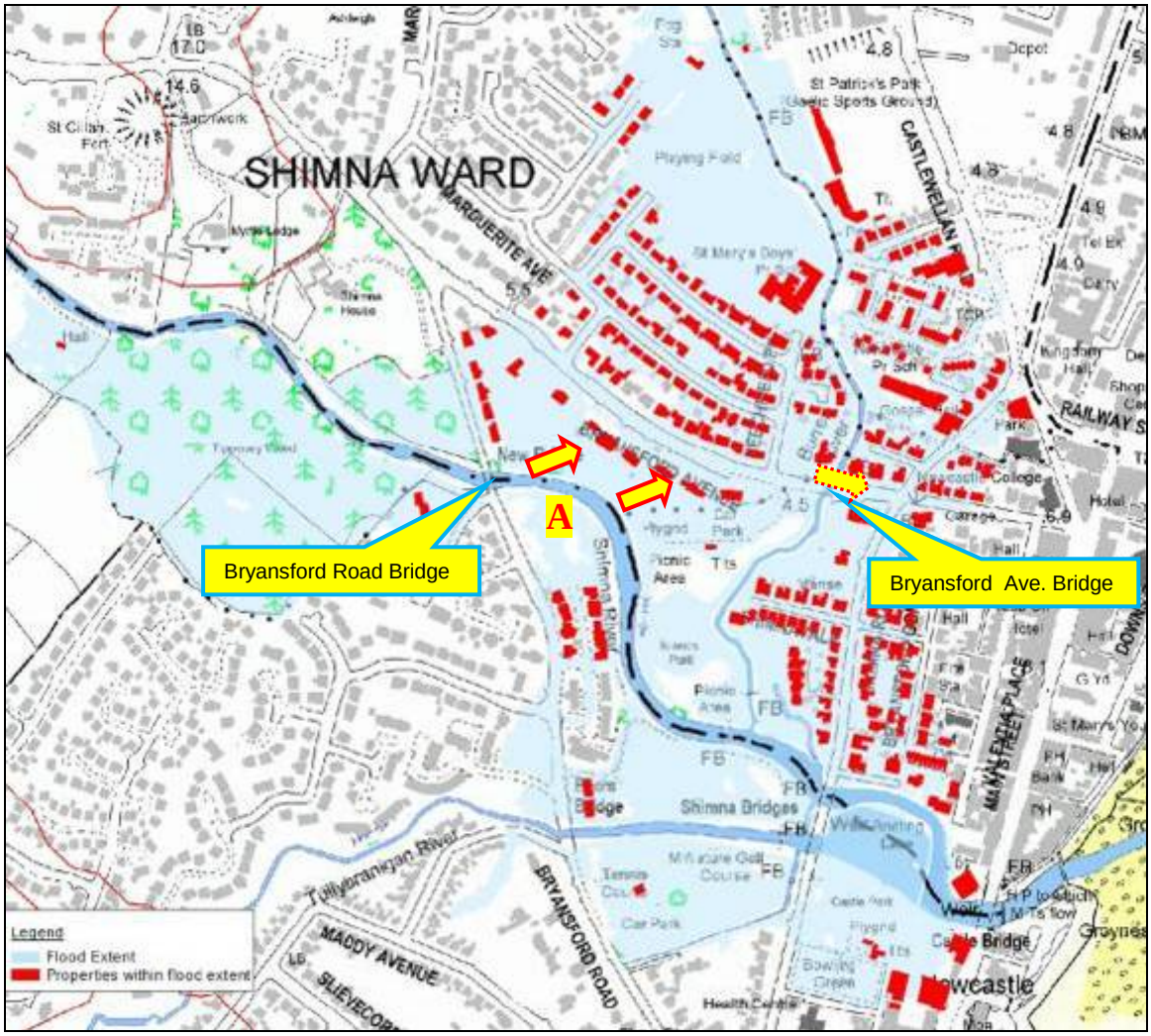

Figure 5.7.4.2 - Newcastle SFRA, Shimna River (and tributaries) - 1% AEP Floodplain

Figure 5.7.4.2 illustrates the predicted geographical extents of the potential fluvial flooding at Newcastle for a 1% AEP flood event in the Shimna River and its tributaries. The details of the potential impacts of the flooding on property and key infrastructure is summarised in Table 5.7.4.1. The model shows that at the 1% AEP (1 in 100 year) flood event, floodwater begins to overspill the banks in the vicinity of the Bryansford Road Bridge (marked as point A on Figure 5.7.4.2). The floodwater then flows across Bryansford Avenue into Beechfield Park and on towards the Bryansford Avenue Bridge. The Bryansford Avenue Bridge then acts as an aqueduct and conveys the floodwater over the Burren River to the eastern side of the town, causing flooding to properties in and around Shimna Road and Shimna Vale. This flooding mechanism, predicted by the model, corresponds with the actual flood routing observed during the severe flood event in August 2008.

Importantly, the model shows that the Burren Flood Defences, recently constructed by Rivers Agency to protect the town from repeated flooding from the Burren River, do not get overtopped by a 1% AEP (1 in 100

year) event. Therefore, although properties in the east side of town are adequately protected from flooding by the Burren River, significant numbers continue to at risk from the Shimna River. In total there are around 300 properties at risk of flooding from the Shimna River. The majority of these are located within the wedge shaped residential area that is sandwiched between the left bank of the Shimna River and the Burren River (near their confluence) and also behind the existing flood defences on the left bank of the Burren River. However, there is a small number of properties located on the right bank of the Shimna River at Shimna Mile, Riversdale Park and Bryansford Road which are exposed to shallow depth flooding (typically less than 300mm). The flooding mechanism at the more frequent 10% AEP (1 in 10 year) event is similar to that described above except that the area of inundation is substantially reduced and, as a consequence, there is lesser number of properties (around 80) estimated to be affected by flooding. The present value of the total property damages from potential future floods is calculated to be in excess of £5.5 million. This figure has been abstracted from the recent *Shimna River, Newcastle Flood Risk Assessment Economic Appraisal* report (RPS 2014) which is considered to be more accurate than the calculation of damages through the automated FRISM tool that is used generally for the economic assessments carried out for the FRMPs.

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Table 5.7.4.1 Newcastle SFRA – Shimna River and tributaries			
Potential Adverse Consequences – Fluvial Flooding			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**77**	**N.A.**	**274**
Non Residential (Nr)	**5**	**N.A.**	**14**
Economic Damage (£)	**£99k**	**N.A.**	**£6.2m**
Annual Average Damage (£)	***£312k**		
Present Value (£)	***£5.5m**		
IPPC sites (Nr)	**0**		**0**
Community Assets (Nr)	**0**		**0**
Care Homes	**0**		**0**
GP Surgery's	**0**		**0**
Fire stations	**0**		**0**
Hospitals	**0**		**0**
Police Stations	**0**		**0**
Schools	**0**		**1**
Key Infrastructure (Nr)	**3**		**10**
NIW Wastewater Treatment Works	**0**		**0**
NIW Sewage Pumping Stations	**3**		**5**
NIW Water Treatment Work	**0**		**0**
NIW Treated Water Pumping Stations	**0**		**0**
NIE Substation 6to11kV	**0**		**5**
NIE Substation 33kV	**0**		**0**
NIE Substation 275kV	**0**		**0**
NIE Substation 110kV	**0**		**0**
Road Service - Trunk Road	**0**		**0**
Environmental Designated sites (Nr)	**6**		**6**
AONB	**1**		**1**
ASSI	**2**		**2**
Environmentally Sensitive Areas	**0**		**0**
Maritime Nature Reserve	**0**		**0**
Nature Reserve	**0**		**0**
RAMSAR	**0**		**0**
SAC	**1**		**1**
Sites of Local Nature Conservation Importance	**2**		**2**
SPA	**0**		**0**
RSPB Reserve	**0**		**0**
UWT Nature Reserve	**0**		**0**
Built Heritage sites (Nr)			**2**
National Trust	**0**		**0**
Listed Buildings	**0**		**1**
Sites and Monuments Records	**0**		**1**
Buildings of Special Architectural or Historical Interest	**0**		**0**
Areas of Significant Archaeological Interest	**0**		**0**
Historic Gardens	**0**		**0**

**Figures from Shimna River, Newcastle Flood Risk Assessment Economic Appraisal report (2014)*

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Leitrim River and Murlough Drain

The modelled reach of the Leitrim River extends from just upstream of Annsborough to its outlet to the sea at Dundrum Bay. Within this 9.5km reach there are 9 bridges and a number of weirs that affect flows in the channel and the hydrodynamic affects of these structures are included within the model. The modelled section of the Murlough Drain extends from the Castlewellan Road to its confluence with the Leitrim River a distance of around 2km.

The developed areas that are prone to flooding from the Leitrim River and its tributary the Murlough Drain, together with a description of the flooding mechanisms, are as follows.

Figure 5.7.4.3 illustrates the predicted geographical extents of the fluvial floodplains at Newcastle for a 1% AEP (1 in 100 year) flood event on the Leitrim River and its tributary the Murlough Drain.

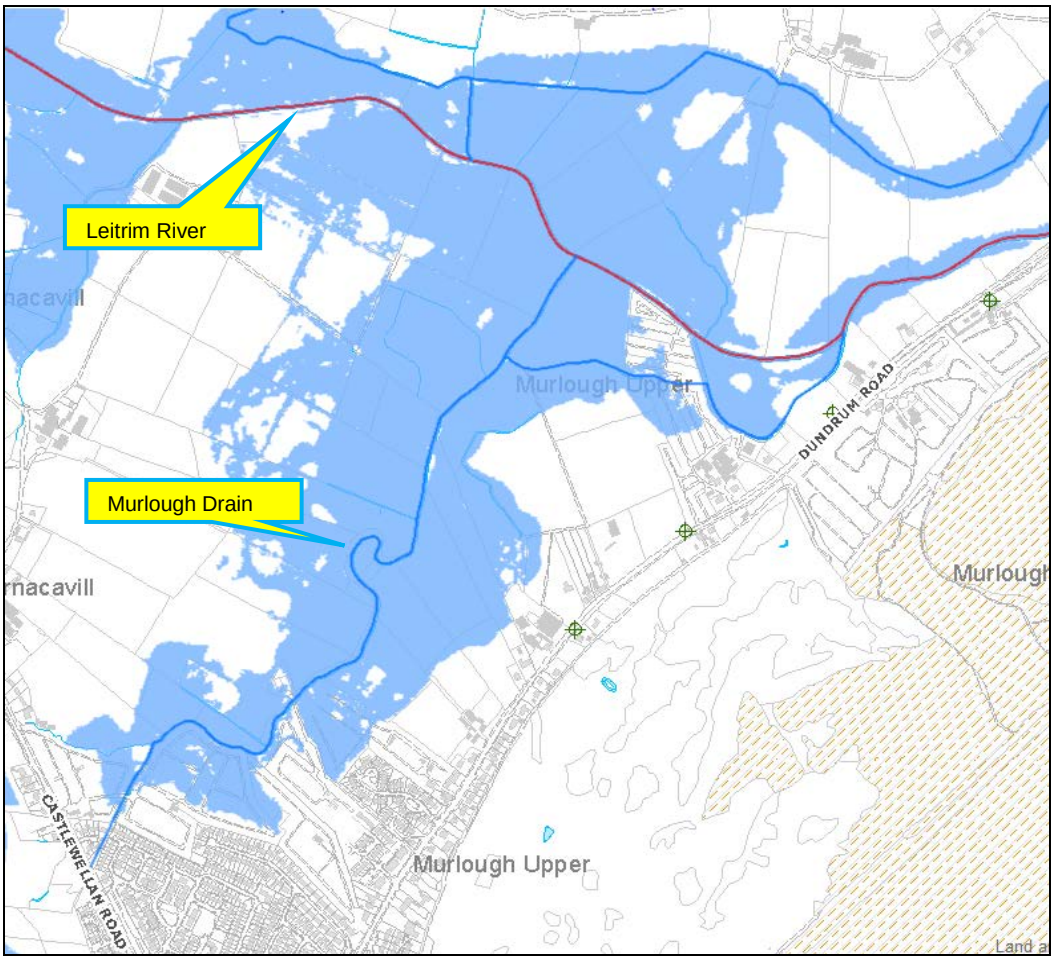

Figure 5.7.4.3 - Newcastle SFRA, Leitrim River and Murlough Drain - 1% AEP Floodplain

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The floodplain for the Leitrim River and its tributary the Murlough Drain are essentially flat. Therefore, when river levels rise above bank height in either of these watercourses, the area that floods is extensive and causes the inundation of large areas of agricultural land and partial flooding to three caravan park sites with entrances off the Dundrum Road. The depth of flooding across the areas occupied by the caravan parks is very shallow and typically less than 150mm. Therefore, it is likely that most of the caravans within the flood plain would avoid internal flood damage. The location of the vulnerable caravan parks are illustrated in the figure 5.7.4.4

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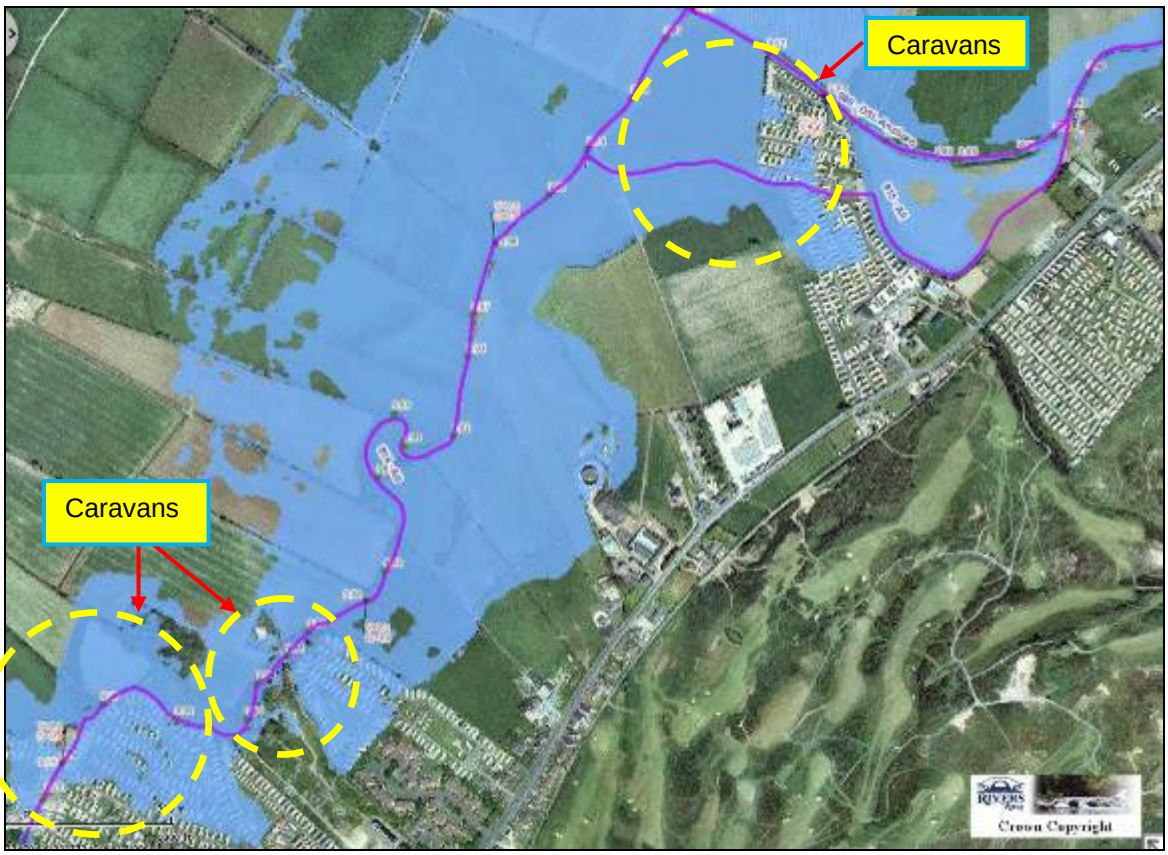

Figure 5.7.4.4 - Newcastle SFRA, Leitrim River and Murlough Drain
Location of caravan parks within the 1 % AEP Floodplain

A feasibility study was undertaken by Rivers Agency in 2003 to establish if a flood alleviation scheme to mitigate the flood risk from the Leitrim River/Murlough Drain was likely to be economically viable. The conclusion of this feasibility study report was that the estimated cost of providing flood defences was around £7m and that the benefits in terms of the potential cost of the flood damage avoided was negligible. The main reason that calculated benefits were very low is that government guidance on economic appraisal does not allow the cost of damages to flooded caravans to be taken into consideration. However, even in the event that the cost of the caravan damages could be taken into account, a flood alleviation scheme would not be economically viable. Consequently, there will be no structural flood mitigation measures specific to these watercourses included within the plan.

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The Glen River

The Glen River flows around the southern end of the town. Its upper catchment is entirely mountainous and dominated by Slieve Donard and Slieve Commedagh. It flows to the sea at Patton's Bridge on the Central Promenade and the modelled reach extends from the outlet to the foot of the hill at Donard Wood some 400m upstream.

The model shows that even at the 1% AEP event the flow in the Glen River remains within the confines of its channel and, as there is no potential significant risk to property, there will be no flood mitigation measures specific to this watercourse included in the plan.

5.7.5 Proposed Fluvial Flood Mitigation Measures

Prevention

As well as managing the existing flood risk to people and properties in Newcastle it is important that the flood risk is not increased by new development in areas of known flood risk. Northern Ireland's planning policies adopt a precautionary approach to development that aim to prevent future development that may be at risk of flooding or that may increase the risk of flooding elsewhere.

Reference should be made to Section 4.4 under the headings Planning NI and Local Government regarding the reform and restructuring of the planning system in Northern Ireland. Rivers Agency's Planning Advisory Unit provides advice to Planning NI and Local Councils in relation to the prevention of flooding. In particular Local Councils are advised on the preparation of Development Plans and at the Planning Application stage. Flood mapping information is used to inform the local Development Plans to ensure, where possible, that new zonings are located outside the identified flood risk areas. In the determination of planning applications any proposed development within a flood risk area will either be advised against or will be further considered if it meets one of the "Exception" rules and is accompanied by a suitable Flood Risk/Drainage Assessment. Applications that relate to "Greenfield" built development in fluvial floodplains are unlikely to be accepted, whereas applications for recreation purposes and amenity open space will usually be accepted.

Development Plans

In the preparation of new Development Plans for Newcastle, Rivers Agency will advise against bringing forward sites or the zoning of any land, particularly for built development, that has been identified from the flood maps as being within the 1 in 100 year fluvial floodplain, reservoir inundation area or is susceptible elsewhere to surface water flooding.

Rivers Agency will also review the existing development plan for Newcastle (Ards and Down Area Plan) with a view to addressing flood risk issues which have only recently been identified as a result of the new flood maps.

The main (undeveloped) flooded areas, amongst others, within the Newcastle Significant Flood Risk Area are:

Burren River

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- East of the river to the Castlewellan Road and to the north of Ardkeel Park
- West of the river in the playing fields area at St May's Primary School
- To the east of the river on both sides of the Castlewellan Road
- To the west of the river in Marguerite and Elmgrove Park Areas

Shimna River

- To the south of the river at Shimna Mile and Riverside Park
- To the North of the river along Bryansford Avenue

Shanslieve Drive Stream

- To the south of the river along the Shimna Road and Bryansford Road

Murlough Drain

- To the east of the drain at the caravan parks.

Planning Applications

Fluvial Areas at risk

Rivers Agency shall advise against the development of all sites that are located within the 1 in 100 year fluvial floodplain, irrespective of whether they are located within a current development plan or as a single site application outside the plan area.

For those sites within the 1 in 100 year fluvial floodplain where the principle of development has been accepted by Local Council as meeting the 'Exception Test', Rivers Agency will further consider the application through the appraisal of an accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures.

The main existing developed areas, amongst others, at flood risk within Newcastle were re-development may be likely to take place are:

- An area sandwiched between the Shimna River and the Burren River which includes existing developments in the vicinity of Bryansford, Elmgrove and Larchfield Park.
- An area to the east of the Burren River which includes developments in the vicinity of Shimnavale, Shimna Road, Shimana Park, Dunwellan Park and Burren Park.

Areas at Risk of Surface Water flooding

For those sites outside the 1 in 100 year fluvial floodplain that are located in an area where there is evidence of a history of surface water flooding (identified by flood hardship payments) Rivers Agency will further consider the application through the appraisal of the accompanying Drainage Assessment that will need to demonstrate suitable flood mitigation measures.

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Where there is potential for surface water flooding as predicted by the Surface Water Maps (areas highlighted purple) Rivers Agency will advise that the applicant should assess the flood risk and drainage impact to the site and construct in an appropriate manner.

The main areas within Newcastle that have a history of surface water flooding area at:

- Tullybranigan Road
- Shimnavale
- Burren Park
- Marguerite Avenue

Areas at Risk of Flood Inundation from Reservoirs

For all development proposals that are located within the potential flood inundation area of a Controlled Reservoir we will further consider the application through the appraisal of the accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures. If it is a new development proposal, Rivers Agency will also need the applicant to demonstrate that the condition, management and maintenance regime of the reservoir is appropriate to provide sufficient assurance regarding reservoir safety.

Controlled Reservoirs identified in the Newcastle area are:

- Lough Island Reavy

Protection

Structural measures are still one of the main options in providing flood protection to people and property impacted by the effects of extensive flooding. It is therefore important that we continue to target investment by providing flood defences, culvert alleviation schemes and infrastructure upgrade works to those communities at greatest need.

The alleviation of surface water flooding, in particular, will require input from a number of bodies. The Flood Investment and Planning Group, FIPG, provides a coordinated approach across Government in relation to the investigation of flooding, agreeing responsibilities and identifying collaborative solutions. The group is represented by Rivers Agency, NI Water and Transport NI, amongst others, with flood risk management responsibilities.

There are a number of stages to follow when procuring a flood alleviation scheme. The potential scheme needs to be first subjected to a feasibility study that will also include an economic appraisal. From the detailed Hazard and Risk Maps a Flood Risk Metric tool (FRISM) is used in urbanised flooded areas to get an estimate of the likely property damages as a result of a range of flood events. The estimated cost of a scheme is then compared to the total ‘damage avoidance benefits’ that the scheme will provide to property over the scheme’s design life. If the benefit/cost ratio is greater than 1, then the potential scheme will be referred to Rivers Agency’s Capital Procurement Unit for a feasibility study to be undertaken.

If the flooding issue identified is not solely Rivers Agency's responsibility, or is the responsibility of NI Water or Transport NI such as a local drainage or road infrastructure issue, then it will be referred either to FIPG or directly to the responsible body, for their further consideration.

If a cost benefit analysis identifies a viable scheme, it will be placed on a prioritisation list and progressed alongside other competing schemes. The position on the list will depend on a set marking criteria, such as the benefit/ cost ratio and the overall scheme costs. Depending on the availability of resources it may take anything from between 2 – 5 years for the scheme to progress from the start of the feasibility study to construction works commencing on the ground.

Fluvial mitigation

Having conducted a detailed assessment of the fluvial flood risk from all of the rivers in the Newcastle SFRA, Rivers Agency has determined that the level of flood risk from the Shimna River is sufficient to justify investment in a flood alleviation scheme.

Rivers Agency has recently completed a detailed feasibility study and economic appraisal of the options to provide flood defences at the Shimna River. This study has demonstrated that a publicly funded scheme is economically viable and approval to proceed to the design stage is currently being sought from the Department of Finance and Personnel (DFP). The preferred option from the feasibility study is for the provision of hard defences (flood walls and embankments) along both banks of the river upstream and downstream of Bryansford Road Bridge at an estimated cost of around £4million. Subject to approval by DFP and the necessary resources, the construction of the defences are programmed to commence in 2018/19.

Surface Water/Sewerage Flooding Mitigation Measures

The ongoing flooding at the Mourneview housing development was referred to the recently formed cross-departmental Flood Investment Planning Group (FIPG) for a resolution. FIPG agreed to coordinate a government wide investigation and solution (if appropriate) as the flooding appeared to be related to an 'unadopted' sewerage system, for which NI Water has no statutory responsibility and also because road drainage may be a contributing factor and a potential solution could involve more than one of the drainage authorities. On the basis of FIPG recommendations, NI Water has taken a lead on this issue and is currently with Transport NI, Rivers Agency and NIEA on a flood study for the area. The aim of this study is to identify an economically viable engineering solution that will reduce the risk of flooding to properties in the area while continuing to protect bathing water quality. It is anticipated that the study will be completed in spring 2016.

As an interim measure, NI Water has cleaned the existing sewerage system, to ensure that it has the maximum possible drainage capacity and will continue to maintain these to a regular programme until the completion of the proposed capital works scheme.

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Preparedness

In Newcastle it is not possible to prevent or protect against all flooding. Indeed even where flood defences exist it is possible in an extreme event that these could be over topped and flooding could still occur.

Having recognised this fact, considerable effort in recent years has been made by emergency planners in a Government Departments, Councils and the Emergency Services working together and sharing information to ensure a coordinated response.

However, despite these improvements, during significant flood events the emergency response of Government Departments and the Emergency Services can become over stretched. This means that not all calls for assistance during a flood event may be responded to in a timely manner. With this in mind it is important that households and communities, subject to a known flood risk, are prepared. The detail of preparedness actions, including flood warning and informing activities planned from a regional perspective, are provided in Appendix E.

This is not Government withdrawing from any undertaking to respond in emergencies but an additional layer of support to ensure Government Departments and the public work together to reduce the overall impacts of flooding.

From the flood risk assessment it would appear that 1 area in Newcastle has flooded in the recent past and may benefit from the flood warning and informing proposals, outlined in Appendix D.

A pilot project of community engagement to deliver flood warning and informing, held in 2014, identified basic assessment formulae to assess and score areas that could potentially be a focus for flood warning and informing actions. Based on this scoring the following area could be considered suitable for being included in a programme of community engagement to deliver flood warning and informing initiatives:-

- Bryansford Avenue / Shimna Road area.

Key activities that could be undertaken are:

- Explaining the potential and limitations of Community Resilience;
- Briefing communities on information available, particularly from the Met Office;
- The facilitation of self-help initiatives, including remote sandbag storage; and
- Reviewing and validating all elements of the Community Engagement Plan to help the community communicate effectively in an emergency and work together.

The table in Appendix I shows how this community rank in the overall context of the 20 FRA's in this Plan. It should be noted that this is an indicative assessment which may change subject to further information on flood risk becoming available.

The rollout of this work is dependent on funding being available.

5.8 Newtownards Significant Flood Risk Area

The core boundary of the Newtownards SFRA, which has been determined through the PFRA, is located within the Strangford local Flood Management Area and is illustrated in Figure 5.8.1 below.

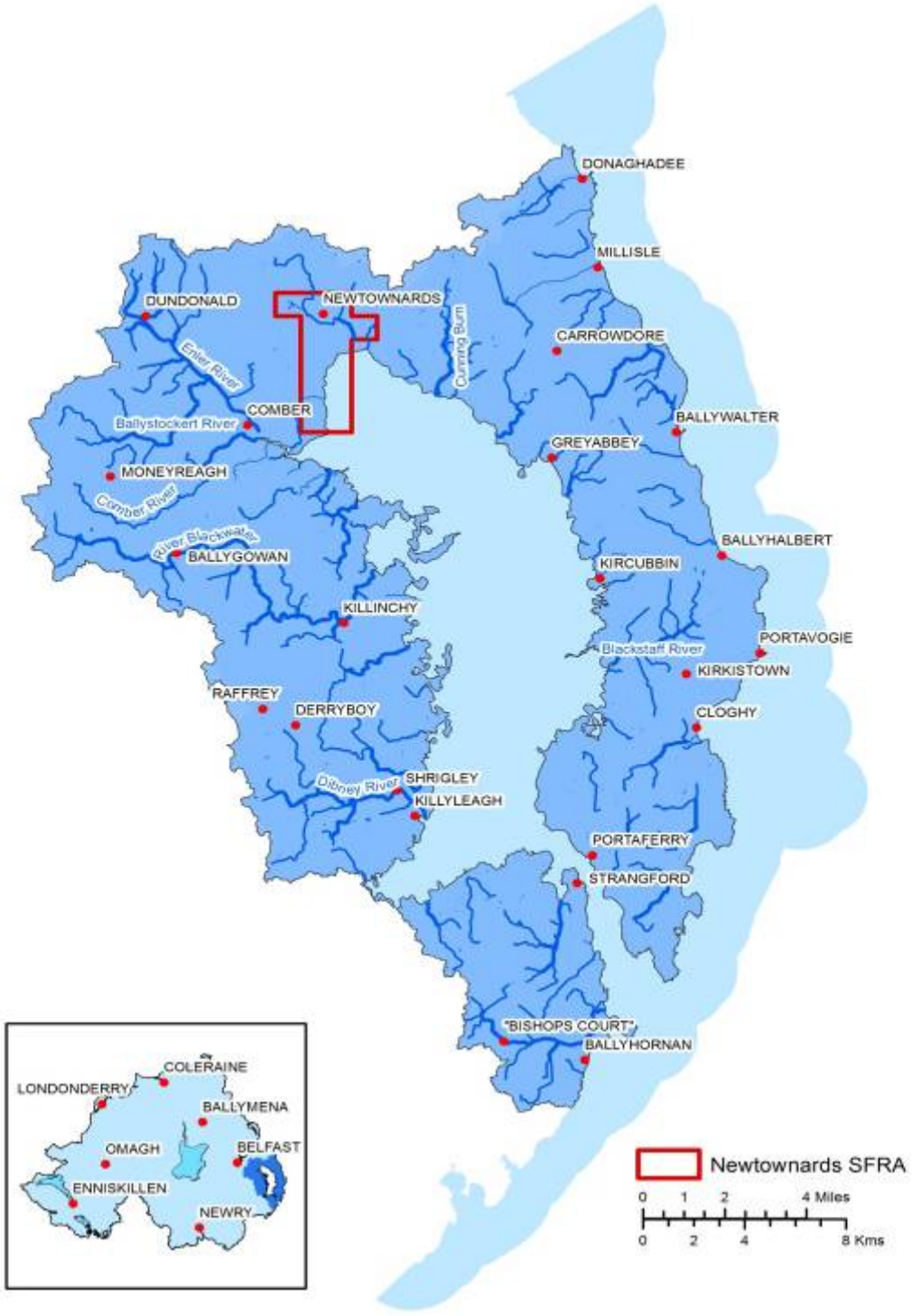

Figure 5.8.1 - Strangford Local Flood Management Area and Newtownards SFRA

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5.8.1 Flooding History

Sea defences at the northern end of Strangford Lough were initially constructed as part of a land reclamation scheme by Lord Londonderry in 1810. In 1859 the original embankment was extended southwards to Ballyrickard and in the 1950s, the construction of a waste water pumping station required further extensions. Significant improvement works to the defences were carried out in the 1970s when the banks were raised and widened and rock armouring was placed on the seaward face.

In December 1981 there was a significant breach of the sea defence near the Newtownards Airfield which caused flooding as far back as the Castle Gardens Primary School on the Portaferry Road (see photograph below). This breach was immediately repaired and, to reduce the likelihood of future failures, a programme of major refurbishment works was undertaken between 1983 and 1987.

Photograph 5.8.1.1 - Flooding at Portaferry Road (Dec 1981)

Despite this work the defences continued to deteriorate due to damaging winter storms and a project to replace the most vulnerable section at the foreshore adjacent to the Airfield was completed in March 2001. This project involved the reconstruction of existing earth embankments with rock armour protected steel core embankments at a cost of around £4m. In addition to the work to improve the sea defences at the foreshore, another project was undertaken at the same time to improve the defences on the Ards Canal, which flows through the centre of the town to discharge through the structure known locally as the 'Floodgates' at the Portaferry Road. The Ards Canal defences form an integral part of the sea defence systems as the water levels in the lower canal rises and falls in sympathy with the tide in Strangford Lough and, during extreme tidal events prevents sea water overspilling the banks and causing flooding to the town. The scheme on the Ards Canal involved the reconstruction of approximately 2.4km of the existing canal banks and was completed in 2000 at a cost of around £1m.

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Photograph 5.8.1.2 - Newtownards SFRA – Sea Defences

Since the works to enhance the Newtownards Flood Defences in 2000/2001 there have been at least two extreme tidal events at Strangford Lough, most notably in February 2002 and latterly in January 2014. On both occasions the defences performed as intended and there was no significant flooding from the sea. The only minor flooding recorded during these events was to roads in the vicinity of South Street due to seepage through joints in the floodwalls and backflow through road gullies, which are connected to sewerage systems that discharge to the canal without a non-return valve.

Photograph 5.8.1.3 - Newtownards SFRA – Extreme Coastal Storm Surge (Jan 2014)

5.8.2 PFRA – Identification of Potentially Significant Flood Sources

According to the Preliminary Flood Risk Assessment (Dec 2011) the town of Newtownards, in terms of the potential adverse consequences of flooding, is ranked third of the twenty SFRA within Northern Ireland (see Figure 4.1). On the basis of this initial assessment, which was undertaken using the Strategic Flood Maps, the town is considered to at significant risk from both tidal and fluvial flooding with up 2700 properties estimated to be located within the 1 in 100 year fluvial and/or 1 in 200 year coastal floodplain.

A large proportion of the town is located within the 'undefended' 1 in 200 year coastal floodplain, the extent of which is illustrated in Figure 5.8.2.1 below. It should be noted that the PFRA flagged up the potential for significant tidal inundation at Newtownards because this national assessment was based on strategic 'undefended' flood models which ignore the presence of existing flood defence systems such as the Newtownards Sea Defences. Therefore, the assessment is in effect based on the worst case scenario, as it assumes there is no benefit from the existing defences. This precautionary approach was taken because, at the time of the assessment, there was a degree of uncertainty about the level of protection that each of our existing flood defence systems provides. By adopting this approach, the urban areas that are located behind existing flood defence structures were determined to be SFRA by default and as a consequence, detailed Flood Hazard/Risk Maps had to be prepared in compliance with the requirements of the Directive. This precautionary approach provided the opportunity to undertake the detailed structural assessments and flood modelling necessary to remove the uncertainty and establish the actual level of protection offered by these defences.

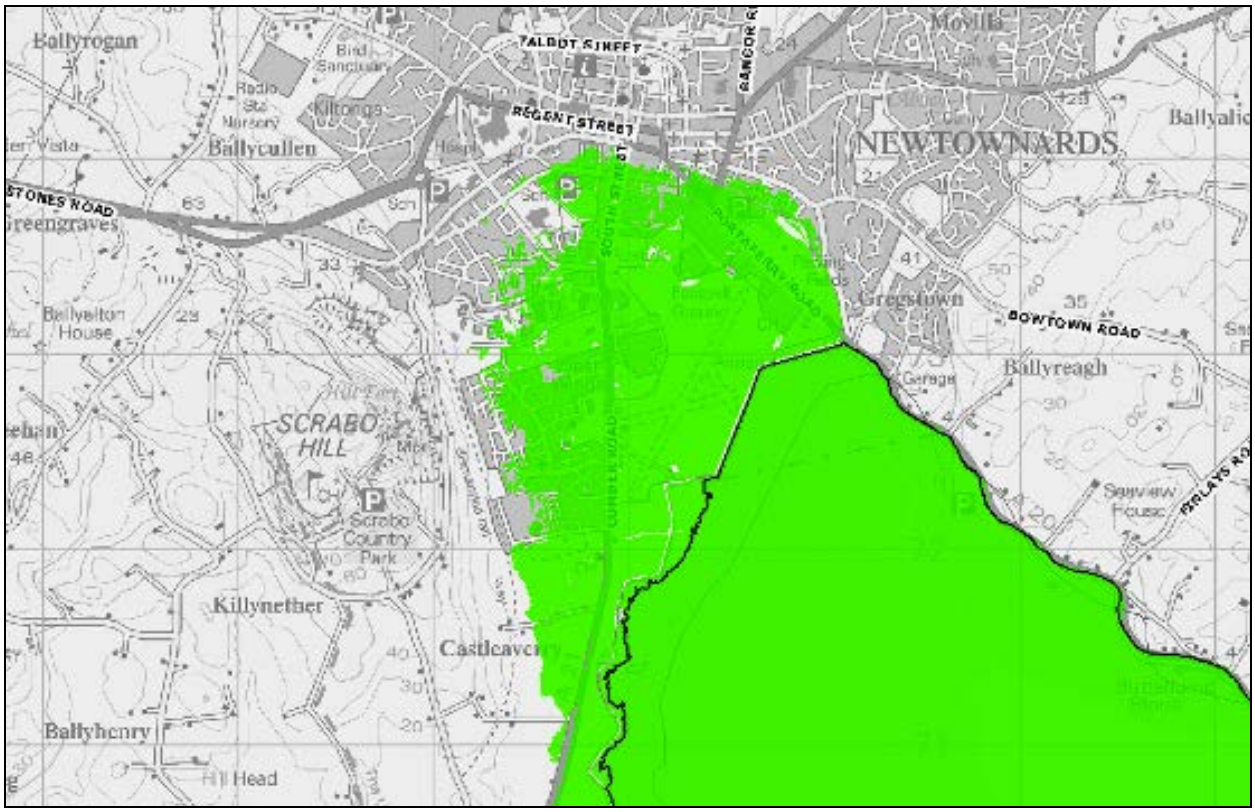

Figure 5.8.2.1 - Newtownards SFRA – Undefended Coastal Flood Plain, Strategic (0.5% AEP) 1 in 200 year event**.**

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Newtownards is also considered to be at risk from significant fluvial flooding and the strategic fluvial map used for the PFRA indicates that the extent of the fluvial floodplain for the 1% AEP (1 in 100 year) event (see Figure 5.8.2.2) is almost identical to that illustrated above for the tidal flooding. The strategic flood model estimated that flooding could occur from the network of small rivers (many of which are culverted) which flow into the tidally influenced drainage channel known as the Ards Canal. As the water level in the canal rises and falls due to the influence of the tide in Strangford Lough, this can drown-out the culvert outlets and substantially reduce the discharge capacity of these culverted systems.

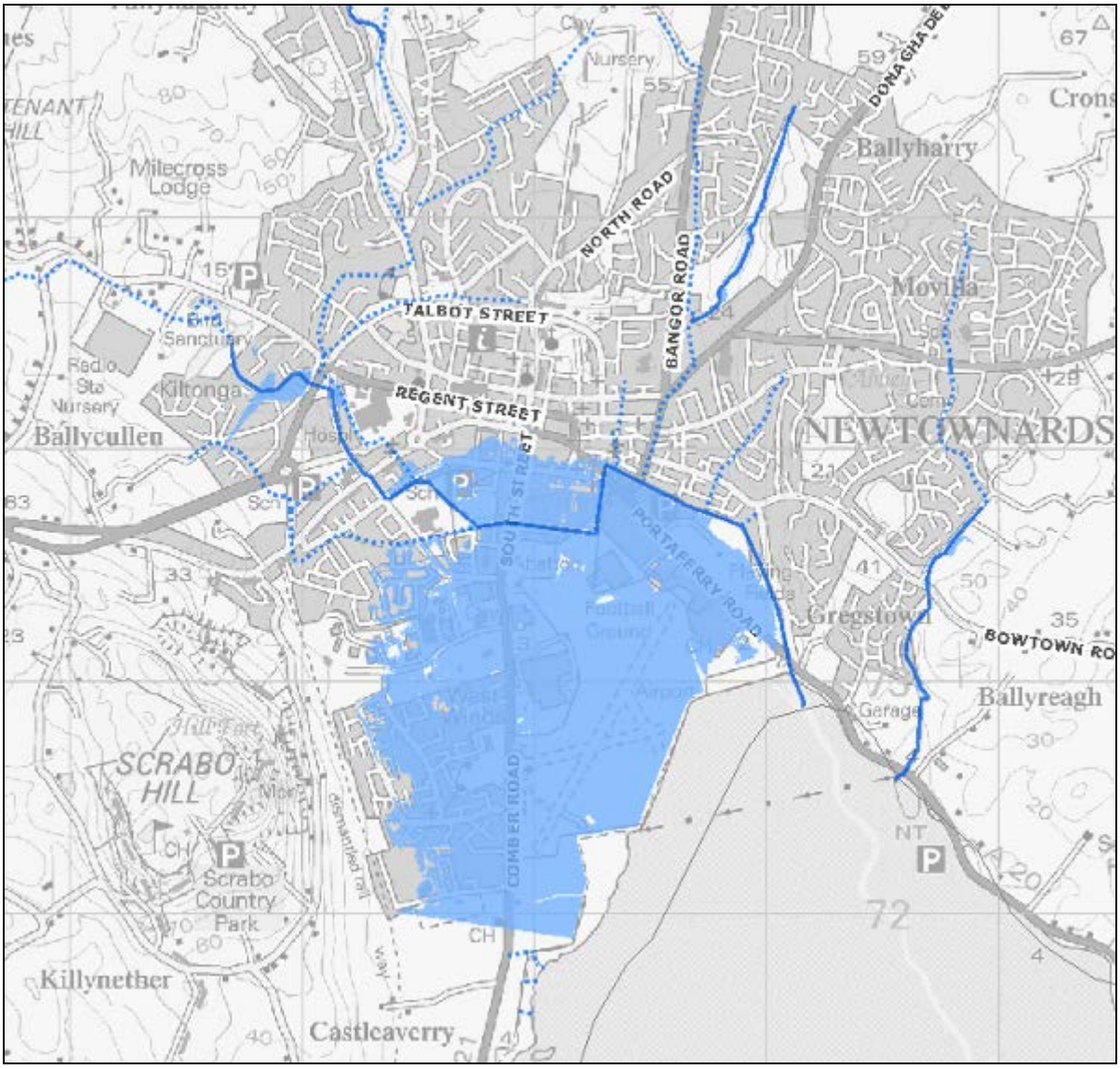

Figure 5.8.2.2 - Newtownards SFRA – Undefended Fluvial Flood Plain, Strategic (1% AEP) 1 in 100 year event.

To facilitate a more robust assessment of the level of flood risk to Newtownards from rivers and the sea, Rivers Agency developed detailed predictive flood models for each of these sources. The Flood Hazard Maps produced using the detailed flood models are more accurate than the strategic maps which may be

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over estimating or under estimating the number of properties at risk of flooding. Details of the flood models and their output are described in the following sections

5.8.3 Catchment Description

Newtownards town fringes the northern tip of Strangford Lough and relies on the sea defences (described in the 'Flooding History section above) to protect low lying areas of the town from coastal flooding. The town is drained through a network of small watercourses (largely culverted) which flow to the tidally influenced drainage channel known as the Ards Canal. The Ards Canal has a catchment area of around 20km^2 and its major tributaries are the Glen River and Ballyharry Stream which flow to the canal from the north, and the Kiltronga Stream and Scrabo Stream from the west. The Bowstown Road Stream, which fringes the east side of the town, flows directly to the sea and not to the Canal. Cully's Stream, Glen River, Kiltonga Stream and Ballycullen Steam are predominantly rural in their upper reaches while the Ballyharry and Bowtown Road catchments are entirely urban. Both the Kiltonga Stream and the Glen River has been impounded as they near the urban limits of the town. The impoundment of the Kiltonga Stream has created the fairly substantial Kiltonga Dams (upper and lower) which are an important feature of the Kiltonga Wildfowl Refuge on the Old Belfast Road. The Glen River impoundment has formed two ponds near Glen House on the Crawfordsburn Road. .

A condition assessment of the culverted sections of the watercourses throughout the town, found that they are generally in a fair to good structural condition with a couple of notable exceptions. A 200m section of rectangular box culvert which links open sections of the Ards Canal at each end of John Street is assessed as Grade 4 (poor) condition. Likewise, on the Ballycullen Stream, a couple of sections of 600mm diameter culvert with a combined length of 100m, located within the confines of the Movieland Cinema site at Blair Mayne Road South are assessed as Grade 4.

5.8.4 Coastal Flood Risk Assessment

Strangford Lough Flood Model and Levels

For the purposes of producing inundation flood mapping for the overtopping of the Newtownards Sea Defence system, which includes the Ards Canal defences, the extreme sea water levels for a range of return periods were derived using the methodology described in the Rivers Agency's report Strangford and Belfast Extreme Tides Boundary Condition (August 2009). The tidal simulations for Strangford Lough were undertaken using a detailed MIKE 21 HD model which is a sub-model driven by the Irish Surge and Tidal Model that is used to determine extreme sea levels around the non-estuarine coastline of Ireland. Based on the Strangford tidal model the estimated extreme tidal levels at Newtownards are shown in Table 5.8.3.1 below.

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	Strangford Lough – Newtownards Estimated Extreme Water levels	
	Annual Exceedance Probability - (Return Period)	**Extreme Water Level (m OD)**
Present Day	10% AEP - (1 in 10 year)	3.11
	0.5% AEP - (1 in 200 year)	3.36
	0.1% AEP - (1 in 1000 year)	3.60
Year 2030	10% AEP - (1 in 10 year)	3.18
	0.5% AEP - (1 in 200 year)	3.43
	0.1% AEP - (1 in 1000 year)	3.68
Year 2100	10% AEP - (1 in 10 year)	3.86
	0.5% AEP - (1 in 200 year)	4.11
	0.1% AEP - (1 in 1000 year)	4.35

Tidal Flooding Mechanisms

A GPS survey of the primary defences at the foreshore between the Floodgates and the Ards Allotment established that the lowest crest level is around 4.3m OD. Therefore, based on the estimated extreme tidal levels obtained from the detailed model (see Table 5.8.3.1) there is no significant risk of the primary defences at the foreshore being overtopped by a tidal storm surge. With a minimum level of 4.3m OD, the primary sea defences have a substantial freeboard of around 1m at the predicted level of the 0.5% AEP (1 in 200 year) present day event. Although there is always the possibility of limited flooding behind the defences due to wave overtopping, this is likely to limited in scale and unlikely to present a significant risk to properties.

The design crest level of the defence structures along the Ards Canal is 3.40m OD and a recent survey confirmed that the heights of the various sections are consistently above this level except for one short section which is around 200mm lower. Despite this low spot in the canals defences, the dynamic model predicts that the defences will not overtop when water levels in the canal are raised due to the tidal backflow from a 1 in 200 year storm surge in Strangford Lough. Even if floodwater was to overspill the Canal defences at the identified low spot, the worst that would happen is that floodwater would pond on agricultural land between the edge of town and the primary sea defences. However, there is always likely to be some minor localised flooding in the vicinity of the canal during extreme tidal events. This will occur due to the backing up of drainage and sewerage systems and also from leakage through joints or cracks in the walls (see Photograph 5.8.1.3) and is likely to cause flooding of roads and possibly, very small numbers of properties.

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On the basis of the foregoing, it is safe to assume that the Newtownards Sea Defences will not be overtopped by extreme tidal surges up to and including the 0.5% AEP (1 in 200 year) event. This is confirmed by the detailed tidal model and reflected in the Flood Hazard maps which are available through Flood Maps NI (see Figure 5.8.3.1 below for abstract).

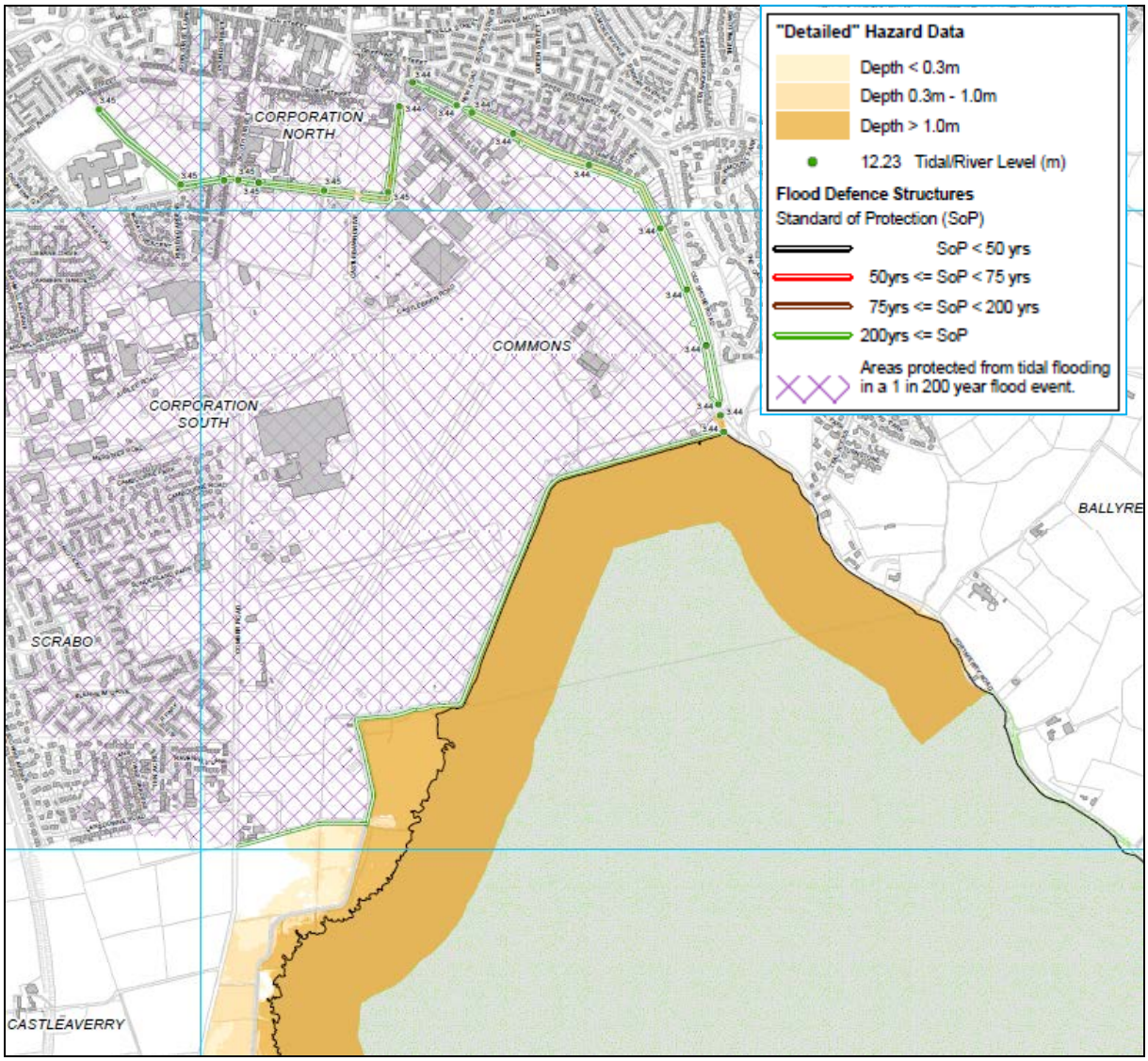

Figure 5.8.3.1 - Newtownards SFRA – Sea Defences and Area Benefitting (1 in 200 year event)

Whilst overtopping of the defences is not likely present a significant risk, there is always a possibility that a breach in the defences could occur during an extreme tidal event due to a structural defect and that this could result in flooding to property located behind the defences. However, the defences are currently considered to be in good structural condition and the potential for a breach failure mechanism is effectively mitigated through implementation of the Rivers Agency's Asset Management Plan (AMP).

Within the Agency's AMP the Newtownards Flood Defences are categorised as *'very high consequence'*. This categorisation ensures that they are inspected by its Asset Management Unit (AMU) on an annual basis

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to assess their structural condition and identify defects. All defects identified by AMU are referred to appropriate staff in the Lisburn Area Office who arrange for the necessary repairs to be undertaken. The Lisburn Area Office, which has operational responsibility for the defences, also undertakes routine inspections to identify and repair defects on an at least yearly basis. In addition, Rivers Agency's staff conduct post flood investigations after all major tidal events to identify leakage paths and were necessary, undertake remedial works to prevent their reoccurrence and improve the future performance of the defences. All elements of the defence system are currently assessed as Grade 3 or better (fair to good condition) and there is every confidence that they will continue to provide an appropriate level of protection by continued application of the existing asset management procedures.

Potential Adverse Consequences

Due to the effectiveness of the sea defence systems, which were reconstructed at considerable public expense in the 2000/2001, there is predicted to be no significant risk to the town of Newtownards from tidal inundation. The sea defences protect an extensive area of around 3km^2 which includes the airfield and substantial residential/commercial property from tidal storm surges up to the 1 in 200 year event. The geographical extent of this protected area is shown using purple cross hatching in Figure 5.8.3.1.

As the Newtownards coastal defence system is in a good structural condition and provides an appropriate standard of flood protection to the town there are no additional measures required to mitigate the coastal flood risk.

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5.8.5 Fluvial Flood Risk Assessment

Fluvial Model

Fundamental to the fluvial risk assessment was the development of a single Infoworks ICM model for the Ards Canal and its tributaries within the urban extents of the town. The model takes account of the tidal influence from Strangford Lough on the Ards Canal water level and is capable of simulating the flood mechanisms, taking account of the interactions between the various watercourses located within the urban area. The extent of the watercourse reaches (both open and culverted) which have been modelled in detail, are illustrated in Figure 5.8.4.1 below.

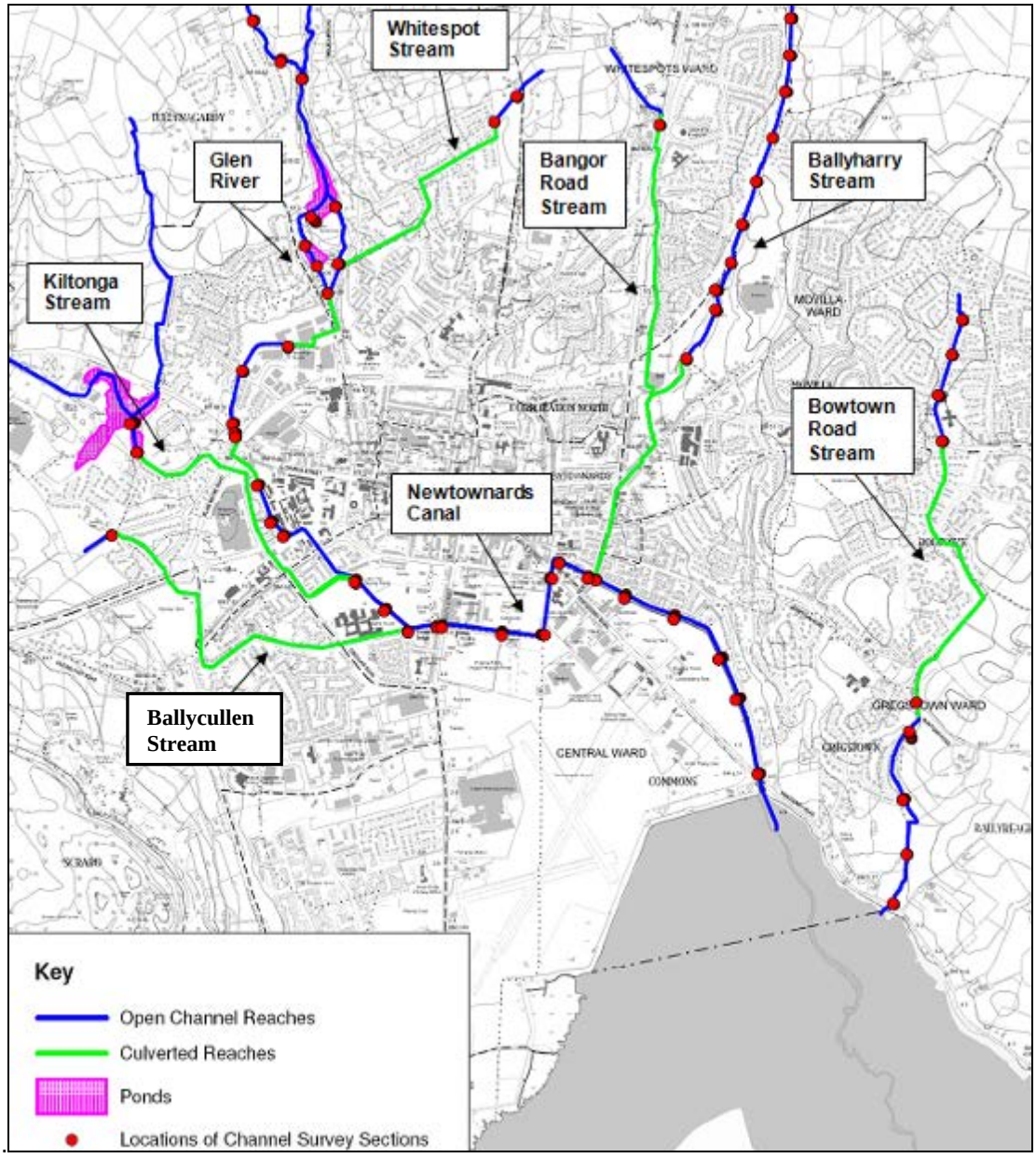

Figure 5.8.4.1 - Newtownards SFRA - Modelled Watercourses

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Fluvial Flooding Mechanisms

The detailed fluvial models for the watercourses in Newtownards predict that the likelihood of the town flooding from rivers is generally very low. It is notable that, since the introduction of the Flooding Hardship Payment Scheme in 2007, there have been as few as 4 payments issued to householders and it would appear that these were related to surface water problems. Of the many watercourses located within the urban footprint, Ballycullen Stream is the only watercourse that is predicted to flood property at the 1% AEP (1 in 100 yr) event. The flood mechanism for this is described below and illustrated in Figure 5.8.4.2.

Ballycullen Stream

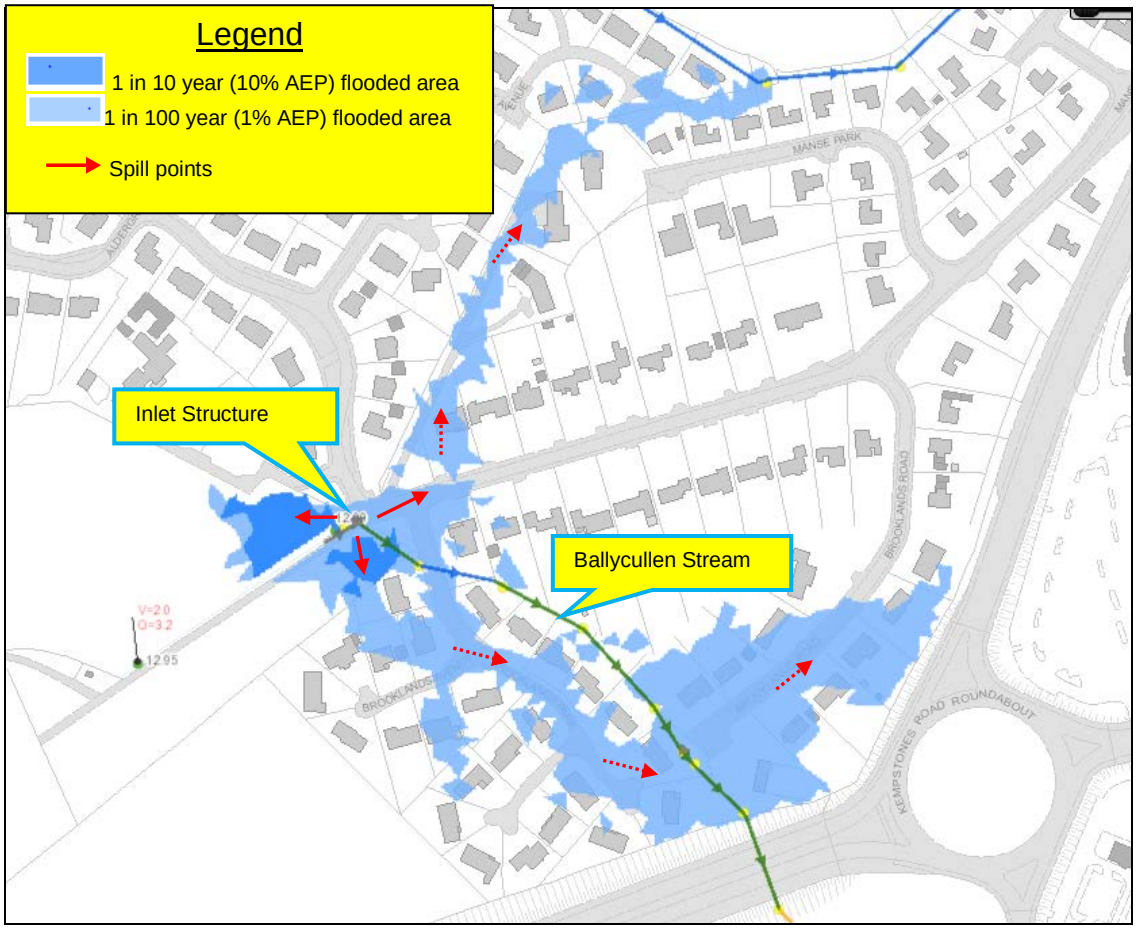

Figure 5.8.4.2 - Newtownards SFRA – Ballycullen Stream flood inundation area, (1% AEP)

The model predicts that at the relatively frequent 10% AEP event, floodwater overspills the banks of the open watercourse at the inlet to the culvert at Brooklands Park. However, in this scenario the flooding is limited to the corner of the fields either side of the watercourse. The extents of the flooding is predicted to increase at the more extreme (and less frequent) events with flooding mainly to the grounds of 15 properties in Brooklands Park and Brooklands Road predicted at the 4% AEP (1 in 25 year) and 33 properties at the 1 in 100 year event. It is calculated that the present value of the damages to property from potential future floods is around £270k. There are historical records to indicate that the watercourse overflowed in July 2010 in the

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manner predicted by the model, however there is no evidence that any of the properties in the area actually flooded internally.

Table 5.8.4.1 Newtownards SFRA – Ballycullen Stream			
Potential Adverse Consequences – Fluvial Flooding			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**0**	**15**	**33**
Non Residential (Nr)	**0**	**0**	**0**
Economic Damage (£)	**0**	**£16,077**	**£238,344**
Annual Average Damage (£)	**£9,045**		
Present Value (£)	**£271k**		
IPPC sites (Nr)	**0**	**0**	**0**
Community Assets (Nr)	**0**	**0**	**0**
Care Homes	**0**	**0**	**0**
GP Surgery's	**0**	**0**	**0**
Fire stations	**0**	**0**	**0**
Hospitals	**0**	**0**	**0**
Police Stations	**0**	**0**	**0**
Schools	**0**	**0**	**0**
Key Infrastructure (Nr)	**0**	**1**	**1**
NIW Wastewater Treatment Works	**0**	**0**	**0**
NIW Sewage Pumping Stations	**0**	**0**	**0**
NIW Water Treatment Work	**0**	**0**	**0**
NIW Treated Water Pumping Stations	**0**	**0**	**0**
NIE Substation 6to11kV	**0**	**1**	**1**
NIE Substation 33kV	**0**	**0**	**0**
NIE Substation 275kV	**0**	**0**	**0**
NIE Substation 110kV	**0**	**0**	**0**
Road Service - Trunk Road	**0**	**0**	**0**
Environmental Designated sites (Nr)	**0**	**0**	**0**
AONB	**0**	**0**	**0**
ASSI	**0**	**0**	**0**
Environmentally Sensitive Areas	**0**	**0**	**0**
Maritime Nature Reserve	**0**	**0**	**0**
Nature Reserve	**0**	**0**	**0**
RAMSAR	**0**	**0**	**0**
SAC	**0**	**0**	**0**
Sites of Local Nature Conservation Importance	**0**	**0**	**0**
SPA	**0**	**0**	**0**
RSPB Reserve	**0**	**0**	**0**
UWT Nature Reserve	**0**	**0**	**0**
Built Heritage sites (Nr)	**0**	**0**	**0**
National Trust	**0**	**0**	**0**
Listed Buildings	**0**	**0**	**0**
Sites and Monuments Records	**0**	**0**	**0**
Buildings of Special Architectural or Historical Interest	**0**	**0**	**0**
Areas of Significant Archaeological Interest	**0**	**0**	**0**
Historic Gardens	**0**	**0**	**0**

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Proposed Fluvial Flood Mitigation Measures

Prevention

As well as managing the existing flood risk to people and properties in Newtownards it is important that the flood risk is not increased by new development in areas of known flood risk. Northern Ireland's planning policies adopt a precautionary approach to development that aims to prevent future development that may be at risk of flooding or that may increase the risk of flooding elsewhere.

Reference should be made to Section 4.4 under the headings Planning NI and Local Government regarding the reform and restructuring of the planning system in Northern Ireland. Rivers Agency's Planning Advisory Unit provides advice to Planning NI and Local Councils in relation to the prevention of flooding. In particular Local Councils are advised on Development Plans and at the Planning Application stage. Flood mapping information is used to inform the preparation of the local Development Plans to ensure, where possible, that new zonings are located outside the identified flood risk areas. In the determination of planning applications any proposed development within a flood risk area will either be advised against or will be further considered if it meets one of the "Exception" rules and is accompanied by a suitable Flood Risk/Drainage Assessment. Applications that relate to "Greenfield" built development in fluvial floodplains are unlikely to be accepted, whereas applications for recreation purposes and amenity open space will usually be accepted.

Development Plans

In the preparation of new Development Plans for Newtownards, Rivers Agency will advise against bringing forward sites or the zoning of any land, particularly for built development that has been identified from the flood maps as being within the 1 in 100 year fluvial floodplain, reservoir inundation area or is susceptible elsewhere to surface water flooding.

Rivers Agency shall also review the existing Development Plan for Newtownards (Ards and Down Area Plan 2015) with a view to addressing flood risk issues which have only recently been identified as a result of the new flood maps.

The main (undeveloped) flooded areas, amongst others, within the Newtownards Significant Flood Risk Area are the:

- East side of Bowstown Road (adjacent to Burnreagh Drive)

Planning Applications

Fluvial Areas at risk

Rivers Agency shall advise against the development of all sites that are located within the 1 in 100 year fluvial floodplain, irrespective of whether they are located within a current development plan or as a single site application outside the plan area.

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For those sites within the 1 in 100 year fluvial floodplain where the principle of development has been accepted by Local Council as meeting the 'Exception Test', Rivers Agency will further consider the application through the appraisal of an accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures.

The main existing developed areas, amongst others, at flood risk within Newtownards where re-development may be likely to take place are:

- In the vicinity of the Ballycullen Stream at Brooklands Park/ Brooklands Avenue.

Areas at Risk of Surface Water flooding

For those sites outside the 1 in 100 year fluvial floodplain that are located in an area where there is evidence of a history of surface water flooding (identified by flood hardship payments) Rivers Agency will further consider the application through the appraisal of the accompanying Drainage Assessment that will need to demonstrate suitable flood mitigation measures.

Where there is potential for surface water flooding as indicated in Surface Water Map the Surface (areas highlighted purple), Rivers Agency will advise that the applicant should assess the flood risk and drainage impact to the site and construct in an appropriate manner.

The main areas identified in Newtownards as being at surface water flood risk are:

- East of Blair Mayne South Road to the Cinema.
- In the vicinity of Brooklands development
- Grounds of Victoria Primary School
- At the locus of Queen's Hall/Old Market Square
- East side of Bowtown Road Stream near the Cronstown Cottage development.

Areas at Risk of Flood Inundation from Reservoirs

For all development proposals that are located within the potential flood inundation area of a Controlled Reservoir we will further consider the application through the appraisal of the accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures. If it is a new development proposal, Rivers Agency will also need the applicant to demonstrate that the condition, management and maintenance regime of the reservoir is appropriate to provide sufficient assurance regarding reservoir safety.

Controlled Reservoirs identified in the Newtownards area are as follows:

- **Strangford Lough Wildfowlers Pond**
- **Kiltonga Dams**

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Protection

Structural measures are still one of the main options in providing flood protection to people and property impacted by the effects of extensive flooding. It is therefore important that we continue to target investment by providing flood defences, culvert alleviation schemes and infrastructure upgrade works to those communities at greatest need.

The alleviation of surface water flooding, in particular, will require input from a number of bodies. The Flood Investment and Planning Group, FIPG, provides a coordinated approach across Government in relation to the investigation of flooding, agreeing responsibilities and identifying collaborative solutions. The group is represented by Rivers Agency, NI Water and Transport NI, amongst others, with flood risk management responsibilities.

There are a number of stages to follow when procuring a flood alleviation scheme. The potential scheme needs to be first subjected to a feasibility study that will also include an economic appraisal. From the detailed Hazard and Risk Maps a Flood Risk Metric Tool' (FRISM) is used in urbanised flooded areas to get an estimate of the likely property damages as a result of a range of flood events. The estimated cost of a scheme is then compared to the total 'damage avoidance benefits' that the scheme will provide to property over the scheme's design life. If the benefit/cost ratio is greater than 1, then the potential scheme will be referred to Rivers Agency's Capital Procurement Unit for a feasibility study to be undertaken.

If the flooding issue identified is not solely Rivers Agency's responsibility, or is the responsibility of NI Water or Transport NI such as a local drainage or road infrastructure issue, then it will be referred either to FIPG or directly to the responsible body, for their further consideration.

If a cost benefit analysis identifies a viable scheme, it will be placed on a prioritisation list and progressed alongside other competing schemes. The position on the list will depend on a set marking criteria, such as the benefit/ cost ratio and the overall scheme costs. Depending on the availability of resources it may take anything from between 2 – 5 years for the scheme to progress from the start of the feasibility study to construction works commencing on the ground.

Having conducted a detailed assessment of the fluvial flood risk from all of the rivers in the Newtownards SFRA, Rivers Agency has determined that with the exception of Ballycullen Stream, all of the watercourses have the capacity to vent extreme floods up to and including the 1% AEP event and do not present a significant flood risk to property. The flood risk from the Ballycullen Stream is determined to be moderate with in excess of 30 properties predicted to flood at the 1 in 100 year event. As the present value of the total damages to property from all potential future floods has been calculated to be in excess of £270k, it is possible that a flood alleviation scheme for the Ballycullen Stream may be economically viable. Therefore, Rivers Agency proposes to undertake a feasibility study for a potential flood alleviation scheme on the Ballycullen Stream. The timing for the commencement of this flood study will depend on its priority within the Flood Study Programme and will be subject to the future resources available to Rivers Agency. As there is no apparent

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evidence of actual internal flooding to properties from the Ballycullen Stream, this study is likely to be a low priority.

Preparedness

In Newtownards it is not possible to prevent or protect against all flooding. Indeed even where flood defences exist it is possible in an extreme event that these could be over topped and flooding could still occur.

Having recognised this fact, considerable effort in recent years has been made by emergency planners in a Government Departments, Councils and the Emergency Services working together and sharing information to ensure a coordinated response.

However, despite these improvements, during significant flood events the emergency response of Government Departments and the Emergency Services can become over stretched. This means that not all calls for assistance during a flood event may be responded to in a timely manner. With this in mind it is important that households and communities, subject to a known flood risk, are prepared. The detail of preparedness actions including flood warning and informing activities planned from a regional perspective are provided in Appendix A.

This is not Government withdrawing from any undertaking to respond in emergencies but an additional layer of support to ensure Government Departments and the public work together to reduce the overall impacts of flooding.

From the flood risk assessment there at least 2 areas of Newtownards that have flooded in the recent past that may benefit from the flood warning and informing proposals, outlined in Appendix D.

A pilot project of community engagement to deliver flood warning and informing, held in 2014, identified basic assessment formulae to assess and score areas that could potentially be a focus for flood warning and informing actions. Based on this scoring these areas did not score high enough to be placed within the top 20 communities to be offered a programme of community engagement during the period of this plan. However, if communities want to become more resilient, the Department is committed to providing assistance were possible to develop the consistent approach to resilience. The NI Direct website www.nidirect.gov.uk/ will host further information and advice on what to do in advance of flooding, what to do during flooding and how to recover after flooding. The website will also contain templates for communities wishing to develop their own plan.

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5.9. Carrickfergus & Kilroot Power Station – Significant Flood Risk Area

The core boundary of the Carrickfergus & Kilroot Power Station SFRA, which has been determined through the PFRA, is located within the Belfast Lough and Tidal Lagan Local Flood Management Area and is illustrated in Figure 5.9.1 below.

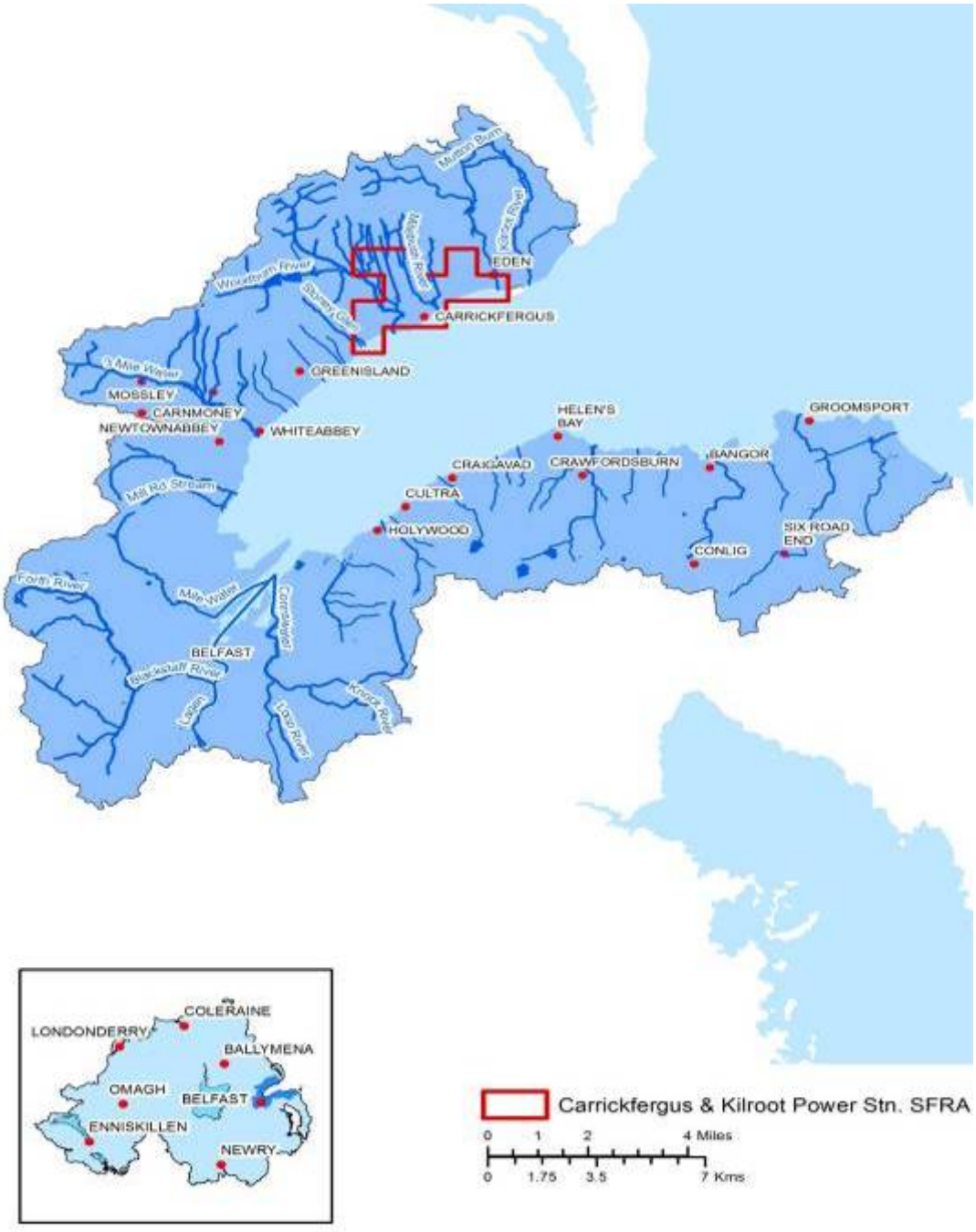

Figure 5.9.1 - Belfast Lough & Tidal Lagan Local Flood Management Area and Carrickfergus & Kilroot PS

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5.9.1 Flooding History

There is evidence of localised flooding in Carrickfergus dating back to the 1980s and at some locations it is known to have occurred on a repeated basis. However, since the mid 1990s there has been a marked reduction in the instances of flooding following completion of two major flood alleviation schemes known as the North West Diversion and the North East Diversion (described below in the 'Catchment Characteristics' section). The most recent significant flooding events occurred on 19 September 1999 and latterly on 21 June 2002 when at least 20 residential properties and one commercial property flooded within the town. However, it should be noted that the June 2002 event was assessed by the Meteorological Office as having a return period of 1 in 300 years, which is an extreme event that is well beyond the design standard for any drainage or sewerage system. Much of the property flooding prior to 2002 occurred in the Joymount area in the vicinity of the lower Sullatober Stream. A flood alleviation scheme on the Sullatober Steam, designed to protect around 38 properties from floods up the 1 in 100 year event, has been recently completed. This major project, which cost in excess of £2 million, was completed in three phases over the period 2011 – 2015. Photograph 5.9.1.1 shows a large box culvert and flood storage area that was constructed as part of this scheme. Since the introduction of the Flood Relief Payment Scheme in 2007 there have only been 6 payments issued to homeowners in Carrickfergus due to internal property flooding. Four of these payments relate to the recent extreme tidal event in January 2014 which caused flooding at Rhanbuoy Park. The other two payments relate to properties which flooded during the extreme weather event which occurred in August 2008 and affected large parts of the province. These properties are located sufficiently remote from a watercourse to conclude that they probably flooded due to surface water.

Photograph 5.9.1.1 – Sullatober Water Flood Alleviation Scheme (2014) – Culvert and Flood Storage

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5.9.2 PFRA – Identification of Potentially Significant Flood Sources

According to the Preliminary Flood Risk Assessment (Dec 2011) the town of Carrickfergus, in terms of the potential adverse consequences of flooding, is ranked sixth of the twenty SFRA within Northern Ireland (see Figure 4.1). On the basis of this initial assessment, which was undertaken using the Strategic Flood Maps, the predominant risk to the town was considered to arise almost exclusively from fluvial flooding. The strategic fluvial models (see Figure 5.9.2.1) predict the potential inundation of large residential areas at the west side of town which may adversely affect up to 2300 individual properties at a 1 in 100 year event. There was also a concern that this number may be much greater as many of the minor watercourses flowing through the urban area had not been modelled at the time of the PFRA.

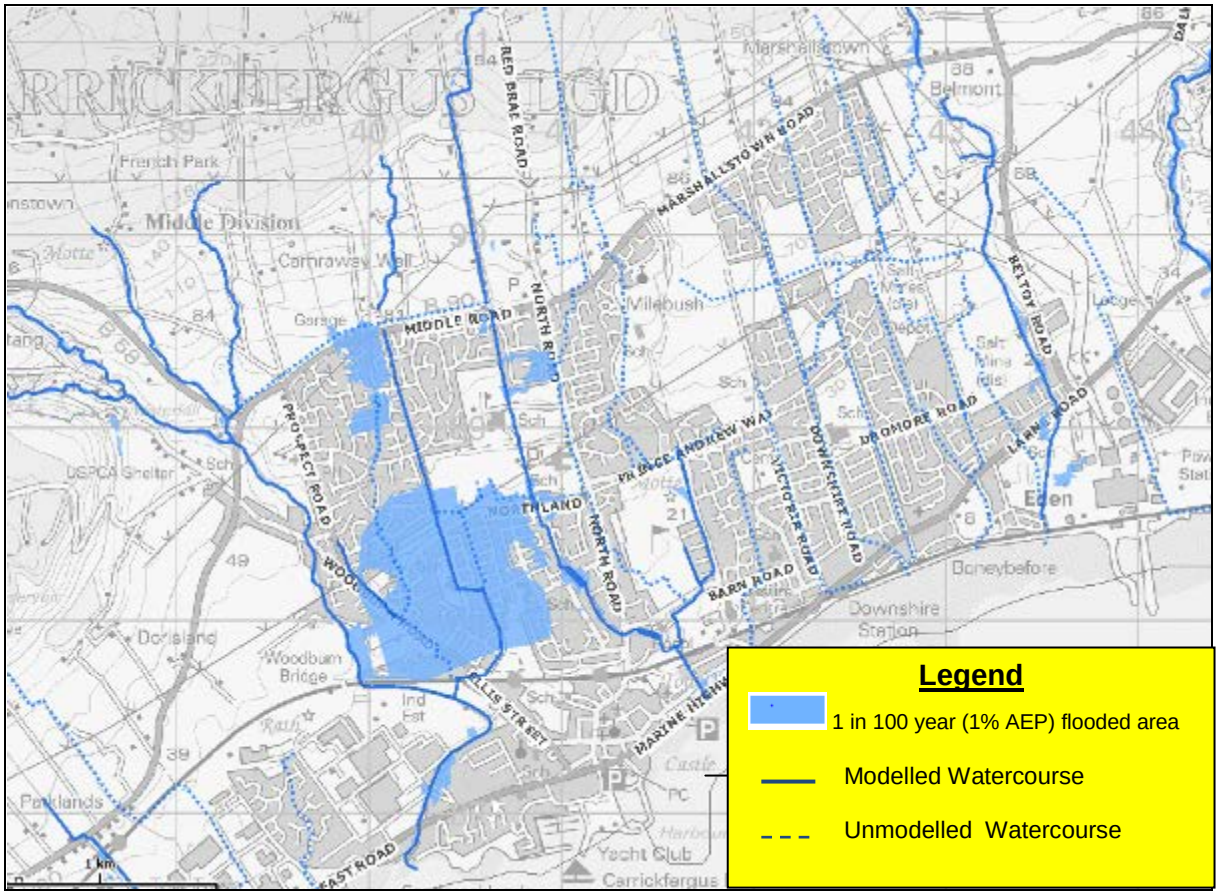

Figure 5.9.2.1 - Carrickfergus & Kilroot P.S. SFRA – Undefended Fluvial Flood Plains, Strategic 1% AEP (1 in 100 yr) event

Although situated on the coast, the town is not considered to be at significant risk from tidal inundation. The tidal model developed for Belfast Lough, which takes into account of the combined effects of tidal, surge and wind combinations, predicts that at the 1 in 200 year event flooding to property is likely to be confined to two main areas. At the western edge of the town's coastal fringe (near the outflow of the Woodburn River), it is estimated that in excess of 20 properties in the vicinity of Rhanbouy Park will be inundated to depths of up to 700mm. Tidal flooding is also predicted to occur to at least 30 properties which front the west and north sides of the Carrickfergus Marina. However, the predicted flooding around the Marina is estimated to be

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shallow (less than 300mm) and as a consequence, it is possible that the elevation of the property thresholds may be sufficient to prevent internal flooding to many of these properties.

To facilitate a more robust assessment of the fluvial flood risk to Carrickfergus, Rivers Agency developed detailed predictive flood models for all of the watercourses which flow through and have the capacity to adversely affect the urbanised areas. The Flood Hazard Maps produced using the detailed flood models are more accurate than the strategic maps which may be over estimating or under estimating the number of properties at risk of flooding. Details of the models and their output are described in the following sections.

5.9.3 Catchment Description

The town of Carrickfergus is situated on the North Western shore of Belfast Lough approximately 11 miles from Belfast. The area is drained by a series of watercourse which run almost in parallel from their source in the Carrickfergus Hills north of the town to their outfalls with the sea. Although the natural watercourse catchments are typically narrow, and vary in size from around 5 to 10 km^2 these were deliberately modified by the Northwest Diversion and Northeast Diversion flood alleviation schemes which were undertaken in the 1980s and 1990s respectively. The Diversions were carried out by Rivers Agency in response to repeated occurrences of localised flooding throughout the town. They were also carried out to prevent the possibility of downstream worsening from increased flows arising from housing developments which at that time were proposed for the north east corner of the town near Marshallstown Road. Essentially the Diversions intercept the majority of the flow in most of the watercourses before they enter the urban zone, thereby reducing the risk that they will overspill during extreme events. The Diversions redirect flows to the Woodburn River on the west flank and to the Copeland Water on the east.

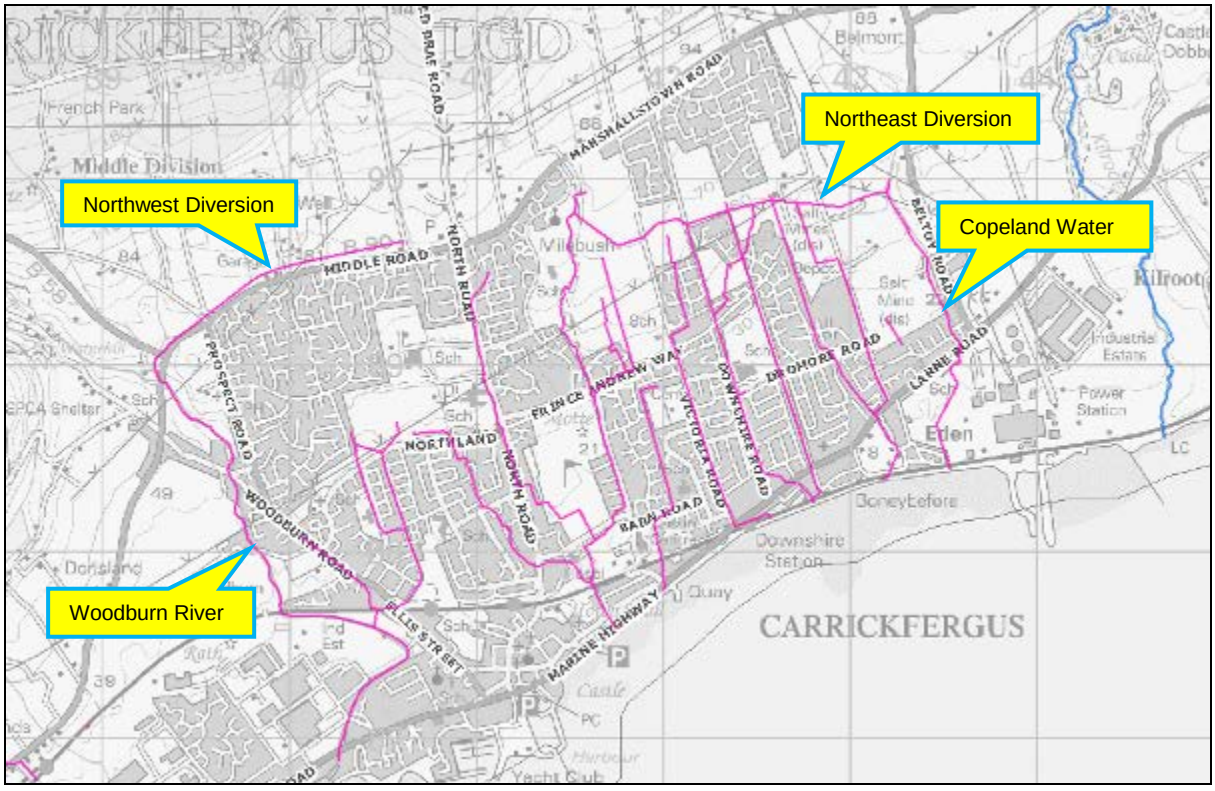

Figure 5.9.3.1 - Carrickfergus & Kilroot PS SFRA – North West and North East Diversions

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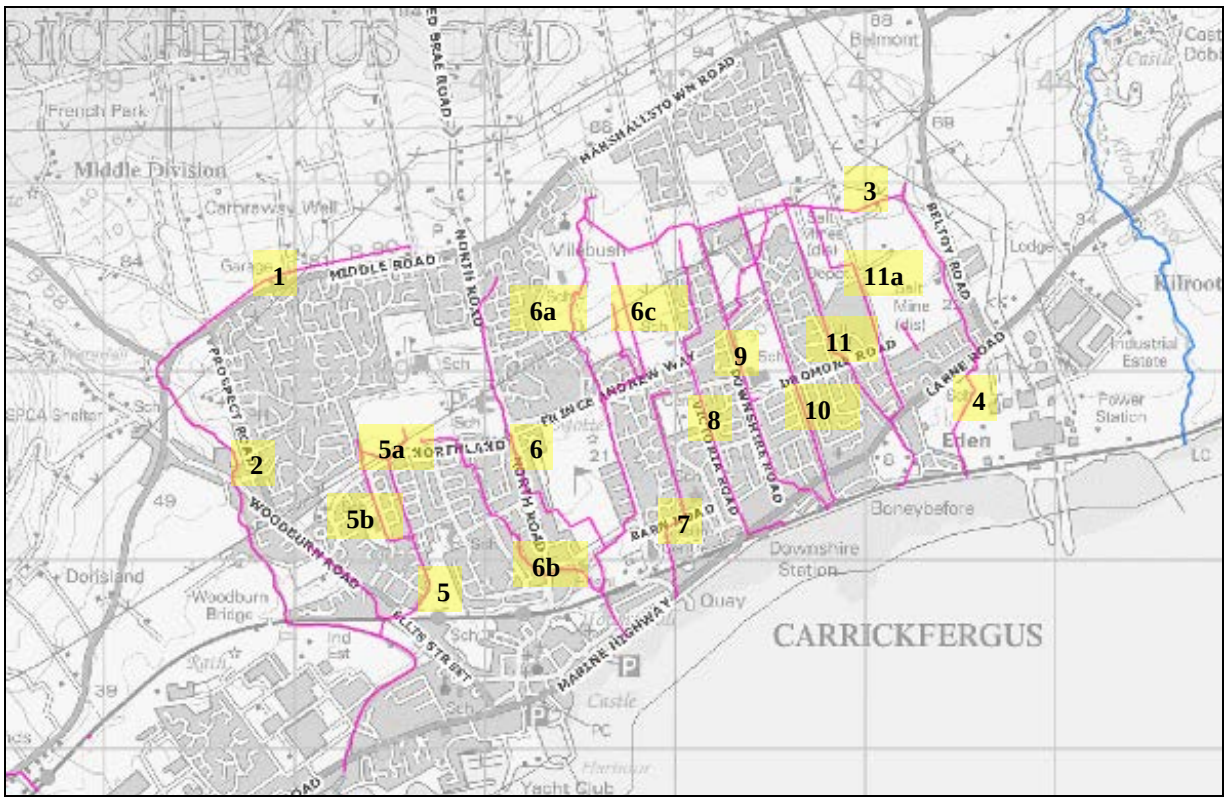
5.9.4 Fluvial Flood Risk Assessment

Fluvial Modelling Methodology and Scope

Fundamental to the detailed fluvial risk assessment was the development of a hydrodynamic model for each of the main watercourses (and tributaries) which have the potential to adversely impact the urbanised areas within the Carrickfergus & Kilroot Power Station SFRA. The names, location and extents of the watercourses which were modelled in detail are indicated in Figure 5.9.4.1 below.



1	Northwest Diversion	5b	Carnraway Burn	8	Victoria Road Stream
2	Woodburn River	6	Sullatober Water	9	Downshire Road Stream
3	Northeast Diversion	6a	North Road Stream	10	Bluefield Stream
4	Copeland Water	6b	Buskin Burn	11	Cloughlands Stream
5	Sunnylands Stream	6c	Prince William Stream	11a	Trailcock Lane
5a	Burleigh Stream	7	Barn Stream		

Figure 5.9.4.1 - Carrickfergus & Kilroot PS SFRA - Location and extents of modelled watercourses

Based on these detailed flood models the watercourses that are estimated to present a flood risk to property are the Northwest Diversion, Carnraway Burn, Buskin Burn, North Road Stream, Downshire Road Stream, Copeland Water, Northeast Diversion and Cloughlands Stream. In most cases the risk is relatively low and it would be surprising if future flooding from the watercourses within Carrickfergus caused substantial numbers

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of properties to flood on a fairly frequent basis. The flooding mechanisms for the watercourses that are estimated to present a risk of flooding to property are as follows.

Flooding Mechanisms

Northwest Diversion

The Northwest (NW) Diversion, constructed in the 1980s, is essentially a large (1350mm to 1800mm diameter) culvert which has been laid at the outskirts of the town to intercept a proportion of the flows from a number of the natural watercourses before they enter the western side of the urbanised zone. The NW Diversion takes a large proportion of the flows from the Buskin Burn, Sunnylands Stream, Carnraway Burn and a number of minor tributaries. The diverted flow from these watercourses is conducted around the northwest corner of the town and discharges to the Woodburn River which flanks the west side of the town and flows to its outlet with the sea at Rhanbuoy Park. The purpose of the Diversion is to substantially lower the flows in the natural watercourses during extreme rainfall events and thereby reduce the likelihood that they will cause flooding to property. The culverts in this watercourse have been assessed to be in a satisfactory structural condition.

Figure 5.9.4.2 - Carrickfergus & Kilroot PS SFRA, Northwest Diversion - 1% AEP Floodplain

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The developed areas that are prone flooding from the Northwest Diversion, together with a description of the flooding mechanisms are as follows.

The model predicts that the floodwater may overspill the headwalls of the flow separation structure that is designed to divert partial flows from the Burleigh stream to the culverted NW Diversion. It is estimated that flooding to property could begin to occur at the relatively infrequent 1 in 75 year event. It shows that when the floodwater overspills the structure headwalls, it flows across the Middle Road and rushes along steeply sloping carriageways within the Meadow Hill, Hillview and Rathlin Heights housing developments before spilling back into an open section undesignated of the Carnraway Stream near Mourneview Park. Although it estimated that up to 40 properties located within the flood inundation area for the 1 in 100 year event, it is important to note that the topography within the residential areas affected is very steep and, as a consequence, the depth of flooding is estimated to be shallow (less than 300mm). Therefore, many off the properties are likely to escape internal flooding due to the elevation of their thresholds above ground level. Since the installation of the NW Diversion in the 1980s there have been no instances of flooding in the manner predicted by the model and no records of flooding to any of the properties that are estimated to be at risk. The absence of any historical records of flooding would suggest that the watercourse is unlikely to present a significant flood risk to property except in the most extreme events (i.e. 1 in 75 year or greater).

Carnraway Burn

The Carnraway Burn is a very small urban tributary of the Sunnylands Stream. It has a highly urbanised catchment (less than 0.64 km_2) and is assumed to rise in the vicinity of Slemish Heights where it flows in a north easterly direction for around 1.2km to its confluence with the Sunnylands Stream at the railway cutting near the Clipperstown Shopping Centre. The lower reach of the watercourse in designated and extends from the confluence with the Sunnylands Stream and terminates at an inlet chamber located to the rear of Fairview Terrace some 600m upstream. This section is completely culverted with concrete pipes in the range 600mm to 1050mm diameter and these have been assessed to be in good structural condition except for a short (40m) length at the upstream end. A substantial undesignated tributary joins the Carnraway Burn approximately 100m downstream of the inlet chamber at Fairview Terrace. This undesignated tributary is culverted with concrete pipes up to 900mm diameter and it is known that these are in poor structural condition. Approximately half of the upper undesignated section of the Carnraway Burn is culverted with small diameter pipes and the open sections are heavily vegetated.

The developed areas that are prone flooding from the Carnraway Burn, together with a description of the flooding mechanisms are as follows.

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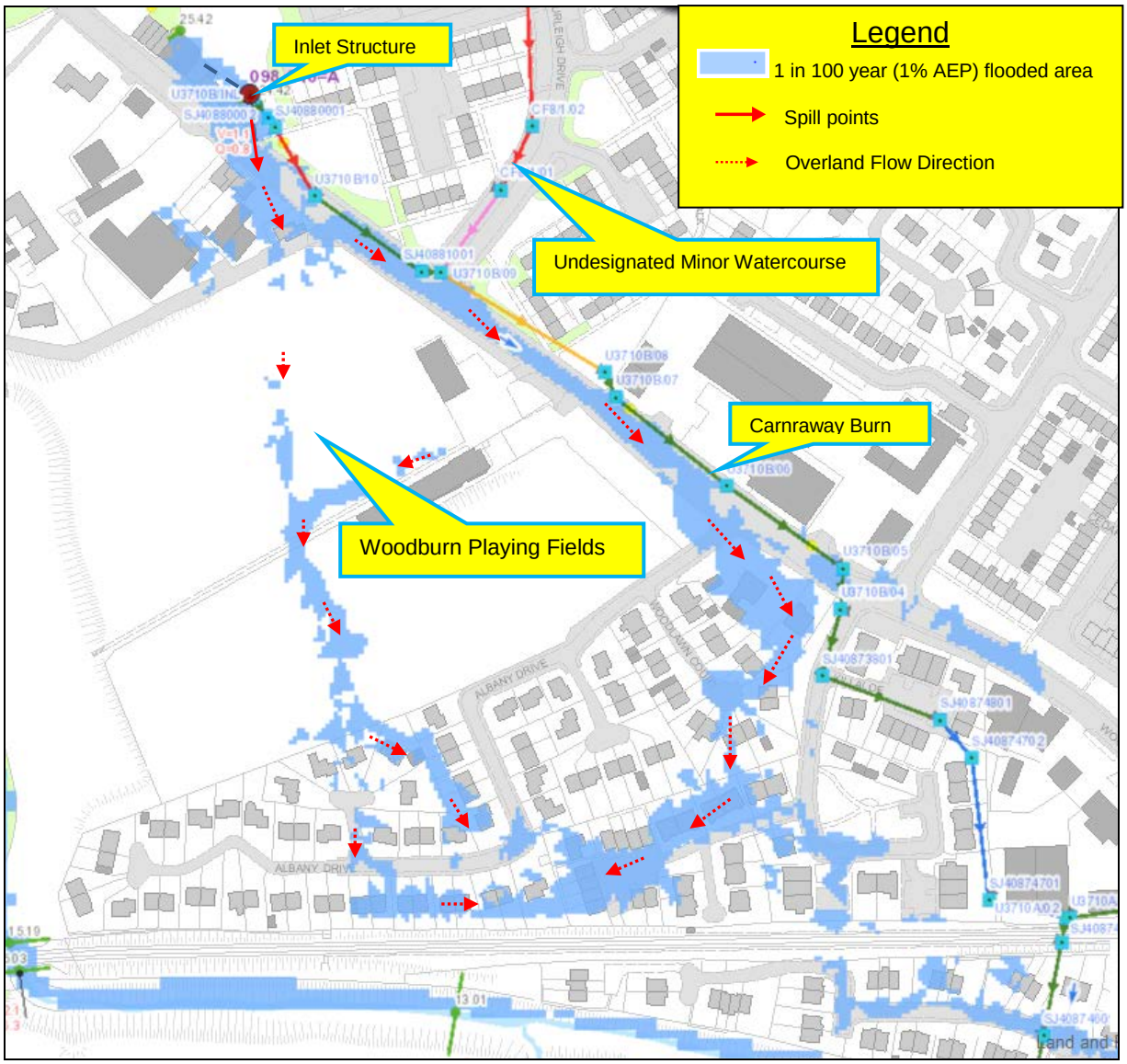

Figure 5.9.4.3 - Carrickfergus & Kilroot PS SFRA, Carnraway Burn - 1% AEP Floodplain

The model predicts that at the 1 in 25 year event, floodwater from the open section of Carnraway Burn at the rear of Fairview Terrace may jump the inlet structure and flow downhill via the Woodburn Road carriageway to cause minor flooding to the gardens of a couple of properties near the junction with Killaloe road. The likely cause of this failure is that the 600mm diameter pipe at the head of the culverted system does not have sufficient capacity to vent the flow at the inlet. At the more extreme events there is an additional flood pathway across the surface of the Woodburn Playing fields that conducts floodwater to the housing development at Albany Drive. The extent of the flooding to property increases for more extreme events and up to twenty properties are estimated to be located within the flood inundation areas predicted at the 1 in 100 year event.

The residential areas which are likely to be adversely affected by flooding are primarily in and around Albany Drive and Killaloe. However the model predicts that the depth of flooding across these areas is shallow (less than 300mm) and therefore, there is a likelihood that many of the properties will escape internal flooding due

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to the height of their thresholds above ground level. The absence of any historical records of flooding at these locations would suggest that the watercourse is unlikely to present a significant flood risk to property except in the most extreme events (i.e. 1 in 75 year or greater).

Rivers Agency has received a small cluster of flood calls from the owners of properties at Fairview Terrace (dating from 1995 to 2005). However, these appear to be related to blockages at the culvert inlet and not as a consequence of overtopping from an extreme flood.

Buskin Burn

Flows from the rural catchment of the Buskin Burn are captured by the NW Diversion before the watercourse enters the town's urban boundary at the Middle Road. Beyond the Diversion the watercourse is culverted and flows in a southerly direction until it emerges from the Milebush housing development some 270m downstream. From here it flows in an open channel that fringes the eastern boundary of the Carrickfergus Grammar School and its playing fields to the Northland Road. Beyond the Northland Road the watercourse is designated and flows through a highly urbanised area to the Bird Sanctuary Pond at the Carrickfergus Leisure Centre and finally discharges via the pond outfall to the designated Sullatober Water. The designated reach of the watercourse, which extends to around 1.3km, is completely culverted with the exception of a short open section (approx 125m) in the vicinity of Rose Brook Grove. The culverts are a mix of rectangular box culverts (typically 750mm X 1500mm) and circular concrete pipes (900mm to 1050mm) with a short section of triple 600mm diameter pipes near Bridewell Drive. All of the culverts are assessed to be in a satisfactory structural condition.

The developed areas that are prone to flooding from the Buskin Burn, together with a description of the flooding mechanisms are as follows.

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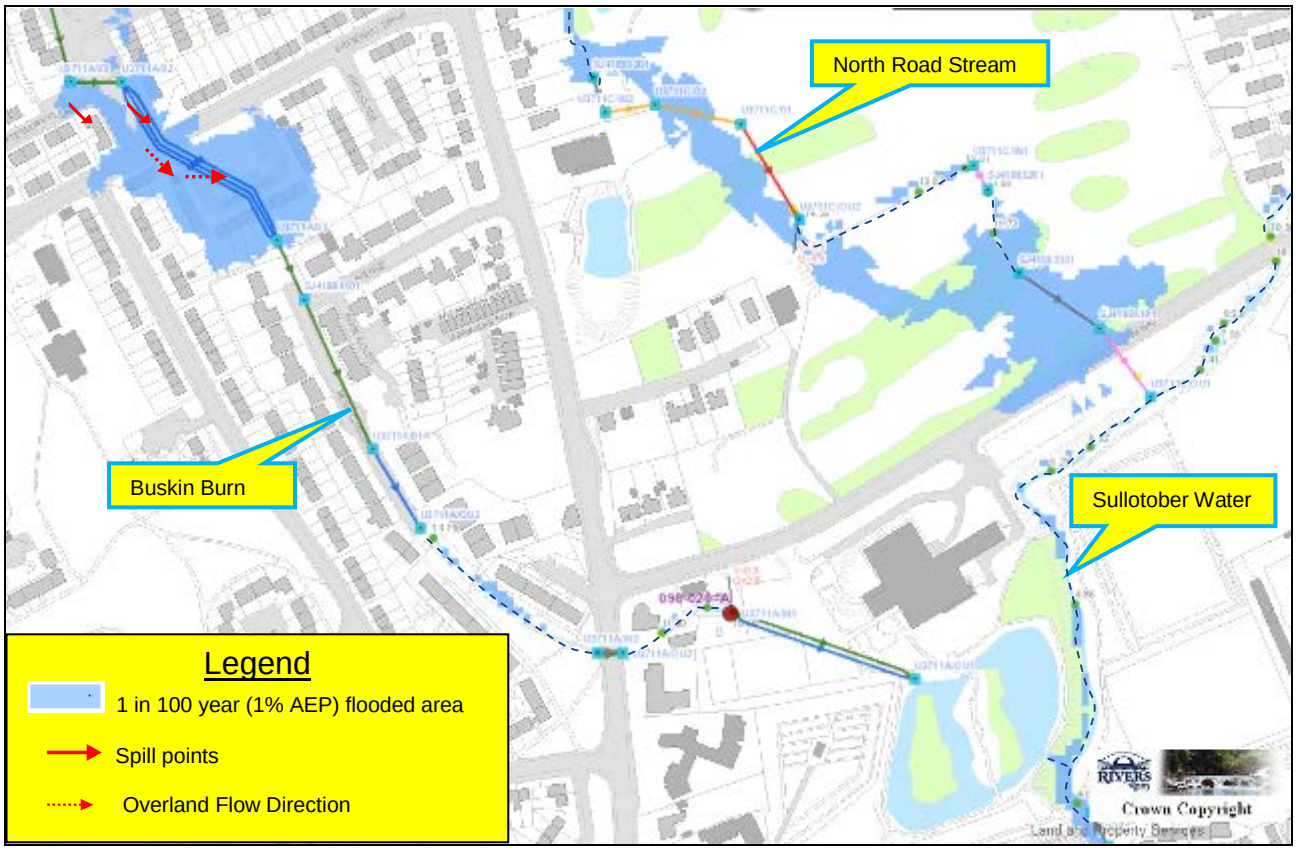

Figure 5.9.4.4 - Carrickfergus & Kilroot PS SFRA, Buskin Burn - 1% AEP Floodplain

The model predicts that the culverts at the junction of Bridewell Drive and Drumhoy Drive are incapable of venting the estimated flow for the frequently occurring 4% AEP (1 in 5 year) flood event. As the culverts surcharge, floodwater spills to the surface through two manholes located on grassed verges either side of the Drumhoy Driver near Shaftesbury Place. This floodwater is routed overland to the Green Park housing development where it collects in a depression in the landscape and floods around 20 properties. A similar flooding mechanism is predicted for each of the more extreme flood events except that the height of the water in the depression increases to the extent that properties in Green Park could be flooded internally up to 1m deep. There are no historical records of flooding in the vicinity of Green Park. Given that the model is predicting flooding on a very frequent basis (i.e. on average once every five years) the absence of a flood history would suggest that the model is overstating the likelihood of flooding. However, even though the model may be exaggerating the level of risk it cannot be assumed that the risk is not real and significant. It is notable that, at the location of the flooding, there is an unusual network configuration where a rectangular box culvert transitions to a triple 600mm diameter pipe combination within a chamber. This unusual network configuration may be causing a genuine hydraulic impediment which could result in flooding or, on the other hand, it could simply be presenting a glitch in the predictive model that is causing it to produce results that are unrepresentative of the real world situation.

North Road Stream

The North Road Stream is small tributary of the Sullatober Water. It has a narrow and steeply sloping catchment less than 1km^2 which is rural in nature above the Marshallstown Road and highly urbanised below. The watercourse flows in a southerly direction entering the urban zone as it crosses the Marshallstown Road and is culverted for around 0.7km as it passes through the Marlborough and Oakland housing developments to the playing fields at the junction of North Road and Oakland Drive. Beyond this the watercourse flows in an open channel for around 0.4 km as it flows along the eastern boundary of the Carrickfergus College campus. The watercourse is again culverted for a length of around 0.4km along the verges of the North Road. The final 0.6km reach of the watercourse runs through Carrickfergus Golf Course and alternates between open and culverted sections until it discharges to the Sullatober Water 100m east of the Carrickfergus Leisure Centre at Prince William Way.

The piped culverts are generally small in size with diameters ranging from 450mm to 650mm. A high proportion of the culverts in the upper reaches that run through the Marlborough and Oakland housing developments are assessed to be in poor structural condition.

The developed areas that are prone flooding from the North Road Stream, together with a description of the flooding mechanisms are as follows.

Within the upper reaches of the watercourse the model predicts flooding to property from two separate spill points due to insufficient hydraulic capacity of the culvert network. Flooding from the first of the spill points (see Figure 5.9.4.5) at the Marshallstown Road is estimated to commence at the 4% AEP (1 in 25 year) event when a 450mm surcharges causing a floodwater to rise to surface via a manhole on the carriageway. The floodwater flows across the surface for a short distance and ponds at the Marlborough housing development. However, flooding is slight and even at the more extreme 1 in 100 year event it is estimated that the depth of the flooding will be no more than 300mm and although 5 properties are shown to be located in the inundation area, it is possible that some of these may avoid internal flooding due to the height of their thresholds. Homeowners in this area have made at least seven phone calls to the emergency Floodline requesting assistance over the period 1998 to 2002. Although the majority of the calls appear to be related to road drainage issues, high flows in the watercourse may be a contributing factor. There have been no claims for flood relief payments arising from this location since the introduction of the scheme in June 2007.

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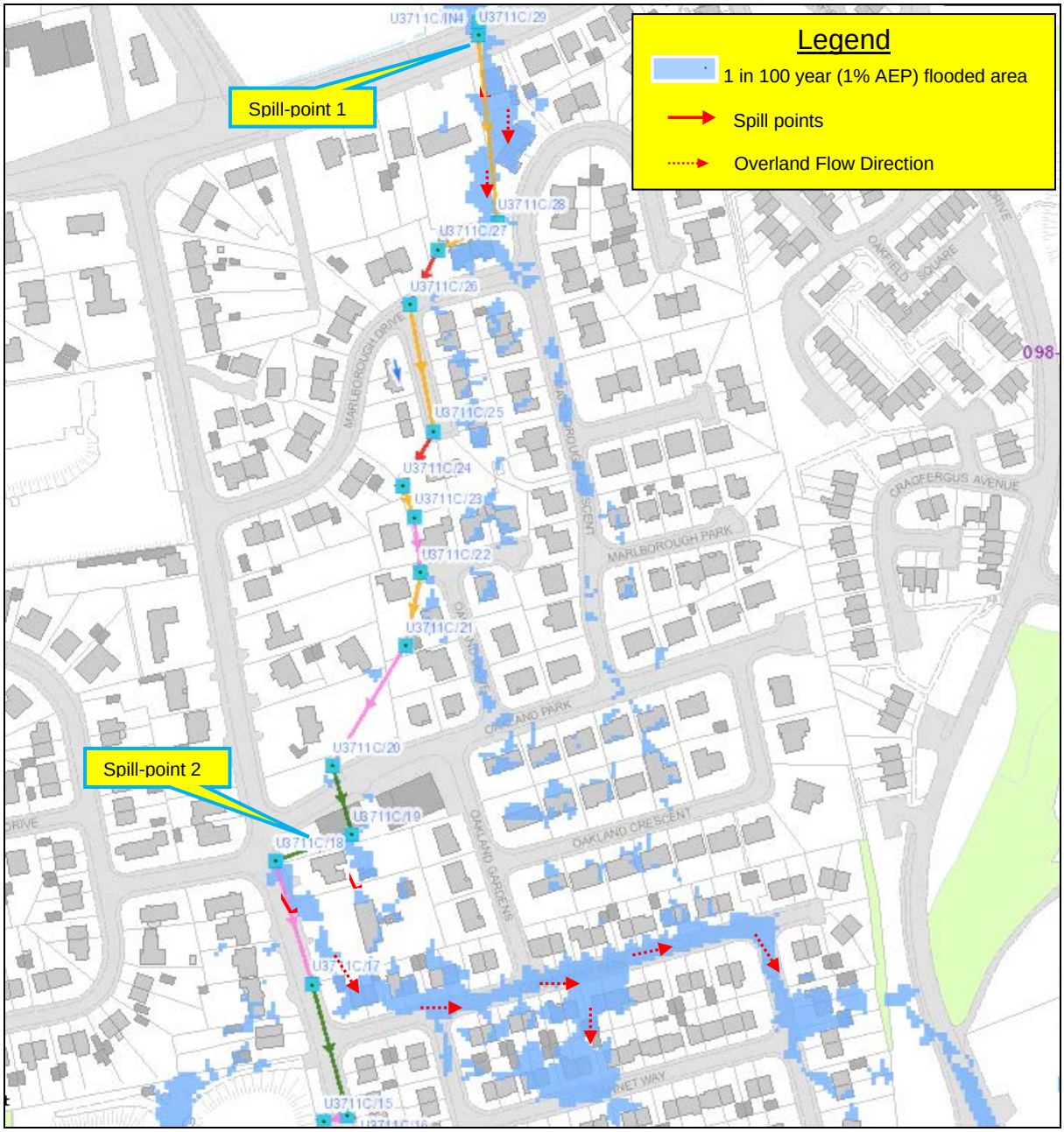

Figure 5.9.4.5 - Carrickfergus & Kilroot PS SFRA, North Road Stream - 1% AEP Floodplain

The model also predicts flooding from two manholes in the vicinity of Oakland Park which is illustrated at Spill-point 2. It is noticeable that there is a distinct dog-leg in the culverts at Oakland Park which may be causing a localised reduction in the flow carrying capacity of the culverted system. The culvert is estimated to surcharge at the frequent 10% AEP (1 in 10 year) event, causing floodwater to rise up in the manholes and spill to the surface. At this event flooding is limited to roads and gardens and no properties are likely to be flooded. Even at the 1 in 100 year event, the flooding is restricted to a relatively small area between Cormorant Park and Gannet Way and the depth of the flooding is shallow (less than 200mm). There are no more than eight properties located within the estimated 1 in 100 year flood inundation area and as the flooding is shallow it is a possibility that some of these may not flood internally due to the height of their thresholds. Within the immediate area there have been only three phone calls from homeowners to the

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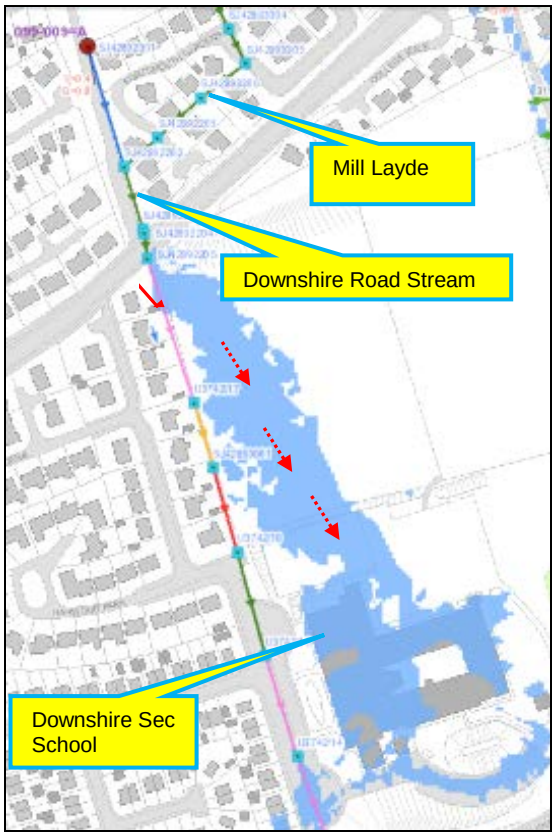
emergency Floodline to request assistance on two separate occasions (1987 and 2002). Two of these calls have been attributed to blocked road gullies. There have been no claims for flood relief payments arising from this location since the introduction of the scheme in June 2007.

Downshire Road Stream

Flows from the rural catchment of the Downshire Road Stream are captured by the Northeast Diversion before it approaches the Broadlands housing development. Beyond the Diversion the watercourse is designated, and starved of its natural flow, it essentially starts life as a dry open channel which runs in a southerly direction along the eastern side of Broadlands, then forms the boundary between a couple of fields and the Victoria housing development before entering a 450mm diameter culvert at Plymouth Gardens. A designated 450mm diameter culverted tributary, the Mill Layde, enters the Buskin Burn from the east around 70m downstream of the inlet structure at Plymouth Gardens. The watercourse is almost completely culverted from Plymouth Gardens, following the route of the Downshire Road to its tidal outfall at Boney Before, a distance of around 1.3km. There is a short (20m) section of open watercourse in a grassed verge on the Downshire Road near its junction with Churchill Drive. The piped culverts have diameters in the range 750mm to 900mm and numerous sections with a combined length in excess of 500m are considered to be in an unsatisfactory structural condition.

The developed areas that are prone flooding from the Downshire Road Stream, together with a description of the flooding mechanisms are as follows.

The model indicates that flooding to property can arise due to hydraulic under-capacity of the culvert network at two distinct locations, both of which are on the Downshire Road.



The model predicts that a culvert section at Prince Andrew Way will surcharge at the 1 in 25 year event and vent to the surface through a manhole in the grassed verge. The floodwater is routed downhill over playing fields to pond in shallow depressions within the grounds of the Downshire Secondary School. There is no risk of internal flooding to property at this event. At the more extreme 1 in 100 year event, the extent of the flooding around the school building is more extensive but, as it is unlikely to exceed 200mm in depth, there is a possibility that internal flooding to the building may be avoided.

There is no historical evidence of flooding to the school. There have been a number of phone calls to the emergency Floodline from homeowners in Plymouth Gardens which would suggest that the nearby inlet grilles to the Mill Layde and Downshire Road Stream are presenting a recurring problem due to blockages.

Figure 5.9.4.6 - Carrickfergus & Kilroot PS SFRA, Downshire Road Stream - 1% AEP Floodplain

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A culvert section, located outside of the entrance to the Downshire Road School is predicted to be overwhelmed at the relatively frequent 1 in 10 year event. This causes floodwater to rise up in a manhole and spill onto the Downshire Road where it is conveyed downhill for 250m within the carriageway, and finally turns into and ponds in and around Castle Road. The extent of the very shallow depth ponding at this event is limited to the grounds of a few residential properties which is unlikely to result in internal flooding to property. At the more extreme 1 in 100 year event the flood mechanism remains the same, except that there are potentially up to 15 properties located within the predicted increased flood inundation area. However, even at this extreme event, flood depths are shallow (lower than 300mm) and it is possible that many of these houses may escape internal flooding due to the height of their thresholds.

It would appear that a potential reason for the flooding at this location is that the short length of 600mm diameter culvert located between pipes of larger diameters and is causing a hydraulic restriction.

Within the immediate area there has been only one phone call from a homeowner to the emergency Floodline to request assistance (2007) and this would appear to be related to the property's sewer. There have been no claims for flood relief payments arising from this location since the introduction of the scheme in June 2007.

Figure 5.9.4.7 - Carrickfergus & Kilroot PS SFRA, Downshire Road Stream - 1% AEP Floodplain

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Copeland Water

The Copeland Water fringes the east side of town. It rises in Porg Hill and flows in a southerly direction for around 3.5km to its tidal outfall at the western edge of Kilroot Power Station site. Its natural catchment, which extends to around 2.5km^2 is largely rural. However, as it receives the outfall from the Northeast Diversion which captures the flows from numerous watercourses, it is effectively draining a much larger additional catchment in excess of 10km^2. The watercourse is designated from just above the point at which it receives the outfall from the Northeast Diversion. The designated watercourse initially flows within an open channel until it reaches the access road to Sunnybank Nursery. At this point there is a flow separation structure which diverts most of the flow into an 1850mm culvert, leaving the existing open channel with a residual compensatory flow. The culvert and open channel continue in parallel for around 500m to Copeland Avenue and come together at an inlet structure that conducts all of the flow into a large box culvert. This watercourse continues within a culvert (that changes in size and type) for a further 1.2km, passing under housing developments either side of the Larne Road, through the grounds of the Power Station, and reverts back to an open channel at the Loughview Village housing estate, and continues to its tidal outfall some 100m downstream. All of the large culverts, which are a mix of concrete pipes and box types, have been assessed to be in satisfactory condition.

The developed areas that are prone flooding from the Copeland Water, together with a description of the flooding mechanisms are as follows.

The model predicts that at the 1 in 25 year event floodwater overspills the inlet structure at Copeland Road which is designed to merge the parallel flows from the 1850mm diameter culvert and open watercourse into a box culvert. The floodwater spills across the surface, through gardens and along access roads in the Copeland and Beltoy housing developments, crossing the Larne Road and eventually ponding on the many access roads and hardstanding areas at the west side of the Power Station site. At this event there are no properties located within the estimated flood inundation area. At the more extreme 1 in 100 year event the flood mechanism is the same, and although the size of flood inundation is substantially larger the depth of flooding is generally shallow (less than 300mm). At least 10 residential properties are estimated to be located with the flood inundation area.

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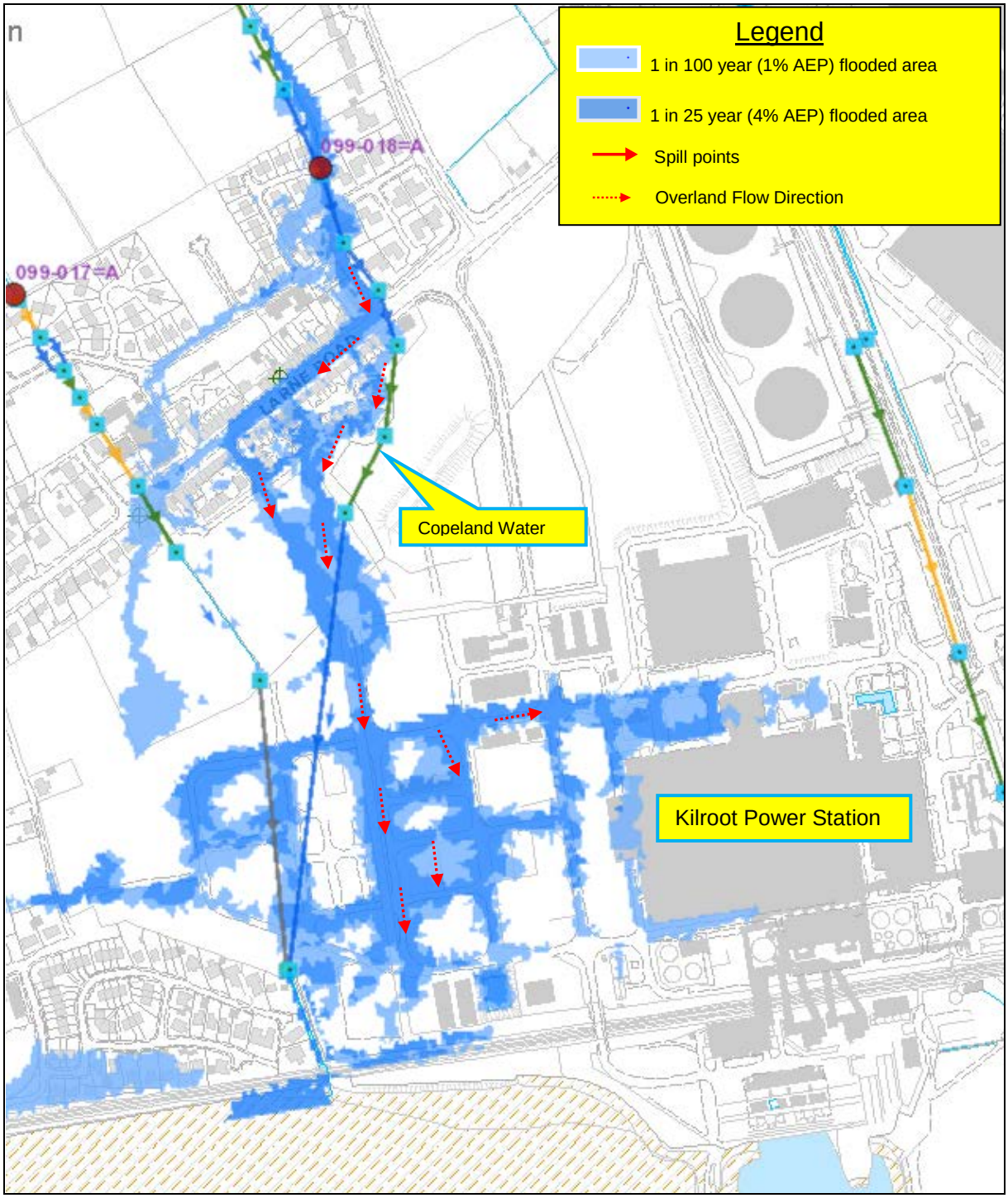

Figure 5.9.4.8 - Carrickfergus & Kilroot PS SFRA, Copeland Water - 1% AEP Floodplain

Northeast Diversion

The Northeast Diversion constructed in the 1980s is essentially a large (1200mm to 1800mm diameter) culvert which has been laid at the outskirts of the town to intercept a proportion of the flows from a number of the natural watercourses before they enter the eastern side of the urbanised zone. The NE Diversion takes a large proportion of the flows from the Sullatober Watercourse, Downshire Road, Bluefield Stream and a

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number of minor tributaries. The diverted flow from these watercourses is conducted around the northeast corner of the town and discharges to the Copeland Water which flanks the east side of the town and flows to its outlet with the sea near the Kilroot Power Station. The total combined catchment for watercourse reaches that are substantially captured by the Diversion exceeds 17km^2 and is almost completely rural in nature. The purpose of the Diversion is to substantially lower the flows in the natural watercourses during extreme rainfall events and thereby reduce the likelihood that they will cause flooding to property. The culverts in this watercourse have been assessed to be in a satisfactory structural condition.

The developed areas that are prone flooding from the Northeast Diversion, together with a description of the flooding mechanisms are as follows.

The model predicts that a section of culvert which is located in the grassed area bounded between Broadlands Gardens and Broadlands Park does not have the hydraulic capacity necessary to vent the estimated flow at the 1 in 25 year event. It indicates that the 1800mm diameter culvert surcharges, causing floodwater to rise in the manhole located in the centre of the grassed area and spill on to the surface. However, at this event the area of inundation is limited to the gardens of a few properties in the immediate proximity of the spill point and most of the floodwater finds its way into an open section of the Cloughlands Stream. At the 1 in 100 year event the length of the surcharged culvert increases and floodwater spills from a second manhole located in the garden of Tudor Road. The floodwater flows south over the steeply sloping surface, dividing into three separate streams before spilling into open sections of the Cloughlands Stream and Bluefields Stream after a distance of around 600m. Due to the steep gradient of the general topography, the floodwater skims quickly over the surface in relatively shallow depths (less than 300mm). It is estimated that up to around 100 properties are located within the inundation area for the 1 in 100 year event, although due to the shallow depths it is likely that many of these will avoid internal flooding due to the height of their thresholds.

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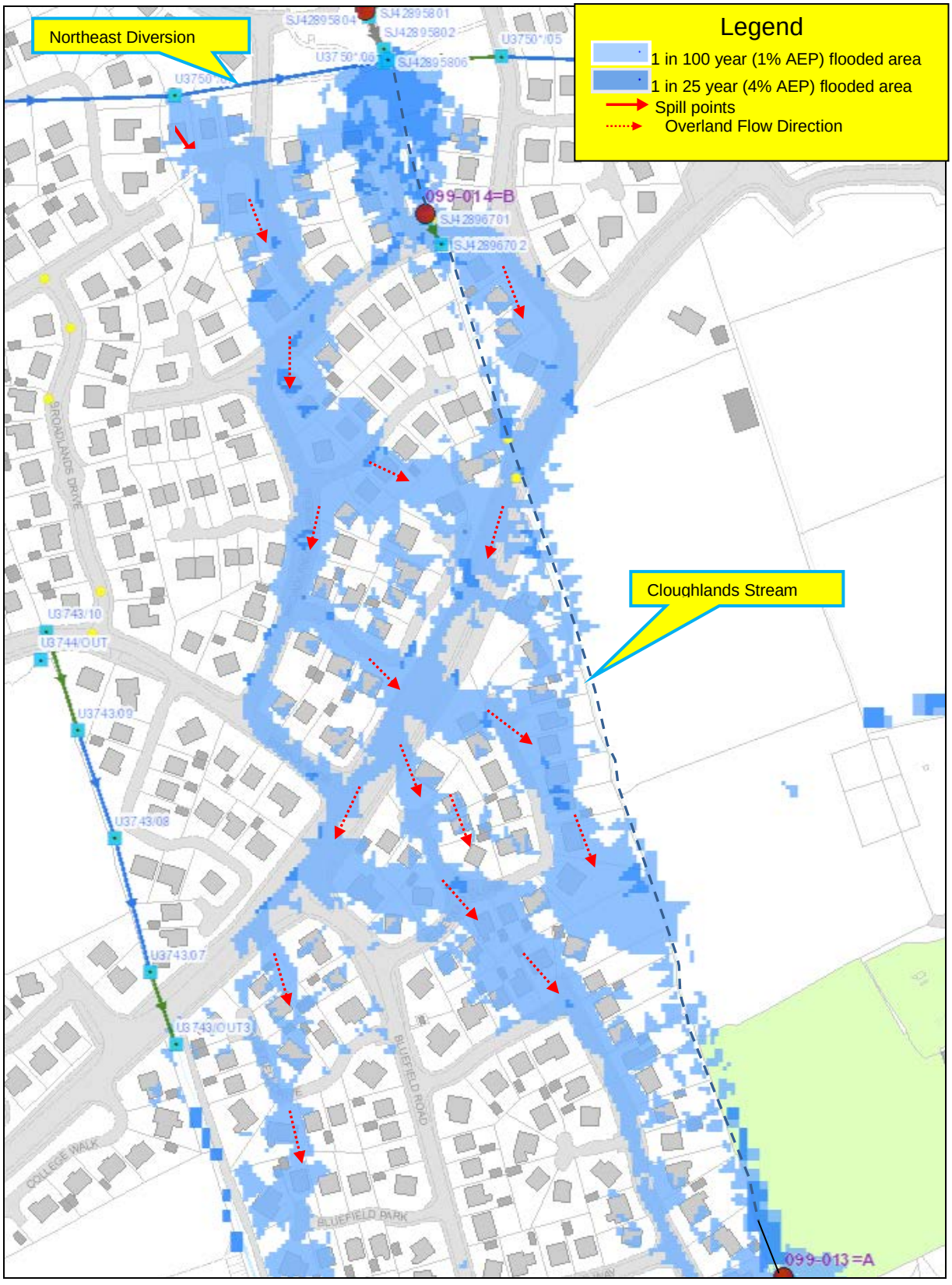

Figure 5.9.4.9 - Carrickfergus & Kilroot PS SFRA, Northeast Diversion - 1% AEP Floodplain

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Cloughlands Steam

A substantial proportion of the flows from the upper catchment of the Cloughlands Stream are captured by the Northeast Diversion as the watercourse approaches the Broadlands housing development. At the flow separation structure the main flow is directed into the Diversion and a residual compensation flow for the Cloughlands Stream is passed though a 300mm diameter culvert. The Cloughlands Stream is designated from the flow separation structure and flows in a southerly direction for around 1.6km to its tidal outlet at the site of the Boney Before sewerage treatment works. The upper section of the designated watercourse from the Diversion to a field at the rear of the NK Fencing site flows in an open channel except for a couple of culverted access road crossings. Beyond this, there are a couple of culverted reaches. The first, which extends to a length of around 270m, conducts the watercourse through the Lennox housing development using 900mm diameter pipes. Two sections of this particular culvert, with a combined length of 180m have been assessed to be in a poor/very poor structural condition. Further downstream the second culverted reach, which has a length of around 0.5km, conducts the watercourse under the Cloughlands housing development and through the Boney Before sewerage treatment works to the tidal outfall under the railway embankment. The pipes in this later reach ranges in size from 1050mm to 1200mm diameter and all sections are assessed to be in a satisfactory structural condition.

The developed areas that are prone flooding from the Cloughlands Stream, together with a description of the flooding mechanisms are as follows.

The model predicts that flooding to property begins to occur at the 1 in 50 year (2% AEP) event from two distinct reaches of the watercourses. The first, indentified as Spill-point 1 on the map below, occurs when floodwater overspills the inlet structure for the 900mm diameter culvert that starts at the rear 21 Regent Street. The floodwater flows over the surface through the Lennox housing development before re-entering the next section of open section some 250m downstream.

There are estimated to be in excess of 20 properties located within the predicted 1 in 50 year flood inundation area, rising to around 70 properties at the more extreme 1 in 100 year event. The depth of the flooding within the residential areas is estimated to be relatively shallow, less than 300mm.

Further downstream, at Spill-point 2 the flooding mechanism is similar with floodwater over-spilling the inlet structure to a 1050mm diameter culvert which commences at the rear of 9 Carrickburn Road. The floodwater is predicted to travel over the surface in a narrow band through the Cloughlands housing development, across the site of the Boney Before sewerage treatment works, to pond behind the railway embankment that fringes the coastline.

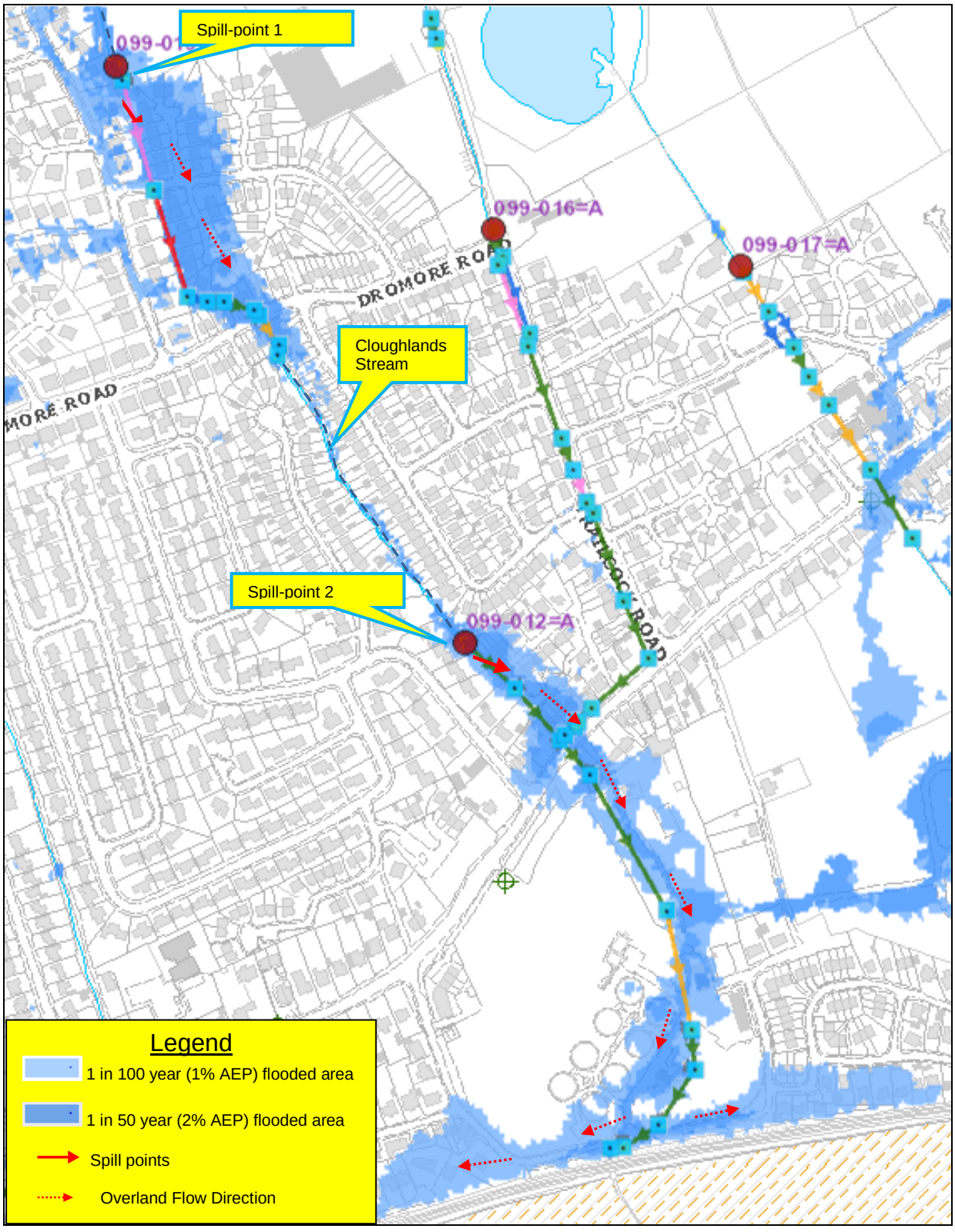

Figure 5.9.4.10 - Carrickfergus & Kilroot PS SFRA, Cloughlands Stream- 1% AEP Floodplain

At the 1 in 50 year event there are estimated to be around 10 properties within the predicted flood inundation area and all of which are located in the vicinity of Cloughlands Park. At the more extreme 1 in 100 year event this increases to around 70 properties and in addition to homes in Cloughlands Park, there are also

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predicted to be significant numbers of flooded homes in the Boney Before and Loughview Village developments.

There have been numerous phone calls to the emergency Floodline from homeowners located in proximity to this section of the Cloughlands Stream watercourse. The nature of the calls, which span the period from 1986 to 2002, would indicate that there is a real risk of flooding to property from the watercourse and would validate the findings of the model.

Potential Adverse Consequences

The watercourse drainage network within the Carrickfergus & Kilroot PS SFRA is a relatively complex system due to the hydraulic inter-dependency between the individual watercourses which were created by the construction of the Northwest Diversion and the Northwest Diversion. Therefore, it has been decided that it would be more appropriate to collate the potential adverse consequences data for the whole of the SFRA rather than for individual watercourses because it is unlikely that any capital investment decisions could be determined from the data for a specific watercourse. The measurements for the potential adverse consequences are listed in Figure 5.9.4.1.

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Table 5.9.4.1 Carrickfergus & Kilroot PS SFRA – All Watercourses			
Potential Adverse Consequences – Fluvial Flooding			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**57**	**182**	**860**
Non Residential (Nr)	**2**	**15**	**41**
Economic Damage (£)	**£235k**	**£324k**	**£1.78m**
Annual Average Damage (£)	**£111k**		
Present Value (£)	**£3.33m**		
IPPC sites (Nr)	**0**	**1**	**0**
Community Assets (Nr)	**0**	**0**	**0**
Care Homes	**0**	**0**	**0**
GP Surgery's	**0**	**0**	**0**
Fire stations	**0**	**0**	**0**
Hospitals	**0**	**0**	**0**
Police Stations	**0**	**0**	**0**
Schools	**0**	**0**	**0**
Key Infrastructure (Nr)	**2**	**2**	**6**
NIW Wastewater Treatment Works	**0**	**0**	**1**
NIW Sewage Pumping Stations	**0**	**0**	**0**
NIW Water Treatment Work	**0**	**0**	**0**
NIW Treated Water Pumping Stations	**0**	**0**	**0**
NIE Substation 6to11kV	**2**	**2**	**5**
NIE Substation 33kV	**0**	**0**	**0**
NIE Substation 275kV	**0**	**0**	**0**
NIE Substation 110kV	**0**	**0**	**0**
Road Service - Trunk Road	**0**	**0**	**0**
Environmental Designated sites (Nr)	**7**	**7**	**7**
AONB	**0**	**0**	**0**
ASSI	**1**	**1**	**1**
Environmentally Sensitive Areas	**0**	**0**	**0**
Maritime Nature Reserve	**0**	**0**	**0**
Nature Reserve	**0**	**0**	**0**
RAMSAR	**1**	**1**	**1**
SAC	**0**	**0**	**0**
Sites of Local Nature Conservation Importance	**3**	**3**	**3**
SPA	**2**	**2**	**2**
RSPB Reserve	**0**	**0**	**0**
UWT Nature Reserve	**0**	**0**	**0**
Built Heritage sites (Nr)	**0**	**0**	**0**
National Trust	**0**	**0**	**0**
Listed Buildings	**0**	**0**	**0**
Sites and Monuments Records	**0**	**0**	**0**
Buildings of Special Architectural or Historical Interest	**0**	**0**	**0**
Areas of Significant Archaeological Interest	**0**	**0**	**0**
Historic Gardens	**0**	**0**	**0**

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5.9.5 Proposed Fluvial Flood Mitigation Measures

Prevention

As well as managing the existing flood risk to people and properties in Carrickfergus and Kilroot Power Station it is important that the flood risk is not increased by new development in areas of known flood risk. Northern Ireland's planning policies adopt a precautionary approach to development that aim to prevent future development that may be at risk of flooding or that may increase the risk of flooding elsewhere.

Reference should be made to Section 4.4 under the headings Planning NI and Local Government regarding the reform and restructuring of the planning system in Northern Ireland. Rivers Agency's Planning Advisory Unit provides advice to Planning NI and Local Councils in relation to the prevention of flooding. In particular Local Councils are advised on Development Plans and at the Planning Application stage. Flood mapping information is used to inform the local Development Plans to ensure, where possible, that new zonings are located outside the identified flood risk areas. In the determination of planning applications any proposed development within a flood risk area will either be advised against or will be further considered if it meets one of the "Exception" rules and is accompanied by a suitable Flood Risk/Drainage Assessment. Applications that relate to "Greenfield" built development in fluvial floodplains are unlikely to be accepted, whereas applications for recreation purposes and amenity open space will usually be accepted.

Development Plans

In the preparation of new Development Plans for Carrickfergus we advise against bringing forward sites or the zoning of any land, particularly for built development, that has been identified from the flood maps as being within the 1 in 100 year fluvial floodplain/1 in 200 year coastal floodplain/reservoir inundation area or is susceptible elsewhere to surface water flooding.

Rivers Agency will also review the existing Development Plan for Carickfergus (Belfast Metropolitan Area Plan, 2015) with a view to addressing flood risk issues which have only recently been identified as a result of the new flood maps.

The main (undeveloped) flooded areas within the Carrickfergus Significant Flood Risk Area are:

North Road Stream

- Area to the north of Prince William Way.

Copeland Water

- Area to the north below the North East Diversion.
- Area to south of the Larne Road

Cloughlands Stream

- Area to south of the Larne Road

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Downshire Stream

- Area to south of Prince Andrew Way

Carnraway Burn

- Fields to the west of the river.

Planning Applications

Fluvial/Coastal Areas at risk

Rivers Agency shall advise against the development of all sites that are located within the 1 in 100 year fluvial floodplain/1 in 200 year coastal floodplain, irrespective of whether they are located within a current development plan or as a single site application outside the plan area.

For those sites within the 1 in 100 year fluvial floodplain/1 in 200 year coastal floodplain where the principle of development has been accepted by Local Council as meeting the 'Exception Test', Rivers Agency will further consider the application through the appraisal of an accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures.

The main existing developed areas, amongst others, at flood risk within Carrickfergus where re-development may be likely to take place are:-

Fluvial

Copeland Water

- Areas at Beltoy Court and both sides of Larne Road.

Cloughlands Stream

- Cloughlands Park to the north of the Larne Road.
- Lennox Park to the north of the Dromore Road.
- Broadlands Gardens to the north of Prince Andrew Way and Bluefield Close to the south of Prince Andrew Way.

Buskin Burn

- Green Park off Bridewell Drive.
-

Carnraway Burn

- Woodlawn Court and Killaloe to the west of the Burn.

Coastal

- Along the Marine highway.

Areas at Risk of Surface Water flooding

For those sites outside the 1 in 100 year fluvial floodplain/1 in 200 year coastal floodplain that are located in an area where there is evidence of a history of surface water flooding (identified by flood hardship payments), Rivers Agency will further consider the application through the appraisal of the accompanying Drainage Assessment that will need to demonstrate suitable flood mitigation measures.

Where there is potential for surface water flooding predicted by the Surface Water Map (areas highlighted purple), River Agency will advise that the applicant should assess the flood risk and drainage impact to the site and construct in an appropriate manner.

The main areas with a flood history, identified in Carrickfergus as being at surface water flood risk are:-

- At the Birches to the east of Woodburn Avenue.
- At the corner of Albert Road and Thomas Street.
- Rhanbuoy Park, south of the Belfast Road and near the coast.

Areas at Risk of Flood Inundation from Reservoirs

For all development proposals that are located within the potential flood inundation area of a Controlled Reservoir we will further consider the application through the appraisal of the accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures. If it is a new development proposal, Rivers Agency will also need the applicant to demonstrate that the condition, management, and maintenance regime of the reservoir is appropriate to provide sufficient assurance regarding reservoir safety.

Controlled Reservoirs identified in the Carrickfergus area are as follows:

- Copeland Reservoir
- Lough Mourne
- Dorisland Reservoir
- South Woodburn Reservoirs (Upper, Middle, Lower)
- North Woodburn Reservoir

Protection

Structural measures are still one of the main options in providing flood protection to people and property impacted by the effects of extensive flooding. It is therefore important that we continue to target investment by providing flood defences, culvert alleviation schemes and infrastructure upgrade works to those communities at greatest need.

The alleviation of surface water flooding, in particular, will require input from a number of bodies. The Flood Investment and Planning Group, FIPG, provides a coordinated approach across Government in relation to the investigation of flooding, agreeing responsibilities and identifying collaborative solutions. The group is

represented by Rivers Agency, NI Water and Transport NI, amongst others, with flood risk management responsibilities.

There are a number of stages to follow when procuring a flood alleviation scheme. The potential scheme needs to be first subjected to a feasibility study that will also include an economic appraisal. From the detailed Hazard and Risk Maps a Flood Risk Metric Tool' (FRISM) is used in urbanised flooded areas to get an estimate of the likely property damages as a result of a range of flood events. The estimated cost of a scheme is then compared to the total 'damage avoidance benefits' that the scheme will provide to property over the scheme's design life. If the benefit/cost ratio is greater than 1, then the potential scheme will be referred to Rivers Agency's Capital Procurement Unit for a feasibility study to be undertaken.

If the flooding issue identified is not solely Rivers Agency's responsibility, or is the responsibility of NI Water or Transport NI such as a local drainage or road infrastructure issue, then it will be referred either to FIPG or directly to the responsible body, for their further consideration.

If a cost benefit analysis identifies a viable scheme, it will be placed on a prioritisation list and progressed alongside other competing schemes. The position on the list will depend on a set marking criteria, such as the benefit/ cost ratio and the overall scheme costs. Depending on the availability of resources it may take anything from between 2 – 5 years for the scheme to progress from the start of the feasibility study to construction works commencing on the ground.

Having conducted a detailed assessment of the fluvial flood risk from all of the rivers in the Carrickfergus and Kilroot PS SFRA, Rivers Agency has determined that the level of flood risk to property may be sufficient to justify structural flood mitigation measures on a number of watercourses at various locations throughout the town. The case for a study is reinforced by the fact that there is substantial number of watercourses that contain lengths of structurally defective culverts that should be considered for refurbishment or replacement.

However, the watercourse drainage network within the Carrickfergus & Kilroot PS SFRA is a relatively complex system due to the hydraulic inter-dependency between the individual watercourses which was created by the construction of the Northwest Diversion and Northwest Diversion. Because of this complexity it is entirely possible that the solution to alleviate flooding from one of the watercourses could be to carry out works at another. Therefore, it has been determined that a holistic flood study and economic appraisal, that takes into consideration the hydraulic dependences between the watercourses, will be undertaken to establish if there are cost/beneficial solutions to alleviate the localised flooding problems identified. This study will be taken forward within the term of this FRMP (i.e. 5 yrs). Any viable flood alleviation works identified through this study will be included in the Rivers Agency's prioritised capital works programme.

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Preparedness

In the Carrickfergus & Kilroot Power Station SFRA it is not possible to prevent or protect against all flooding. Indeed even where flood defences exist it is possible in an extreme event that these could be over topped and flooding could still occur.

Having recognised this fact, considerable effort in recent years has been made by emergency planners in a Government Departments, Councils and the Emergency Services working together and sharing information to ensure a coordinated response.

However, despite these improvements, during significant flood events the emergency response of Government Departments and the Emergency Services can become over stretched. This means that not all calls for assistance during a flood event may be responded to in a timely manner. With this in mind it is important that households and communities, subject to a known flood risk, are prepared. The detail of preparedness actions, including flood warning and informing activities planned from a regional perspective, are provided in Appendix E.

This is not Government withdrawing from any undertaking to respond in emergencies but an additional layer of support to ensure Government Departments and the public work together to reduce the overall impacts of flooding.

From the flood risk assessment there at least 9 areas within the Carrickfergus & Kilroot Power Station SFRA that have flooded in the recent past that may benefit from the flood warning and informing proposals, outlined in Appendix D.

A pilot project of community engagement to deliver flood warning and informing, held in 2014, identified basic assessment formulae to assess and score areas that could potentially be a focus for flood warning and informing actions. Based on this scoring these areas did not score high enough to be placed within the top 20 communities to be offered a programme of community engagement during the period of this plan. However, if communities want to become more resilient, the Department is committed to providing assistance were possible to develop the consistent approach to resilience. The NI Direct website www.nidirect.gov.uk/ will host further information and advice on what to do in advance of flooding, what to do during flooding and how to recover after flooding. The website will also contain templates for communities wishing to develop their own plan.

5.10 Newtownabbey Significant Flood Risk Area

The core boundary of the Newtownabbey SFRA, which has been determined through the PFRA, is located within the Belfast Lough and Tidal Lagan Local Flood Management Area and is illustrated in Figure 5.10.1 below.

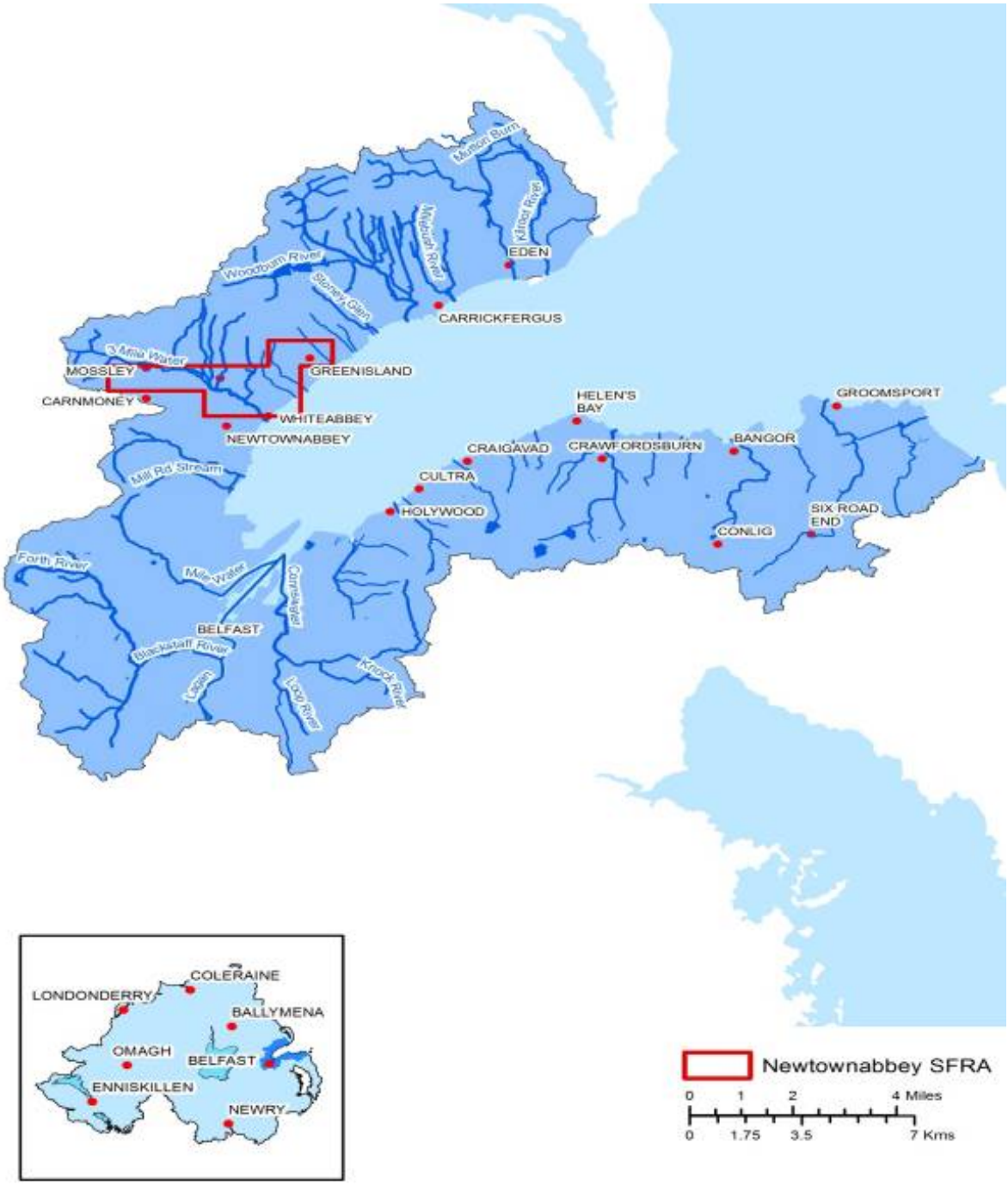

Figure 5.10.1 Belfast Lough & Tidal Lagan Local Flood Management Area and Newtownabbey SFRA

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5.10.1 Flooding History

In recent years a number of flooding events have occurred in the Newtownabbey/Whiteabbey area. Historical reports would suggest that these vary in scale and severity of impact and emanate from surface water, watercourses and sewerage/drainage systems. Notable events, which caused significant flooding of the Shore Road and Whiteabbey Village areas, occurred on 19th September 1999 and again on 21st June 2002. The event in June 2002 was particularly severe and was caused by short duration high intensity rainfall which, the Met Office reports at the time indicated, had a storm return period of 1 in 300 years. This extreme rainfall resulted in widespread surface water flooding and disruption in the area and caused internal flooding to at least 40 residential and 15 commercial properties in Whiteabbey. It is also evident from an examination of the database which records details of the telephone calls to the emergency Floodline that there are distinct clusters of calls to indicate potential problems at specific locations such as Monkstown Avenue/Glenville Road, Twinburn and Whiteabbey Village. It has however been relatively uneventful in recent years, as there have been only 5 payments made to the owners of residential properties in the immediate area since the introduction of the Flooding Hardship Payment Scheme in June 2007.

5.10.2 PFRA – Identification of Potentially Significant Flood Sources

According to the Preliminary Flood Risk Assessment (Dec 2011) the town of Newtownabbey, in terms of the potential adverse consequences of flooding, is ranked fifteenth of the twenty SFRA within Northern Ireland (see Figure 4.1).

It should be noted that the PFRA was based on the Strategic Flood Map (NI) Rivers & Sea which, at the time of this assessment, was the best available information upon which to identify the general areas throughout Northern Ireland that may be prone to flooding from rivers and the sea. However, due to the onerous requirement to produce flood maps that cover the whole of the province, it was necessary to develop the strategic flood models using a broad-scale modelling methodology that had clear limitations.

On the basis of the PFRA it was estimated that there may be in excess of 280 properties located within the 1% AEP (1 in 100 year) fluvial floodplains (see Figure 5.10.2.1) below. The locations of the properties that were indentified to be at potential risk from rivers are in the vicinity of the Lynda housing development (Jordanstown), the Whiteabbey Village area and to a lesser extent the Twinburn housing development (Monkstown). However, at the time of the PFRA there was no predictive flood plains (strategic or otherwise) available for a number of ‘unmodelled’ minor watercourses (which are identified and illustrated in Figure 5.10.2.1) and consequently, this initial estimate of the number of properties at potential risk of flooding was considered to be a lower bound estimate.

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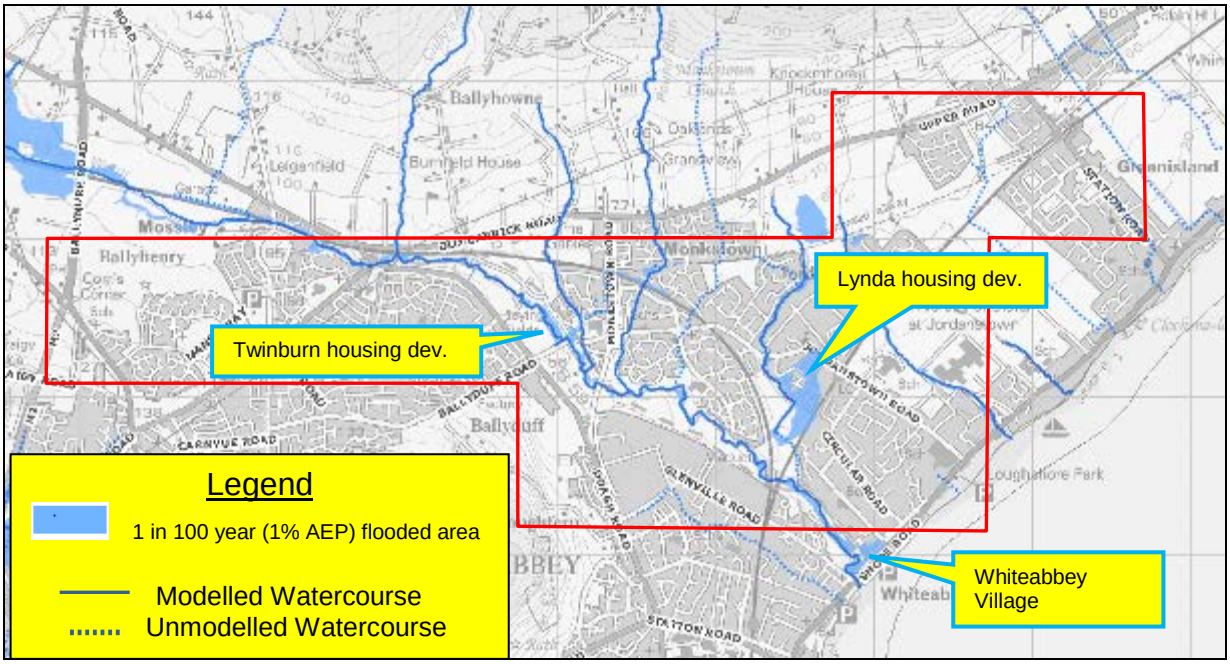

Figure 5.10.2.1 - Newtownabbey–Undefended Fluvial Flood Plains, Strategic 1% AEP (1 in 100 yr)

Although the Newtownabbey area has a coastal fringe, the risk from tidal inundation is not considered to be significant. The estimated economic damages arising from potential future property flooding from the sea are barely 1% of those calculated for the predicted flooding from rivers. According to the strategic flood maps, there are around 20 properties that are estimated to be at risk from tidal inundation at the 0.5% (1 in 200yr). These properties are located in the Whiteabbey Village shopping area and strung out along a 300m section of the 'old' Shore Road between its junctions with the Glenville Road and Circular Road (see Figure 5.10.2.2 below).

The reason that the Strategic Flood Map identifies the area at Whiteabbey Village to be at risk from the sea is that ground levels in some parts of the village are lower than the predicted sea level for the 1 in 200 year event. However, this area is actually protected from direct tidal inundation by the 'new' Shore Road at the seafront. The Shore Road effectively acts as a barrier as it is around 0.5m above the typical ground levels in the village and higher than the predicted 1 in 200 year tidal surge level. Although the sea has no direct overland flow path to the Whiteabbey Village, it could still cause a flooding problem by reducing the discharge capacity of local drainage systems with tidal outfalls or in extreme circumstances by reverse flowing through these systems. Therefore, although the tidal risk is not considered to be 'significant' for the Newtownabbey SFRA and will not be specifically managed through the FRMP, the tidal influence on the watercourses will be taken into account.

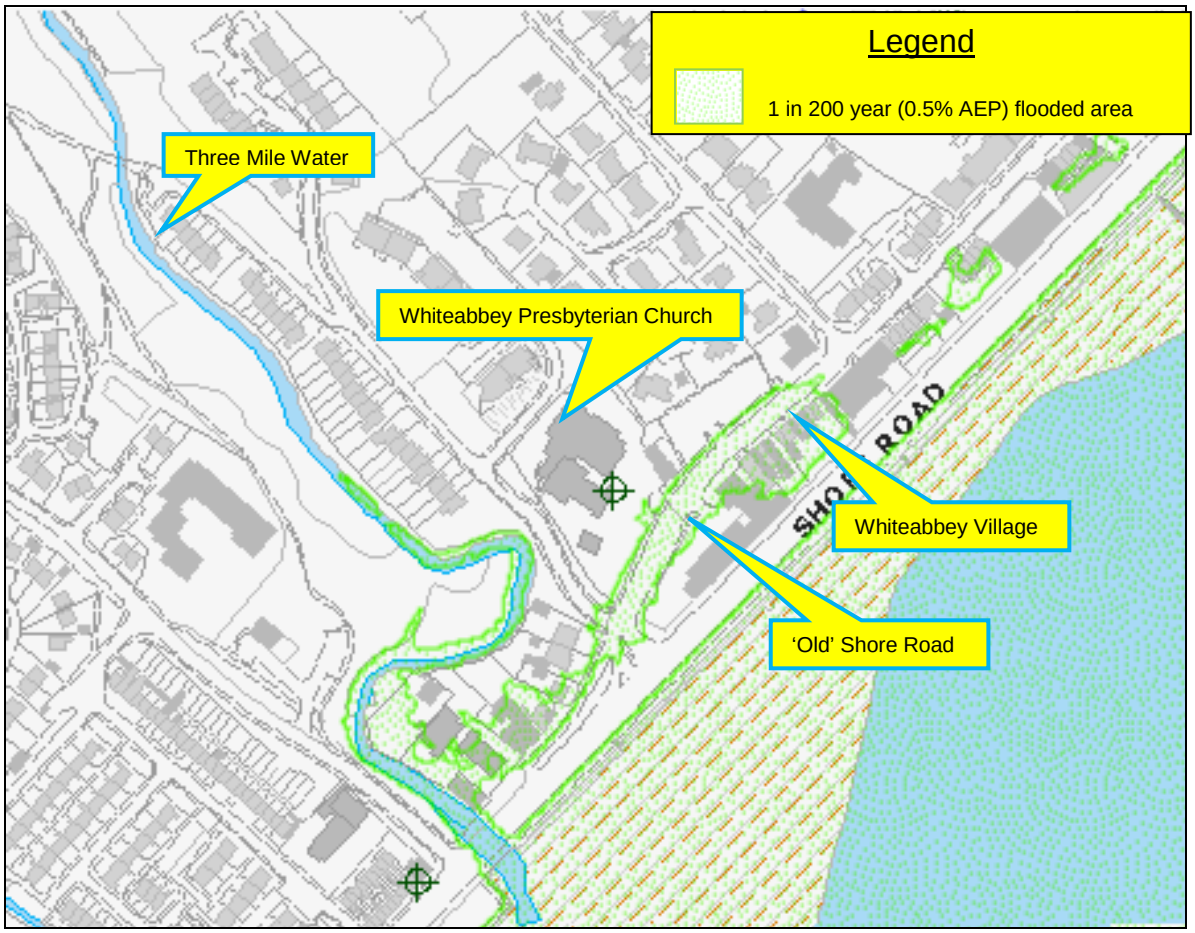

Figure 5.10.2.2 – Newtownabbey SFRA – Undefended Tidal Flood Plain, Strategic 0.5% AEP (1 in 200 yr) event

Although the PFRA concluded that there may be in excess of 280 properties in Newtownabbey at risk of flooding from rivers, it was acknowledged that there was a high degree of uncertainty with this figure as it was based on the Strategic Flood Maps. To reduce this uncertainty and facilitate a more robust assessment of the level of fluvial flood risk to Newtownabbey, Rivers Agency developed detailed predictive flood models for each of the watercourses within the town. The Flood Hazard Maps produced using the detailed flood models are more accurate than the strategic maps which may be over estimating or under estimating the number of properties at risk of flooding. Details of the models and their output are described in the following sections.

5.10.3 Catchment Description

The Borough of Newtownabbey, which has a population in excess of 80,000, is the fourth largest settlement in Northern Ireland. Although the Borough comprises a substantial number of urban residential communities and traditional farming communities, the Newtownabbey SFRA is largely focused on an area that comprises Monkstown, Jordanstown, Whiteabbey and Greenisland. These residential areas are drained by a series of watercourses that arise from the slopes of the Antrim Plateau Escarpment to the west and northwest. Apart from the Three Mile Water which has a significant and predominantly rural catchment with an area exceeding

20km², all of the other watercourses have small and largely urban catchments which are typically less than 2km². Most of the watercourses, apart from the Three Mile Water are heavily engineered and substantially culverted throughout the urban areas. The SFRA has a coastal fringe at the north shore of Belfast Lough and all of the watercourses have a sea outfall at locations along the shoreline between Whiteabbey and Greenisland.

5.10.4 Fluvial Flood Risk Assessment

Fluvial Modelling Methodology and Scope

Fundamental to the detailed fluvial risk assessment was the development of a hydrodynamic model for each of the six main watercourses (and tributaries) which have the potential to adversely impact the urbanised areas within the Newtownabbey SFRA. The names, location and extents of the watercourses which were modelled in detail are indicated in Figure 5.10.4.1 below.

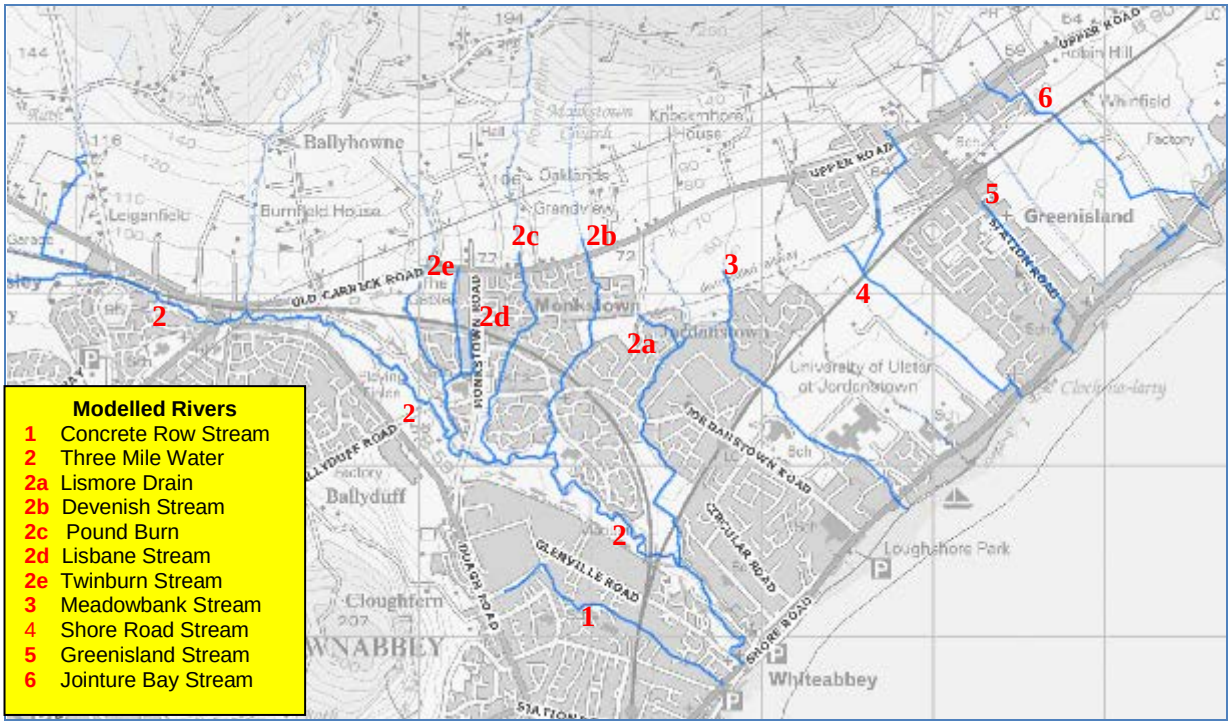

Figure 5.10.4.1 - Newtownabbey SFRA – Modelled Watercourses

The detailed models indicate that there is virtually no risk of flooding from the Meadowbank Stream or Shore Road Stream and therefore these are excluded from any further consideration within the plan. The risk to property from each of the other watercourses in the Newtownabbey SFRA is assessed in the following sections.

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Flood Mechanisms

Concrete Row Stream

The Concrete Row Stream drains a small (1.4km^2) catchment which extends from above the Monkstown Road, to the sea outfall at the Shore Road. The catchment area is significantly urbanised except for a relatively small patch of grassland and scrub to the west of the Doagh Road which equates to less than 20% of the total area. The watercourse first arises in overgrown land fringing the Redon's coal yard site adjacent to Monkstown Road. If flows in a south easterly direction for a distance of around 1.6km to its sea outfall to Belfast Lough near the Shore Road/Dillon's Avenue Junction. The watercourse flows in an open channel for around 640m and within culverts for the other 1000m. Along the route of the watercourse there are as many as six separate culverted sections interspersed with the open sections and these culverts have been laid to facilitate the Abbeyhill, Bleechgreen, Glenview and Glenville housing developments. The lower section of the watercourse between the railway crossing and the tidal outfall is designated by Rivers Agency whilst the upper 1 km reach is currently undesignated and responsibility for its maintenance rests with the riparian owners.

The culverts in the lower 'designated' section of the watercourse are of mixed construction types and include large concrete pipes (1500mm diameter), arches and rectangular boxes. These culverts, which have a combined length of 260m, have been assessed to be in a satisfactory structural condition except for a short 30m length of 1030mm x 750mm rectangular box culvert at the bottom of the Glenville Road. The culverted sections of the upper 'undesignated' reach are all concrete pipes which typically range in size from 1050mm to 1350mm diameter except for a few short sections of small (300mm diameter) pipes at the upper limits around King's Crescent. Although undesignated, these culverts (with a combined length of around 740m) have been inspected by Rivers Agency and are known to be in a satisfactory structural condition except for a short (60m) section of 300mm diameter culvert in the gardens of the properties at 42/44 King's Crescent.

The predictive model indicates that two principle flood risk locations exist within the Concrete Row Stream catchment. The location of the developed areas affected by flooding and the flood mechanisms are described below.

Flood Location 1

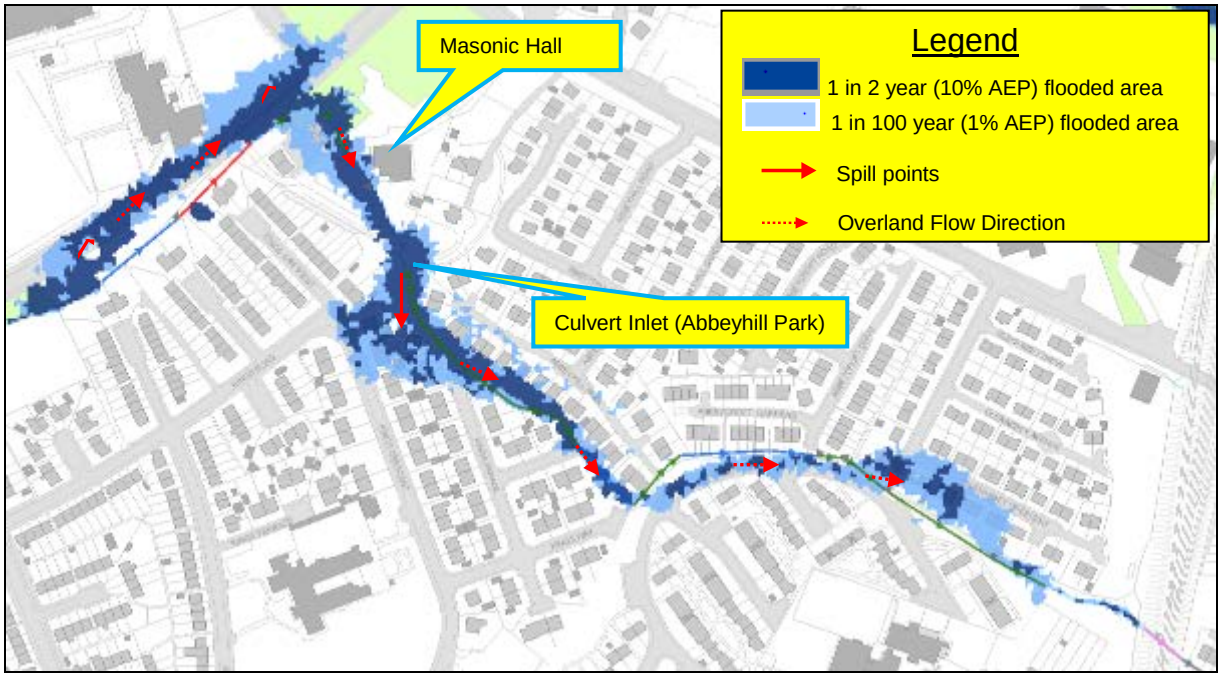

Figure 5.10.4.2 - Newtownabbey SFRA –Concrete Row Stream (1% AEP) – Flood location 1

The model shows that at the very frequent 50% (1 in 2 year) flood event, floodwater begins to spill from a number of locations at a section of the watercourse in the vicinity of the Whiteabbey Masonic Centre. This section of the watercourse is undesignated and the flooding arises from localised restrictions in the culvert network in this area. The principle restriction is at the inlet to the culvert through Abbeyhill Park, which was recently laid to facilitate the construction of the housing development. Although the new culvert is typically 1050mm diameter, it was connected into an existing 450mm pipe which crosses under an access road at its upstream end and this restriction severely inhibits the hydraulic capacity of the watercourse at this location.

Other localised spill points exist at a number of culverted crossings laid under minor access roads and the most upstream section of culvert that runs parallel with Monkstown Avenue, which is only 300mm diameter and undersized for the predicted flows. As floodwater spills from the channel at the Masonic Hall, it flows overland through Kings Crescent, Abbeyhill Park and Glenabbey Crescent and may adversely affect up to 40 properties at the 1 in 100 year event.

Flood Location 2

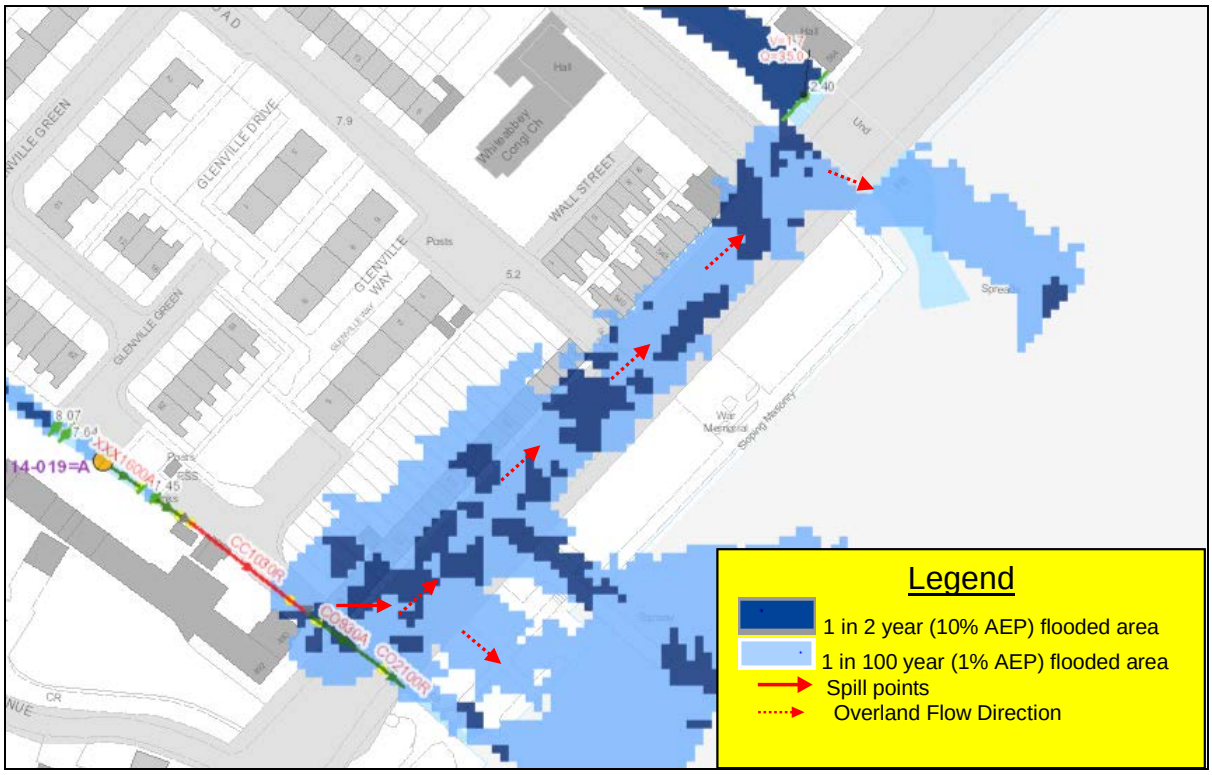

Figure 5.10.4.3 - Newtownabbey SFRA – Concrete Row Stream (1% AEP) – Flood location 2

The model predicts that at the very frequent 50% (1 in 2 year) flood event, the culvert sections just upstream of the sea outfall begin to surcharge, forcing floodwater to spill from a manhole located in the narrow vehicular passageway between numbers 490 and 494 Shore Road. The floodwater flows along the Shore Road carriageway in a north-easterly direction and, after a distance of around 150m, spills into the channel of the Three Mile Water. It is estimated that floodwater will pond on the Shore Road to a depth of up to 300mm and that around 30 terraced properties and a fish restaurant may suffer internal flooding at the 1 in 100 year event.

It has been determined that the culverts at this location are generally undersized and cannot vent the design flows and that other factors including unapproved service obstructions within culverts and hydraulically restrictive inlet structures are increasing the potential for flooding. It is estimated that 64 homes and 6 non-residential properties may be flooded at the 1 in 10 year event, rising to 71 homes and 6 non-residential at the 1 in 100 year event. The total cost of the predicted property damages of future floods from the Concrete Row Stream is estimated to have a present day value of around £552k.

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Table 5.10.4.1 Newtownabbey SFRA – Concrete Row Stream **Potential Adverse Consequences – Fluvial Flooding**			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**64**	**66**	**71**
Non Residential (Nr)	**6**	**8**	**6**
Economic Damage (£)	**£34,145**	**£54,923**	**£159,863**
Annual Average Damage (£)	**£18,411**		
Present Value (£)	**£552k**		
IPPC sites (Nr)	**0**	**0**	**0**
Community Assets (Nr)	**0**	**0**	**0**
Care Homes	**0**	**0**	**0**
GP Surgery's	**0**	**0**	**0**
Fire stations	**0**	**0**	**0**
Hospitals	**0**	**0**	**0**
Police Stations	**0**	**0**	**0**
Schools	**0**	**0**	**0**
Key Infrastructure (Nr)	**2**	**2**	**2**
NIW Wastewater Treatment Works	**0**	**0**	**0**
NIW Sewage Pumping Stations	**0**	**0**	**0**
NIW Water Treatment Work	**0**	**0**	**0**
NIW Treated Water Pumping Stations	**0**	**0**	**0**
NIE Substation 6to11kV	**0**	**0**	**0**
NIE Substation 33kV	**0**	**0**	**0**
NIE Substation 275kV	**0**	**0**	**0**
NIE Substation 110kV	**0**	**0**	**0**
Road Service - Trunk Road	**2**	**2**	**2**
Environmental Designated sites (Nr)	**1**	**1**	**1**
AONB	**0**	**0**	**0**
ASSI	**0**	**0**	**0**
Environmentally Sensitive Areas	**0**	**0**	**0**
Maritime Nature Reserve	**0**	**0**	**0**
Nature Reserve	**0**	**0**	**0**
RAMSAR	**0**	**0**	**0**
SAC	**0**	**0**	**0**
Sites of Local Nature Conservation Importance	**1**	**1**	**1**
SPA	**0**	**0**	**0**
RSPB Reserve	**0**	**0**	**0**
UWT Nature Reserve	**0**	**0**	**0**
Built Heritage sites (Nr)	**0**	**0**	**0**
National Trust	**0**	**0**	**0**
Listed Buildings	**0**	**0**	**0**
Sites and Monuments Records	**0**	**0**	**0**
Buildings of Special Architectural or Historical Interest	**0**	**0**	**0**
Areas of Significant Archaeological Interest	**0**	**0**	**0**
Historic Gardens	**0**	**0**	**0**

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Greenisland Stream

The Greenisland Stream is a relatively short watercourse which first issues within the Greenisland development from a small culvert in the front garden of 119 Station Road. Upstream of this position little is known about the watercourse although in all likelihood, it is conducted via small diameter culverts for at least 650m through a developed area to beyond the Upper Road, where it reverts to an open channel in farmland. The upper reach of the watercourse from 119 Station Road downstream to 67 Station Road is undesignated. This undesignated section, which has a length of around 400m, flows within an open channel that runs through the front gardens of properties which fringe the north side of the Station Road carriageway. This section of open watercourse is repeatedly interrupted (up to around 20 times) by short length of culverts that have been laid under the driveways to the properties.

The lower reach of the watercourse, which extends from 67 Station Road to the sea outfall some 750m downstream, is designated and fully culverted throughout its length. The designated culverts vary in structural form and size and include: Rectangular (330mm x 500mm to 700mm x 1200mm), Circular (450mm to 1050mm) and Arched Roof (800mm x 670mm). A recent survey of these culverts show them to have numerous blockages and a number of sections, with a combined length in excess of 170m are assessed to be in an unsatisfactory structural condition.

The catchment area draining to the watercourse is around 0.6km² and substantially urbanised, with development extending from the sea outfall to the Upper Road. North of the Upper Road the remainder of the catchment is agricultural. At present around 50% of the catchment is calculated to be urbanised and based on the Belfast Metropolitan Area Plan, this could rise in the future to around 60%. The small size of this catchment, together with its high degree of urbanisation, will result in the relatively rapid and intense generation of flood flows within the watercourse for high rainfall events.

Transport NI recently upgraded the A2 Shore Road between Jordanstown and Seapark by constructing a dual carriageway and upgraded the sections of the Greenisland Stream culverts located within the new A2 corridor as required to prevent flooding.

The developed areas that are prone flooding within the Concrete Row Stream, together with a description of the flooding mechanisms are as follows.

The model indicates that flooding from the Greenisland Stream begins to adversely affect property along the length of the Station Road at the relatively frequent 10% AEP (1 in 10 year) event. Floodwater is predicted to overspill the banks at a number of locations along the undesignated open watercourse from as far upstream as the Knockfergus Park/Station Road Junction. Floodwater also spills onto the Station Road at the inlet to the designated and wholly culverted lower reach of the watercourse and from various manholes on route to the sea outfall. This flooding is caused by under capacity throughout the length of the system and exacerbated by the disparate nature of the channel in the undesignated section which constantly changes from open to culverted sections from property to property.

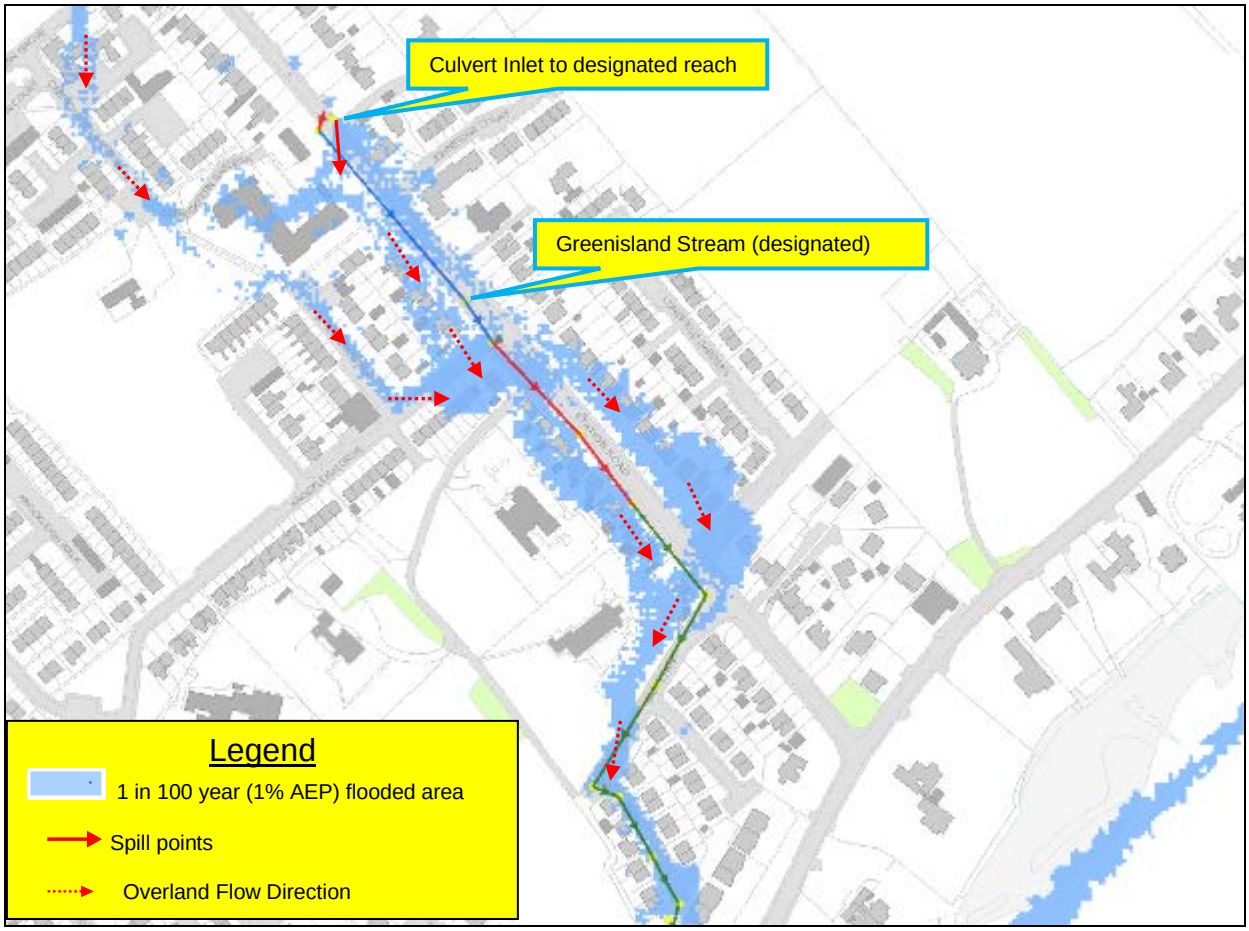

Figure 5.10.4.4 - Newtownabbey SFRA – Greenisland Stream– Fluvial inundation area (1% AEP)

It is estimated that 48 residential properties may be flooded at the 1 in 10 year event, rising to 76 residential and 6 non-residential (which includes a GP Surgery) at the 1 in 100 year event. The total cost of the predicted property damages of future floods is estimated to have a present day value of around £915k.

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Table 5.10.4.2 Newtownabbey SFRA – Greenisland Stream			
Potential Adverse Consequences – Fluvial Flooding			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**48**	**68**	**71**
Non Residential (Nr)	**0**	**3**	**6**
Economic Damage (£)	**£54k**	**£93k**	**£1001k**
Annual Average Damage (£)	**£30.5k**		
Present Value (£)	**£915k**		
IPPC sites (Nr)	**0**	**0**	**0**
Community Assets (Nr)	**1**	**1**	**1**
Care Homes	**0**	**0**	**0**
GP Surgery's	**1**	**1**	**1**
Fire stations	**0**	**0**	**0**
Hospitals	**0**	**0**	**0**
Police Stations	**0**	**0**	**0**
Schools	**0**	**0**	**0**
Key Infrastructure (Nr)	**0**	**0**	**0**
NIW Wastewater Treatment Works	**0**	**0**	**0**
NIW Sewage Pumping Stations	**0**	**0**	**0**
NIW Water Treatment Work	**0**	**0**	**0**
NIW Treated Water Pumping Stations	**0**	**0**	**0**
NIE Substation 6to11kV	**0**	**0**	**0**
NIE Substation 33kV	**0**	**0**	**0**
NIE Substation 275kV	**0**	**0**	**0**
NIE Substation 110kV	**0**	**0**	**0**
Road Service - Trunk Road	**0**	**0**	**0**
Environmental Designated sites (Nr)	**0**	**0**	**0**
AONB	**0**	**0**	**0**
ASSI	**0**	**0**	**0**
Environmentally Sensitive Areas	**0**	**0**	**0**
Maritime Nature Reserve	**0**	**0**	**0**
Nature Reserve	**0**	**0**	**0**
RAMSAR	**0**	**0**	**0**
SAC	**0**	**0**	**0**
Sites of Local Nature Conservation Importance	**0**	**0**	**0**
SPA	**0**	**0**	**0**
RSPB Reserve	**0**	**0**	**0**
UWT Nature Reserve	**0**	**0**	**0**
Built Heritage sites (Nr)	**0**	**0**	**0**
National Trust	**0**	**0**	**0**
Listed Buildings	**0**	**0**	**0**
Sites and Monuments Records	**0**	**0**	**0**
Buildings of Special Architectural or Historical Interest	**0**	**0**	**0**
Areas of Significant Archaeological Interest	**0**	**0**	**0**
Historic Gardens	**0**	**0**	**0**

Three Mile Water (and tributaries)

The Three Mile Water flows from its source in the Antrim Plateau Escarpment through a valley between Carmoney Hill to the South and My Lords Mountain, Carntall and Knockagh to the North. The watercourse crosses the A8 Larne Road (near Corr's Corner), flows through the Mossley and Ballyhenry areas before reaching its sea outfall at the Shore Road/Glenville Road junction. The watercourse, which flows in a south easterly direction from source to sea, is approximately 8.7km long. The upper sections of the watercourse, from its source to Mossley, are relatively flat with an approximate gradient of 1:200. There is a marked increase in the steepness of the watercourse from Mossley to the sea outfall as it flows though a steep-sided valley within a channel which has an average gradient of around 1:65. The steepness of the valley sides immediately adjacent to the river channel have largely prevented development encroaching close to the flow channel.

The watercourse flows mainly within an open channel, and is culverted only at road and railway crossings. The Three Mile Water has a number of significant tributaries which flow from the north to join at various locations along its left bank and include the Ballyearl Stream, Cully's Burn, Brookmount Stream, Twinburn Stream, Lisbane Stream, Pound Burn, Devinish Stream and Lismore Drain. These tributaries drain high ground in the northern segment of the overall rural catchment from My Lord's Mountain and Knockagh to the A8 and beyond this, the urbanised areas of Monkstown and Jordanstown. The lower urbanised reaches of the Three Mile Water are designated from just west of the Monkstown Road, downstream to the sea outfall. Further upstream, a short (500m) section of the watercourse is designated near the Mossley Mill Civic Centre.

The developed areas that are prone flooding within the Three Mile Water (Main Channel) and its tributaries (Brookmount Stream, Twinburn Stream and Lismore Drain) , together with a description of the flooding mechanisms are as follows.

<u>Three Mile Water – Main Channel</u>

The model predicts that at the 1 in 100 year flood event there is no flooding to property from the main channel of the Three Mile Water. This would indicate that there is no need for structural flood alleviation measures to be undertaken for this watercourse. There is however some concern that at the lower reaches near the tidal outfall, the water level at the 1 in 100 year event rises to within 60mm on the left bank adjacent to the relatively new Glenavna Manor Housing development. Therefore, a very slight increase in the river levels would cause floodwater to overspill the bank and result in flooding to property at Glenavna Manor and the Whiteabbey Village. It is known that the site of the Glenavna Manor development flooded during the extreme event in 2002 and in all likelihood the properties constructed since that time would flood if a similar event was to occur in the future.

Brookmount Stream/Twinburn Stream (TMW tributaries)

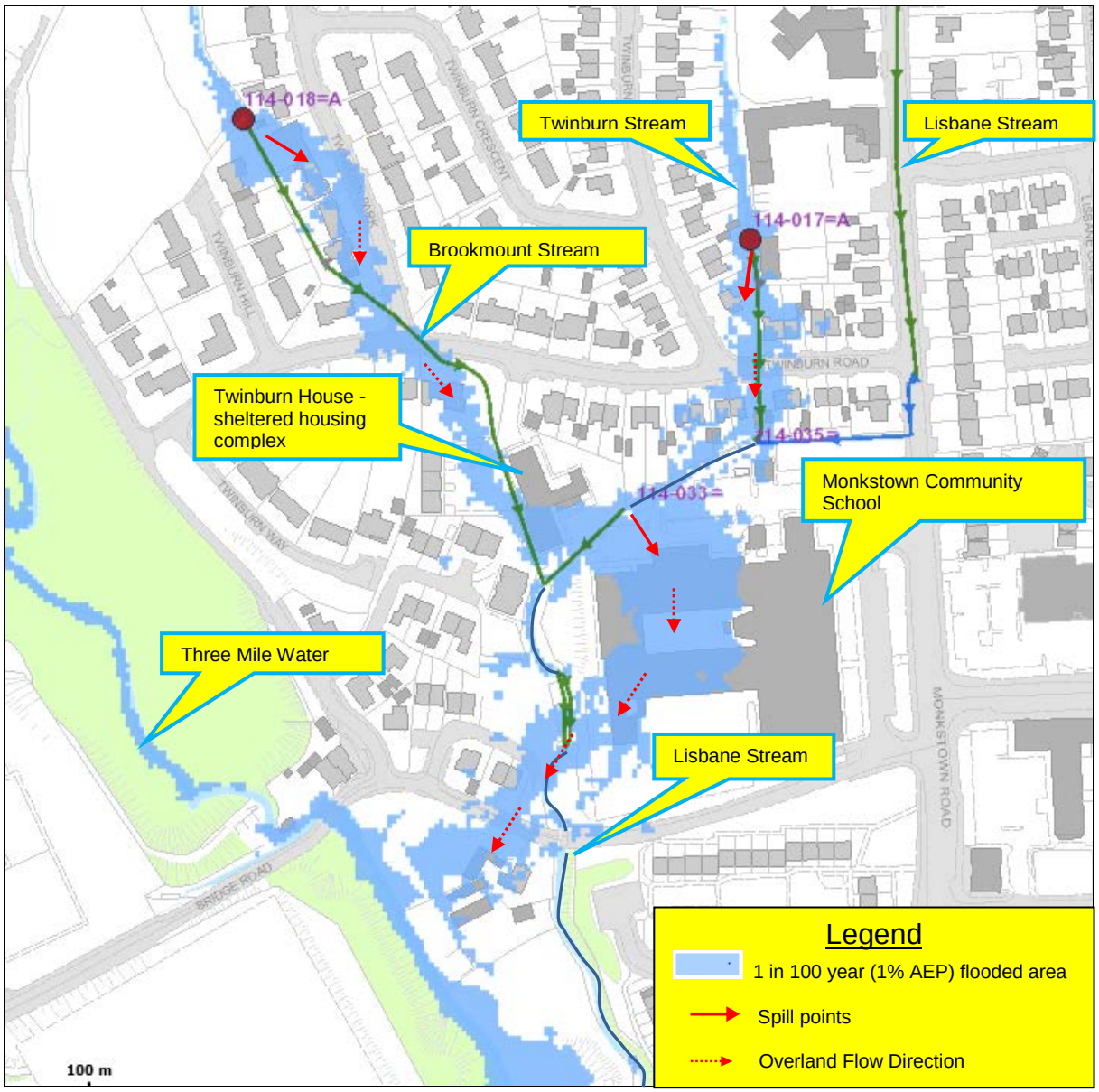

Figure 5.10.4.5 - Newtownabbey SFRA – Brookmount Stream/ Twinburn Stream Fluvial inundation area (1% AEP)

The model predicts that flooding to properties from both the Brookmount Stream and Twinburn Stream begins to occur at the 4% AEP (1 in 25 year) event. It shows that floodwater spills over the banks of open sections of the watercourses at the inlets to culverts located in the grounds of the Monkstown Community School, and the rear gardens of two residential properties (5 Twinburn Drive and 11 Twinburn Park). It is estimated that at this location up to 26 residential properties and 3 non-residential properties which includes Monkstown Community School and Twinburn House sheltered housing complex are at risk of flooding at the 1 in 100 year event. There is historical evidence of flooding in the Twinburn area and during the period 1986 to 2005 there have been at least 9 telephone calls to the flood emergency helpline from homeowners to request assistance from the flood authorities.

Lismore drain (TMW tributary)

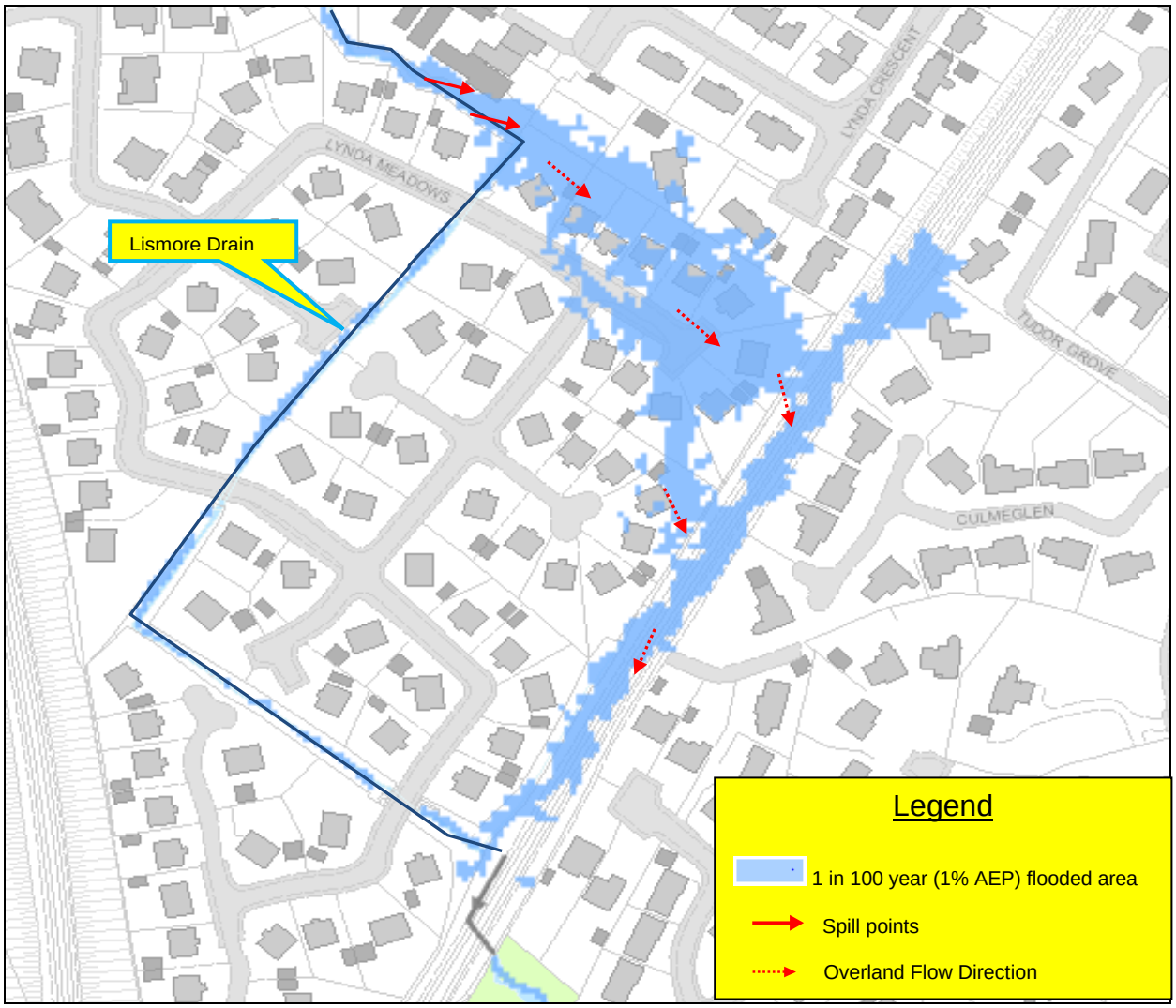

Figure 5.10.4.6 - Newtownabbey SFRA – Lismore Drain– Fluvial inundation area (1% AEP)

The model predicts that localised flooding of the Lynda Meadows development begins to occur at the 1.33% AEP (1 in 75 year) event as floodwater overspills the left bank at an acute bend in the open watercourse section adjacent to 14 Lynda Meadows (See Figure 5.10.4.6). At this event up to 8 properties may be affected by shallow flooding to depths less than 300mm. At the more extreme 1 in 100 year event the number affected may rise to around 16, although in all cases the depth of flooding will be shallow and at some properties may be limited to their gardens and out buildings. There is absolutely no evidence of flooding at this area in the past.

The assessment shows that flood risk to property from the Three Mile Water and its tributaries (Brookmount Stream, Twinburn Stream and Lismore Drain) is relatively low and that very few properties adversely are likely to be adversely affected by frequent flooding. It is estimated that across the whole of the catchment 46 homes and 4 non-residential properties may be flooded at the 1 in 100 year event and that the total cost of the predicted property damages of future floods is estimated to have a present day value of around £54k.

Table 5.10.4.3 Newtownabbey SFRA – Three Mile Water			
Potential Adverse Consequences – Fluvial Flooding			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**1**	**1**	**46**
Non Residential (Nr)	**0**	**1**	**4**
Economic Damage (£)	**£52**	**£52**	**£56,586**
Annual Average Damage (£)	**£1.8k**		
Present Value (£)	**£54k**		
IPPC sites (Nr)	**0**	**0**	**0**
Community Assets (Nr)	**0**	**1**	**1**
Care Homes	**0**	**0**	**0**
GP Surgery's	**0**	**0**	**0**
Fire stations	**0**	**0**	**0**
Hospitals	**0**	**0**	**0**
Police Stations	**0**	**0**	**0**
Schools	**0**	**1**	**1**
Key Infrastructure (Nr)	**0**	**0**	**0**
NIW Wastewater Treatment Works	**0**	**0**	**0**
NIW Sewage Pumping Stations	**0**	**0**	**0**
NIW Water Treatment Work	**0**	**0**	**0**
NIW Treated Water Pumping Stations	**0**	**0**	**0**
NIE Substation 6to11kV	**0**	**0**	**0**
NIE Substation 33kV	**0**	**0**	**0**
NIE Substation 275kV	**0**	**0**	**0**
NIE Substation 110kV	**0**	**0**	**0**
Road Service - Trunk Road	**0**	**0**	**0**
Environmental Designated sites (Nr)	**0**	**0**	**0**
AONB	**0**	**0**	**0**
ASSI	**0**	**0**	**0**
Environmentally Sensitive Areas	**0**	**0**	**0**
Maritime Nature Reserve	**0**	**0**	**0**
Nature Reserve	**0**	**0**	**0**
RAMSAR	**0**	**0**	**0**
SAC	**0**	**0**	**0**
Sites of Local Nature Conservation Importance	**0**	**0**	**0**
SPA	**0**	**0**	**0**
RSPB Reserve	**0**	**0**	**0**
UWT Nature Reserve	**0**	**0**	**0**
Built Heritage sites (Nr)	**5**	**5**	**8**
National Trust	**0**	**0**	**0**
Listed Buildings	**5**	**5**	**8**
Sites and Monuments Records	**0**	**0**	**0**
Buildings of Special Architectural or Historical Interest	**0**	**0**	**0**
Areas of Significant Archaeological Interest	**0**	**0**	**0**
Historic Gardens	**0**	**0**	**0**

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Jointure Bay Stream

The Jointure Bay Stream is a minor watercourse which arises at the base of Knockagh Hill and flows in a south easterly direction for a distance of around 2km to its tidal outfall to Belfast Lough at Jointure Bay, Greenisland. The lower 1.2km of the watercourse is designated from its crossing of the Belfast/Larne railway line downstream to the sea outfall. The lower 600m of the designated section of the watercourse is culverted with 1200mm diameter concrete pipes which have been assessed to be in a satisfactory condition. Upstream of the railway line the Jointure Bay Stream is undesignated and flows within an open channel alongside the Downshire Road. A culverted tributary, the Downshire Gardens Stream which flows through the Downview development connects to the head of the undesignated open section of the Jointure Bay Stream. The final two sections of the Downshire Gardens Stream culvert, which link to the Jointure Bay Stream, are undesignated and their condition is unknown.

The developed areas that are prone flooding within the Jointure Bay Stream, together with a description of the flooding mechanisms are as follows.

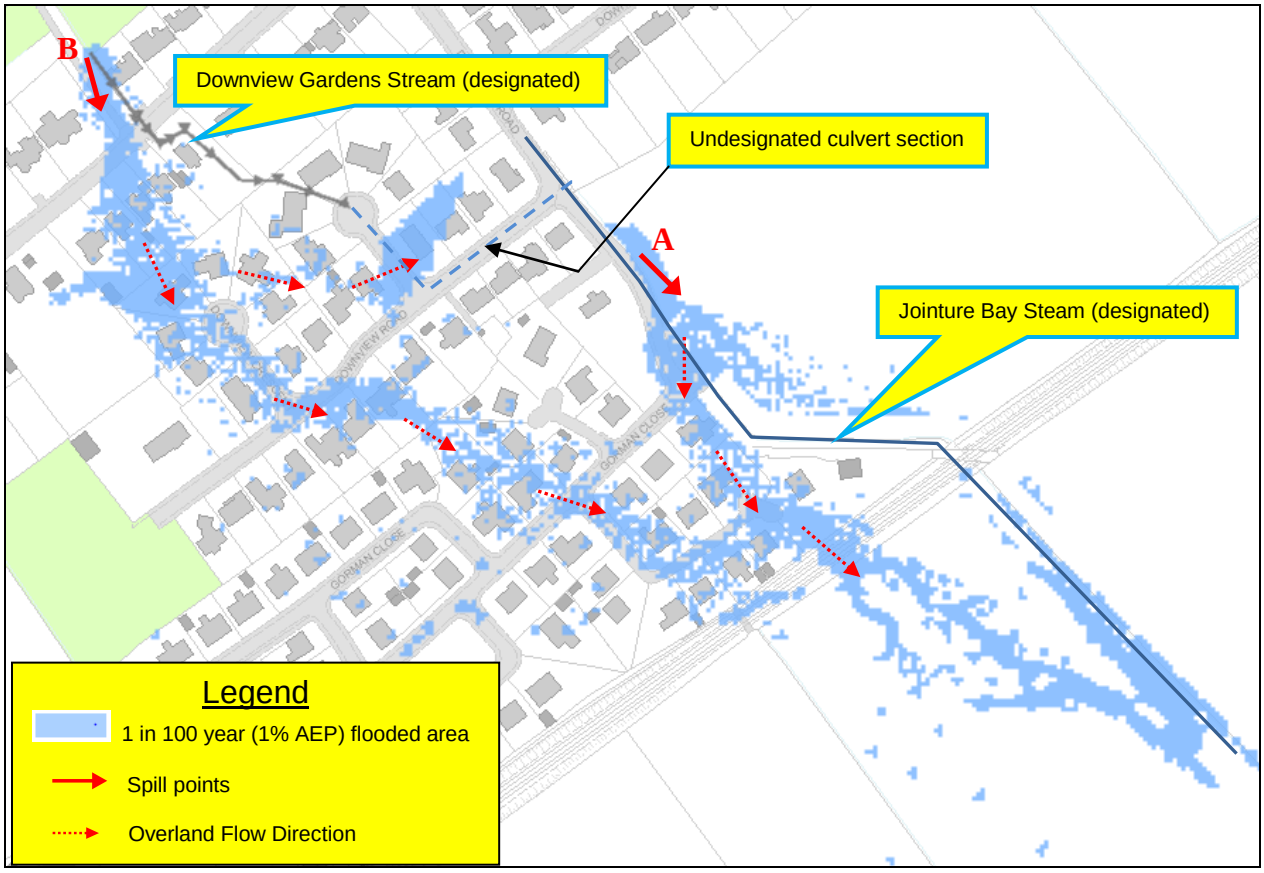

Figure 5.10.4.7 - Newtownabbey SFRA –Jointure Bay Stream & Downshire Gardens Stream Fluvial inundation area (1% AEP)

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The model predicts that flooding within the Downview housing development from the Jointure Bay Stream and Downshire Gardens Stream begins to occur at the very frequent 20% AEP (1 in 5 year) event. Although in this scenario it is unlikely to adversely affect any more than 3 properties. Flooding occurs from two specific locations identified as 'A' and 'B' on the Figure 5.10.4.7. At 'A' floodwater overspills the banks of an open section of the Jointure Stream which runs along the east side of the Downshire Road carriageway and flows overland via the carriageway to inundate properties at Gorman Close. At 'B' floodwater is predicted to overspill the banks of the Downview Gardens Stream at the inlet to a culvert located to the rear of 196 Upper Greenisland Road. The floodwater flows across the surface through the Downshire estate to join with overland flows from the Jointure Bay Stream behind the railway embankment at Gorman Close. It is estimated that at the 1 in 100 year event, flooding from these watercourses may adversely affect up to 57 homes and 4 non-residential properties. There have been numerous phone calls to the flood emergency helpline from the owners of homes in the Downshire housing development. These span the period 1986 to 2006 and relate to a number of homes that are clustered around Downshire Gardens Stream which may indicate that there is a capacity problem with the section of undesignated watercourse which links the Downshire Gardens Stream to the Jointure Bay Stream. The cost of the predicted property damages of future floods is estimated to have a present day value of around £793k.

Table 5.10.4.4 Newtownabbey SFRA – Jointure Bay Stream			
Potential Adverse Consequences – Fluvial Flooding			
	Flood Event % AEP		
	10% AEP	**4% AEP**	**1% AEP**
Residential (Nr)	**6**	**33**	**57**
Non Residential (Nr)	**0**	**0**	**4**
Economic Damage (£)	**£33,585**	**£46,527**	**£68,429**
Annual Average Damage (£)	**£26,429**		
Present Value (£)	**£793k**		
IPPC sites (Nr)	**0**	**0**	**0**
Community Assets (Nr)	**0**	**0**	**1**
Care Homes	**0**	**0**	**0**
GP Surgery's	**0**	**0**	**0**
Fire stations	**0**	**0**	**0**
Hospitals	**0**	**0**	**0**
Police Stations	**0**	**0**	**0**
Schools	**0**	**0**	**0**
Key Infrastructure (Nr)	**0**	**1**	**1**
NIW Wastewater Treatment Works	**0**	**0**	**0**
NIW Sewage Pumping Stations	**0**	**0**	**0**
NIW Water Treatment Work	**0**	**0**	**0**
NIW Treated Water Pumping Stations	**0**	**0**	**0**
NIE Substation 6to11kV	**0**	**1**	**1**
NIE Substation 33kV	**0**	**0**	**0**
NIE Substation 275kV	**0**	**0**	**0**
NIE Substation 110kV	**0**	**0**	**0**
Road Service - Trunk Road	**0**	**0**	**0**
Environmental Designated sites (Nr)	**3**	**3**	**3**
AONB	**0**	**0**	**0**
ASSI	**0**	**0**	**0**
Environmentally Sensitive Areas	**1**	**1**	**1**
Maritime Nature Reserve	**0**	**0**	**0**
Nature Reserve	**0**	**0**	**0**
RAMSAR	**1**	**1**	**1**
SAC	**0**	**0**	**0**
Sites of Local Nature Conservation Importance	**0**	**0**	**0**
SPA	**1**	**1**	**1**
RSPB Reserve	**0**	**0**	**0**
UWT Nature Reserve	**0**	**0**	**0**
Built Heritage sites (Nr)	**0**	**0**	**0**
National Trust	**0**	**0**	**0**
Listed Buildings	**0**	**0**	**0**
Sites and Monuments Records	**0**	**0**	**0**
Buildings of Special Architectural or Historical Interest	**0**	**0**	**0**
Areas of Significant Archaeological Interest	**0**	**0**	**0**
Historic Gardens	**0**	**0**	**0**

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5.10.5 Proposed Fluvial Flood Mitigation Measures

Prevention

As well as managing the existing flood risk to people and properties in Newtownabbey it is important that the flood risk is not increased by new development in areas of known flood risk. Northern Ireland's planning policies adopt a precautionary approach to development that aim to prevent future development that may be at risk of flooding or that may increase the risk of flooding elsewhere.

Reference should be made to Section 4.4 under the headings Planning NI and Local Government regarding the reform and restructuring of the planning system in Northern Ireland. Rivers Agency's Planning Advisory Unit provides advice to Planning NI and Local Councils in relation to the prevention of flooding. In particular Local Councils are advised on Development Plans and at the Planning Application stage. Flood mapping information is used to inform the local Development Plans to ensure, where possible, that new zonings are located outside the identified flood risk areas. In the determination of planning applications any proposed development within a flood risk area will either be advised against or will be further considered if it meets one of the "Exception" rules and is accompanied by a suitable Flood Risk/Drainage Assessment. Applications that relate to "Greenfield" built development in fluvial floodplains are unlikely to be accepted, whereas applications for recreation purposes and amenity open space will usually be accepted.

Development Plans

In the preparation of new Development Plans for Newtownabbey, Rivers Agency will advise against bringing forward sites or the zoning of any land, particularly for built development, that has been identified from the flood maps as being within the 1 in 100 year fluvial floodplain/1 in 200 year coastal floodplain/reservoir inundation area or is susceptible elsewhere to surface water flooding.

Rivers Agency will also review the existing Development Plan for Newtownabbey (Belfast Metropolitan Area Plan, 2015) with a view to addressing flood risk issues which have only recently been identified as a result of the new flood maps.

The main (undeveloped) flooded areas, amongst others, within the Newtownabbey Significant Flood Risk Area are:-

Three Mile Water

- A number of areas immediately upstream of the Monkstown Road.
- A number of areas downstream of the Monkstown Road as far as the railway line crossing.

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Planning Applications

Fluvial/Coastal Areas at risk

We shall advise against the development of all sites that are located within the 1 in 100 year fluvial floodplain/1 in 200 year coastal floodplain, irrespective of whether they are located within a current Development Plan or as a single site application outside the plan area.

For those sites within the 1 in 100 year fluvial floodplain/1 in 200 year coastal floodplain where the principle of development has been accepted by Local Council as meeting the 'Exception Test', Rivers Agency will further consider the application through the appraisal of an accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures.

The main existing developed areas, amongst others, at flood risk within Newtownabbey were re-development may be likely to take place are:

Fluvial

Concrete Road Stream

- Areas along Monkstown Avenue and downstream to the railway track crossing.

Lisbane Stream

- Areas in Twinburn upstream of confluence with the Three Mile Water.

Lismore Drain

- Areas at Lismore Meadows upstream of confluence with Three Mile Water.

Greenisland Stream

- Areas along the Station Road.

Coastal

- Along the Shore Road at the outlets of the Concrete Road Stream and the Three Mile Water.

Areas at Risk of Surface Water flooding

For those sites outside the 1 in 100 year fluvial floodplain/1 in 200 year coastal floodplain that are located in an area where there is evidence of a history of surface water flooding (identified by flood hardship payments), Rivers Agency will further consider the application through the appraisal of the accompanying Drainage Assessment that will need to demonstrate suitable flood mitigation measures.

Where there is potential for surface water flooding predicted by the Surface Water Map (areas highlighted purple) Rivers Agency will advise that the applicant should assess the flood risk and drainage impact to the site and construct in an appropriate manner.

The main areas with a flood history, identified in the Newtownabbey SFRA as being at risk from surface water are at:

- Hollybank Drive off Devenish Drive.
- Ballyfore Park off the Fairview Road.
- Neills Lane off the Shore Road.
- Greenisland Terrace on the Upper Station Road above the railway Line.

Area's at Risk of Flood Inundation from Reservoirs

For all development proposals that are located within the potential flood inundation area of a Controlled Reservoir we will further consider the application through the appraisal of the accompanying Flood Risk Assessment that will need to demonstrate suitable flood mitigation measures. If it is a new development proposal we will also need the applicant to demonstrate that the condition, management and maintenance regime of the reservoir is appropriate to provide sufficient assurance regarding reservoir safety.

Controlled Reservoirs identified in the Carrickfergus area are as follows: **Mossley Mill**

Protection

Structural measures are still one of the main options in providing flood protection to people and property impacted by the effects of extensive flooding. It is therefore important that we continue to target investment by providing flood defences, culvert alleviation schemes and infrastructure upgrade works to those communities at greatest need.

The alleviation of surface water flooding, in particular, will require input from a number of bodies. The Flood Investment and Planning Group, FIPG, provides a coordinated approach across Government in relation to the investigation of flooding, agreeing responsibilities and identifying collaborative solutions. The group is represented by Rivers Agency, NI Water and Transport NI, amongst others, with flood risk management responsibilities.

There are a number of stages to follow when procuring a flood alleviation scheme. The potential scheme needs to be first subjected to a feasibility study that will also include an economic appraisal. From the detailed Hazard and Risk Maps a Flood Risk Metric Tool' (FRISM) is used in urbanised flooded areas to get an estimate of the likely property damages as a result of a range of flood events. The estimated cost of a scheme is then compared to the total 'damage avoidance benefits' that the scheme will provide to property over the scheme's design life. If the benefit/cost ratio is greater than 1, then the potential scheme will be referred to Rivers Agency's Capital Procurement Unit for a feasibility study to be undertaken.

If the flooding issue identified is not solely Rivers Agency's responsibility, or is the responsibility of NI Water or Transport NI such as a local drainage or road infrastructure issue, then it will be referred either to FIPG or directly to the responsible body, for their further consideration.

If a cost benefit analysis identifies a viable scheme, it will be placed on a prioritisation list and progressed alongside other competing schemes. The position on the list will depend on a set marking criteria, such as the benefit/ cost ratio and the overall scheme costs. Depending on the availability of resources it may take anything from between 2 – 5 years for the scheme to progress from the start of the feasibility study to construction works commencing on the ground.

Having conducted a detailed assessment of the fluvial flood risk to Newtownabbey, Rivers Agency has determined that potential flood alleviation schemes may be justified for the Concrete Row Stream, Greenisland Stream, Jointure Bay Stream and to a lesser extent the Three Mile Water and its tributaries.

Concrete Row Stream

A feasibility study for the Concrete Row Stream was completed in December 2014 and this identified that a flood alleviation scheme may be cost beneficial. The detailed design for the proposed flood alleviation scheme has commenced and shall be completed in 2016. Initial estimates are that this culvert improvement scheme will cost around £1 million and the works are programmed for the 2018/19 financial year, subject to available funding.

Greenisland Stream

Rivers Agency is currently undertaking a feasibility study for the Greenisland Stream which is programmed for completion in 2016. If this feasibility study identifies that a potential flood alleviation scheme is likely to be economically viable Rivers Agency may, subject to resources and pressures from other potential schemes, commence the detailed design in 2017/18 with the aim to complete works within the term of this FRMP (i.e. by 2021).

Jointure Bay Stream

Flooding to property in the Downshire housing development from the Jointure Bay Stream (and its tributary, the Downshire Gardens Stream) is considered to be significant and a flood alleviation scheme to mitigate the risk may be economically viable. Rivers Agency will produce a pre-feasibility report for the Jointure Bay Stream for inclusion within its prioritised Flood Study Programme by summer 2016.

Three Mile Water (and tributaries)

The flood model for the main Three Mile Water channel predicts that there are no properties located within the 1 in 100 year flood plain of the main channel, although there is estimated relatively small numbers of properties (around 50) at risk at various locations due to flooding two of its tributaries, the Brookmount Stream and Twinburn Stream. Flooding at these locations is supported by historical evidence. As the Net Present Value of potential future flood damages is predicted to be quite low, around 54k, there is presently no clear justification for a publicly funded flood alleviation scheme. However, there is a concern that flooding to the Whiteabbey Village in 2002 may be related to overland flows which arose from overtopping of the watercourse's left bank at an acute bend near the Whiteabbey Presbyterian Church. An added concern is

that since 2002 the Glenavna Manor housing development has been built adjacent to the rivers edge at the location of this suspected breach point and this new development, together with the properties that flooded previously could flood in the future if a similar event was to reoccur. The model predicts that at the 1 in 100 year flood event, the level of the river rises to within 60mm of the top of the bank adjacent to Glenavna Manor. Given this lack of freeboard, there is reasonable cause to be concerned that flooding at this location may occur again. Consequently, Rivers Agency has undertaken a feasibility study to examine this potential problem in greater detail and this will be completed in 2017. If the feasibility study identifies that a potential flood alleviation scheme is likely to be economically viable, Rivers Agency may, subject to resources and pressures from other potential schemes, commence the detailed design in 2018/19 with the aim to complete works within the term of this FRMP (i.e. by 2021)

Preparedness

In Newtownabbey it is not possible to prevent or protect against all flooding. Indeed even where flood defences exist it is possible in an extreme event that these could be over topped and flooding could still occur.

Having recognised this fact, considerable effort in recent years has been made by emergency planners in a Government Departments, Councils and the Emergency Services working together and sharing information to ensure a coordinated response.

However, despite these improvements, during significant flood events the emergency response of Government Departments and the Emergency Services can become over stretched. This means that not all calls for assistance during a flood event may be responded to in a timely manner. With this in mind it is important that households and communities, subject to a known flood risk, are prepared. The detail of preparedness actions, including flood warning and informing activities planned from a regional perspective, are provided in Appendix E.

This is not Government withdrawing from any undertaking to respond in emergencies but an additional layer of support to ensure Government Departments and the public work together to reduce the overall impacts of flooding.

From the flood risk assessment there at least 6 areas within the Newtownabbey SFRA that have flooded in the recent past that may benefit from the flood warning and informing proposals, outlined in Appendix D.

A pilot project of community engagement to deliver flood warning and informing, held in 2014, identified basic assessment formulae to assess and score areas that could potentially be a focus for flood warning and informing actions. Based on this scoring these areas did not score high enough to be placed within the top 20 communities to be offered a programme of community engagement during the period of this plan. However, if communities want to become more resilient, the Department is committed to providing assistance were possible to develop the consistent approach to resilience. The NI Direct website www.nidirect.gov.uk/ will host further information and advice on what to do in advance of flooding,

what to do during flooding and how to recover after flooding. The website will also contain templates for communities wishing to develop their own plan.

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6. Implementation

This section details how the measures to manage flood risk for each Significant Flood Risk Area (SFRA) will be implemented. It also explains how they will influence future actions and highlights the benefits of their implementation.

The measures (Prevention, Protection and Preparedness) are identified for each SFRA in Sections 5 of this document.

The detail on specific protection measures, that is, the appraisal and development of flood alleviation schemes, including natural flood risk management options if feasible, will be developed throughout the cycle of these FRMPs.

6.1 Prevention

6.1.1 Prevention – Implementation

The Prevention measure will be implemented through Rivers Agency's Planning and Advisory Unit providing advice to Planning NI and Local Councils in relation to the prevention of flooding. In particular, Local Councils are advised at the Development Planning and Planning Application stages of the planning process, concerning proposed development in floodplains that it considers to be inappropriate.

The role of Rivers Agency's Planning Advisory Unit (PAU) will be key in implementing this measure.

The detail of the approaches that underpin *Prevention* are expanded upon in the text for each SFRA in Section 5. The implementation of this measure will continue throughout the cycle of these FRMPs.

6.1.2 Prevention – Drivers for future actions

The implementation of this measure will drive the following:-

- The need to review, as necessary, Planning Policies in relation to flood risk.
- The need to have up to date flood risk and hazard mapping.
- The need to further engage with critical infrastructure providers on the appropriate location and resilience of their installations.
- The need to link development emergency response plans, compiled as part of a flood risk assessment, with broader community emergency plans taken forward in implementing the preparedness measure.

6.1.3 Prevention – Key Benefits of Implementation

In Northern Ireland the application of a robust planning policy in relation to land use planning, has already been beneficial in ensuring that the overall numbers of properties and critical infrastructure at risk of flooding do not increase and that any re-development is built with suitable flood resistance/resilience measures.

In Northern Ireland, the number of properties at risk of flooding is around 1 in 18, compared to 1 in 6 in England.

The critical factor in keeping this figure so low in Northern Ireland has been the strict application of a sustainable land-use policy (particularly PPS15). It is vital, therefore, that planning policy relating to flood risk is strictly adhered to throughout the duration of these FRMPs and beyond.

6.2 Protection

6.2.1 Protection - Implementation

Protection measures will be implemented by the completion of already identified and programmed flood alleviation schemes, infrastructure upgrading works and routine maintenance activities, as well as carrying out studies to identify further works to be taken forward.

This will involve Transport NI, NI Water and Rivers Agency both individually and, where necessary, collectively, working together particularly through the auspices of the Flood Investment and Planning Group (FIPG). At an early stage in this first Plan cycle, these organisations will be moving together into a new department which should benefit the implementation process.

The detailed analysis of each of the SFRAs identifies, as appropriate, the need for further studies to determine approaches in implementing protection measures. In some locations this will build upon the investment in flood alleviation schemes already made in these areas.

These FRMPs do not deal with the detail of individual schemes or definite scheme proposals, as this is not possible for all the SFRAs at this stage. The focus, in the first instance, is on assessing the potential benefit, in terms of damage avoided, for each of the SFRAs.

This strategic approach, at this stage, is reasonable as the FRMPs are intended to consider a proactive approach to protection measures, as opposed to a post flood event reactive approach. It also allows for a broader approach in the development of flood protection infrastructure, in terms of funding, partners and the implementation of natural flood risk management techniques.

A Homeowner Flood Protection Grant Scheme, will be introduced in early 2016 This will improve the ability of householders and communities to enhance their property's resistence to flooding through the provision of individual property protection measures.

Details of flood protection measures for any of the SFRAs already underway, or at an advance stage of development will be presented at Local Flood Forum meetings in 2016.

6.2.1 Protection – Drivers for future actions

The implementation of this measure will drive the following:-

- The need for continued inspection and maintenance of drainage and flood protection infrastructure including designated watercourses, culverts, sewerage systems and road drainage systems.

- A proactive, strategic approach, in the development of flood protection measures and work programmes.

- The development of Natural Flood Risk Management techniques in co-operation with partner organisations and the necessary underpinning policies to allow for a wider range of options to be used in developing flood protection measures.

- Greater integration with all flood protection, drainage and watercourse infrastructure providers in developing joint schemes with multiple benefits.

- The opportunity to review investment and financing options from a wider catchment based perspective.

6.2.1 Protection – Key Benefits of Implementation

The key benefits in providing and maintaining flood protection and drainage infrastructure over the duration of these FRMPs is:

- The avoidance of risk to life and damage to property and infrastructure, which would otherwise be unprotected from flood risk.
- Opportunities for 'joined up' working with other infrastructure providers in terms of scheme development and investment efficiency.
- Opportunities to look at flood risk from a catchment-wide perspective with other water resource interested organisations and explore 'multiple benefits' that could be realised.

Other benefits include improved quality of life for those currently anxious about their property's vulnerability to flooding. Less pressure on emergency response resources, in protected areas, will mean improved efficiency in responding to those still exposed to a greater level of flood risk.

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6.3 Preparedness

6.3.1 Preparedness – Implementation

Preparedness measures will be implemented by a range of approaches. These include continuing to work together with co-responders, voluntary sector groups and communities to ensure a co-ordinated and timely emergency response when flooding occurs. The role of Local Government Emergency Planning Co-ordination Officers (EPCOs) is essential in implementing this element of preparedness activities. In addition, lessons learnt from post flood event debrief reports will inform improvements for the future.

Emergency planning exercises will, as resources permit, be held to add clarity to roles and responsibilities and share knowledge.

Flood Warning and Informing activities will also be key to ensuring responders and the public are able to put the necessary preparations in place in the event of flooding. The activities include development of the Community Resilience programme along with installation of new text alert stations to better inform communities at risk.

Enhancement of the 'Flooding Incident Line' will also take place. This will not only improve the reporting of flooding by the public but also communication between co-responders and better information during flooding events.

6.3.2 Preparedness – Drivers for future actions

The implementation of this measure will drive the following:-

- The need for further emergency planning exercises.
- A review of 'Flood Warning and Informing' activities to inform further development in this area.
- Development of the Flooding Incident Line to improve this service for the public and provide real time data to co-responders during a flooding event.

6.3.3 Preparedness – Key Benefits of Implementation

The key benefits in implementing the preparedness measures in this Plan are:-

- Improved emergency response from 'Government' during a flooding event.
- Better integration with co-responders in relation to information sharing before and during a flooding event.
- Communities at known risk more resilient in dealing with flooding.
- Improved communications in relation to reporting a flooding event.

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7. Overview of Measures and Costs of Implementation

7.1 Regional Measures – An Overview

7.1.1 Regional Measure 1 - Rivers Agency Drainage and Flood Defence Infrastructure Management

There are approximately 15,500 properties protected from flooding by above and below ground flood defence and drainage infrastructure which is inspected and maintained by the Department. Properties protected include homes, businesses, key networks of national infrastructure and many important historic buildings.

The Department adopts a sustainable approach to managing the risk of flooding by inspecting and maintaining its flood defence and drainage infrastructure. It also provides new infrastructure to reduce flood risk.

The Department's appraisal of drainage and flood defence infrastructure performance is based on routine visual assessments of infrastructure condition, risk assessments and risk analysis, supported by in-built asset redundancy (e.g. surcharge, free-board, etc). Change in performance can occur due to factors such as structural deterioration over time, physical damage, climatic change, increased development, poor maintenance, lack of resource/funding allocation etc. Thus there are many reasons to periodically undertake performance appraisals.

As an integral part of the management of its infrastructure, the Department considers six core priorities when establishing annual programmes for maintenance and capital expenditure: -

- Fulfil statutory responsibilities;
- Maintain infrastructure networks in a safe and satisfactory condition;
- Have full regard for safety, health and welfare of the public and employees;
- Support economic growth by reducing the risks of flooding;
- Provide the optimum standard of service to customers;
- Comply with the principles of sustainable development.

Achievement of the above priorities is considered when ranking programmes of maintenance works and individual schemes. Furthermore, maintenance and capital programmes are evaluated by taking account of environmental obligations, contractual commitments and cost-benefit criteria prior to inclusion in the annual works programme.

The Department delivers an annual infrastructure maintenance and capital programme aligned to the Department's objectives, annual budget allocations and infrastructure performance targets. In order to

maximise the use of available fiunding, it is necessary to prioritise investment on those elements of the network that provide the greatest drainage and flood risk benefit for the lowest whole-life cost.

7.1.2 Regional Measure 2 - Rivers Agency Watercourse Inspection and Maintenance

DARD Rivers Agency is responsible, on a permissive basis, for the maintenance of designated watercourses in Northern Ireland. This is necessary to alleviate flooding and to assist land drainage. In open watercourses, this work includes clearance of silt and gravel deposits in an environmentally acceptable manner; these build up naturally in river channels and can restrict the flow of water. Debris such as fallen trees, which can lead to blockages in watercourse channels, at bridges or at other channel constrictions, is also removed.

In the urban areas of towns and cities, watercourses may be culverted below ground and there is a substantial network of watercourse culverts in Northern Ireland. A comprehensive inspection and survey programme to assess their structural condition is undertaken on a cyclical basis. The Agency carries out maintenance work along the lengths of these culverts and at their inlets where metal screens, known as grilles, are often located to prevent debris entering and causing blockage which may result in flooding. Grilles are regularly inspected and debris is removed as necessary.

The Department adopts a standardised inspection and maintenance rolling programme to define standards, inspection frequencies and priorities depending on flood risk, land use drainage requirements and watercourse characteristics. Systematic inspection systems provide an objective approach to the need for, and quantification of, maintenance and form a defensible basis for the maintenance programmes. The Department's Maintenance Manual and Policy & Guidance documents provide a framework for the maintenance of Designated Watercourses. All such works are subject to the availability of resources.

Inspections and/or maintenance can be undertaken by Departmental staff or by contract depending on the particular circumstances. Rivers Agency's maintenance programme is published annually and is scrutinised by a variety of bodies with diverse interests.

Culvert inspection is undertaken to determine any obvious structural or serviceability defects that may result in increased flood risk. Inspection and repair of culverts is co-ordinated between operational and Headquarters staff to ensure efficiency and accuracy of records. Culvert inspections take the form of manhole inspections to check for standing water and obvious defects, walkthrough inspections in suitable systems using an underground team of trained personnel or, through surveying by CCTV camera.

Inspection Frequency

Watercourses can flow over considerable distances and have changing characteristics as they move from source to the sea. Due to differing channel characteristics, flood risk and drainage considerations, it is usually unnecessary to maintain the entire length of a watercourse under the same frequency of inspection.

Therefore, watercourses may be divided into defined “reaches”, to be inspected in different years and at different frequencies if required.

Minimum inspection frequencies for open watercourses: -

Rural Areas - In general, an inspection frequency of 6 years is adequate although this may be extended to up to 10 years.

Urban Areas - In general, an annual inspection is undertaken.

Maintenance

Each year the Department carries out routine maintenance work on designated main, minor and urban watercourses. Watercourse maintenance is mainly required to reduce flood risk and to maintain the agricultural production potential of land. Minor works of repair and refurbishment to ancillary structures and installations are also carried out.

Consideration is given to whether any obstructions to flow or reduction in channel dimensions will have a significant impact on drainage and flood defence standards. Land use in the vicinity of a watercourse is taken into account when considering the degree of maintenance required and the methods to be employed. Where works have been identified that may impact on areas with environmental designations or other environmental features, careful consideration is given to the extent and methods used in consultation with the Department’s Environmental staff.

Urban watercourses may require more frequent maintenance. These are generally defined as being within current urban development limits and/or where flooding, if it occurs, is likely to significantly affect built property or major infrastructure. Ad-hoc inspection and maintenance may be undertaken in advance of a storm, in response to complaints, interference by third parties, flooding incidents etc.

7.1.3 Regional Measure 3 - Rivers Agency Planning Advice

Rivers Agency’s Planning Advisory Unit (PAU) plays a key role under the heading of ‘Prevention’ in providing advice to Planning NI and local Councils on all drainage and flood related matters in regard to proposed development. In particular, local Councils are advised on the Development Plans and Planning Application stages. The recent transfer of planning functions from Planning NI to the 11 new Councils in April 2015 has resulted in significant changes for the parties involved in Planning.

Planning Advisory Unit’s responsibilities are as follows:

- Providing expert engineering advice to Planning NI and Councils on proposed Area Development Plans and on individual Planning Applications and providing written representation and attendance at Public Examinations / Planning Appeals when required to do so;
- Providing advice to Planning NI and Councils on Environmental Impact Assessments and Statements relating to developments;

- Minimising flood risk to people, property and the environment through adherence and application of Planning policy relating to Flood Risk;
- Appraising Flood Risk Assessments and Drainage Assessments submitted by developers and their agents in accordance with the requirements of Planning policy;
- Providing internal advice to Rivers Agency staff on complex development issues and strategic infrastructure projects.

7.1.4 Regional Measure 4 - Rivers Agency Capital Works Programme in all areas including the 20 SFRAs

The Department is responsible in the Province for the maintenance of river drainage infrastructure and the execution of works to protect people and property against flooding from watercourses where need has been identified and where intervention can be justified on economic grounds. This is for all areas and not just within the 20 SFRAs. A formal and robust procedure for prioritising works schemes is necessary to ensure the Department addresses the areas of greatest need and facilitates proper management of limited budgets. This procedure also fulfills the requirement for accountability by the Department and reassures the Accounting Officer concerning the expedient use of public funds.

7.1.4.1 Prioritisation - General Principles

The need to carry out Capital Works is identified on a proactive basis, through the Flood Risk Management Plans (FRMPs) which identify Significant Flood Risk Areas (SFRAs) where there is potential for future flooding and, on a reactive basis, where there is a history of previous flooding or where Asset Management Plans (AMPs) identify assets that are in poor condition and need replacing or upgrading.

The Department's Capital Works Programme addresses these needs through the delivery of three main types of works:-

- River Flood Protection
- Coastal Flood Protection
- Repair / Replacement (Urban Culverts)

Each scheme is assessed against the following four criteria which are relevant in the decision making process and enable comparisons to be made on a consistent basis. The criteria listed in order of importance are:

- Degree of protection / Risk of failure
- Economics
- Special Consideration
- Financial Control

A score is assigned to each scheme for each criterion. The criteria are then weighted and scored to determine the final priority score of each individual scheme.

Assessment of Scheme Priority is carried out at an early stage in the life of a potential scheme, once the need for a scheme has been identified. As better information becomes available about the scheme, its priority may be reassessed; this may be undertaken, for example, during completion of the scheme feasibility study or scheme design. Priority may also be reassessed as a result of further flooding or as a result of other changes which may occur which impact on the scheme.

7.1.4.2 Programme Information on the Internet

The Department publishes information on its larger flood risk management projects on the Investment Strategy for Northern Ireland's (ISNI's) website http://isni.gov.uk/ in the form of an 'Investment Activity Report'.

The Department posts information on:

- Construction Projects of value greater than £0.5m and,
- Services Projects e.g. Consultant Feasibility Studies or Reports, of value greater than £100k.

A current list of these flood risk management projects is available on an ISNI Project Report page via the following web-link:-

http://isni.gov.uk/projects_rslt.aspx?p=135

Anyone accessing this Project Report can click on each project to access more detailed information.

Anyone requiring information about flood risk management projects, whether mentioned on the ISNI website or not, they should contact the Department via the contact details included within these FRMP documents.

7.1.5 Regional Measure 5 - DRD Transport NI - Road Drainage

Transport NI is the sole Roads Authority in Northern Ireland. It has responsibility for over 25,000 km of public roads, together with 9,000 km of footpaths and a substantial number of bridges, street lights and public car parks.

Along with DARD Rivers Agency and NI Water, DRD Transport NI is one of the 3 government drainage asset owners in Northern Ireland. Transport NI operates a network of road drainage systems essentially to provide effective drainage of surface water from road carriageways.

Transport NI deals with the impacts of roads-related flooding. They maintain road drainage systems, organise road closures and traffic diversions, clear blockages during flooding and remove debris once flooding has receded. They will also take action to protect property that may be affected by road flooding.

Transport NI applies Sustainable Drainage Systems (SuDS) solutions, where appropriate, in their major road schemes.

Transport NI does not have a capital budget specifically allocated to flooding but in order to prevent as far as possible the occurrence of standing water or flooding of roadways, drainage systems are maintained as and

when required. Gullies in urban and rural areas are cleaned by Transport NI on a programmed basis, generally twice per year in urban situations and once per year in rural areas, and if necessary in an emergency.

In relation to major capital road improvements, an element of the work undertaken will include improved drainage; however, the associated costs attributable to any reduction in flooding are not readily identifiable. To improve drainage, capital funding is allocated through the structural maintenance budget. In 2015-16 year, £3.5m was allocated. The purpose of the allocation is for roads purposes only and it is not utilised for other local drainage or flood alleviation purposes.

Future budget allocations for structural maintenance are not known at this time. Therefore, for the purposes of the FRMP it is assumed that the element of Transport NI's budget which contributes to reduced flooding may be smaller and consequently an annual expenditure of £1m is included against Transport NI in the assessment of Costs for the Plans.

This work and its associated expenditure is considered to be spread throughout the Region and is therefore not specific to Significant Flood Risk Areas or Areas for further Study.

7.1.6 Regional Measure 6 - DRD Water Policy Division– Living with Water Programme

DRD Water Policy considers that significant capital investment is necessary in Belfast's drainage infrastructure to address the following issues:

- Increasing instances of serious flooding;
- Pollution risks: In 2014 the EU Water Framework Directive (WFD) water quality classification of the Belfast Harbour was classified as 'bad', and the inner part of Belfast Lough classified as 'moderate' status. NIEA assessed that this was due to continued diffused and point source pollution, such as from combined sewer overflows and WwTW discharges;
- Wasterwater Treatment Works working above capacity: The main Wastewater Treatment Works serving Belfast (Belfast WwTW at Duncrue) has to operate well above its theoretical design capacity, receiving more sewage than it was designed to treat.

In response to this requirement, in July 2014, the NI Executive agreed that the Department for Regional Development (DRD) should set up an interdepartmental group to develop a 'Strategic Drainage Infrastructure Programme' to determine the capital investment necessary to protect against flood risk (excluding flooding from the sea), enhance the environment and support economic growth.

To facilitate the development of this Programme, DRD has established the 'Living With Water Programme' (LWWP), the Board of which includes representatives from DRD, NI Water, Rivers Agency, TransportNI, Belfast City Council, DOE, NIEA, DFP and the Strategic Investment Board. In order to take a holistic, integrated approach to planning future drainage provision in 2015 the LWWP initiated 15 inter-linked work

packages. The focus of these work packages is to develop the detailed capital investment plan which will, when implemented, achieve the objectives at reduced cost and disruption, whilst also securing the necessary community and stakeholder support.

The main outputs of the Belfast Strategic Infrastructure Programme are expected to be:

a) Private drainage infrastructure – ownership defined, brought up to standard
b) Storm separation - progressed across areas of Belfast
c) Sewers - capacity increased and maintained
d) Watercourses – capacity increased if necessary, maintained, amenity value increased
e) Drainage infrastructure - designed for exceedance
f) Combined Storm Overflows – some closed, others improved
g) Sewage pumping stations - upgraded or replaced
h) Increased storm storage within the sewerage network and WwTW
I) Belfast WwTW upgraded (increased capacity & new discharge standard)

Other activity will include:

- Catchment management measures to reduce diffused pollution
- Increased used of sustainable drainage systems (SuDS)

The LWWP will also drive close working between a number of organisations which are to become part of the new Department for Infrastructure from May 2016. As such, it will be at the forefront of establishing new ways of integrated working to deliver improved services and essential infrastructure across Northern Ireland.

In late 2015 the development of the Programme is being funded through existing resources from the members of the Programme Board. Early estimates for the project delivery stage range from £350m to £750m for Belfast alone, and the various elements of the Programme need to be fully costed. It is envisaged that construction works will commence in 2020 and be completed in 2026. The projected capital expenditure in 2020/21 is £11m.

In relation to the flooding elements of the LWWP, it is projected that these will comprise around 25% of the associated costs. This will include a cost overhead for staff time and consultancy expertise in developing the Programme, generating feasibility studies and design & supervision of capital works.

From the information above, within the period of the Flood Risk Management Plans, the LWWP will be scheduled to commence in the final year of this cycle, so within this Plan period, £11m is projected to be spent of which approx £3m will be on flood alleviation. The main elements of the LWWP will be undertaken during the 2nd FRMP cycle, from 2021-2026 which could entail expenditure on flood alleviation of the order of £90m- £190m. An amount of £1m per annum has been included for fees associated with the development of flood alleviation proposals.

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7.1.7 Regional Measure 7 - Northern Ireland Water – Proposed schemes to alleviate flooding

Northern Ireland Water (NIW) is responsible for the provision of 625 million litres of clean water a day for almost 1.7 million people as well as the treatment of 134 million m^3 of wastewater every year. It is responsible for the following drainage assets:-

- 26,500 km of water-mains;
- 14,500 km of sewerage mains;
- 47 water treatment works and
- 918 wastewater treatment works.

During the 6 year period of the Flood Risk Management Plans, from 2015 – 21, NIW plans to undertake works to alleviate flooding related to their infrastructure, through the following three programme elements in their PC15 business plan:

DG5 (Internal Flooding) Work Programme – these schemes are undertaken to directly address out-of-sewer internal flooding at specific properties;

Stormwater Separation – these schemes aim to keep rainwater out of NI Water's sewers and enhance sewer network capacity by disconnecting impermeable areas and thereby alleviating flooding across the Province. NI Water has a target of removing 190,000m^2 of impermeable surface by the end of the PC15 funding period (i.e. by 2020/21).

SCAMP - Sustainable Catchment Area Management Planning Northern Ireland (SCaMP NI) was initiated in 2013 and aims to improve the quality and reliability of the raw water received at NI Water's raw water abstraction points. The SCaMP improvements are to be achieved through sustainable catchment based solutions that focus on protecting the natural environment delivering favourable condition and habitat improvements and there can also be beneficial effects for downstream water flows (and flooding) as the project includes activities to retain groundwater in upland peat restorations.

7.2 Costs of implementing Flood Risk Management Plans

7.2.1 General

This section gives an overview of the costs of implementing the measures to manage flood risk identified in the 20 SFRAs along with costs of Regional measures which will be undertaken throughout the Northern Ireland region.

The Floods Directive Article 7.3 requires FRMPs to take into account relevant costs. It is to be acknowledged the costs included in this section are high level and strategic in nature and represent an overall order of costs to manage flood risk. The costs in the assessment have been compiled under the broad headings of Prevention, Preparedness, and Protection.

More detailed estimates will be produced over the lifetime of these Plans as more information, particularly in relation to flood 'protection' activities, is known and Regional infrastructure plans and programmes are developed.

7.2.2 Costs included in the PEDU Report 2012

The PEDU report, published in 2012, recommended "that Rivers Agency, Roads Service (now Transport NI) and NI Water work with their parent Departments to review current flood defence expenditure priorities and report to the Executive on their adequacy to meet the potential threats over the next 10 years". This 10 year period encompasses the duration of these Flood Risk Management Plans.

It was estimated that a combined figure of approximately £24 million of resource expenditure and £36 million of capital investment per year for all the Drainage Agencies, was needed to maintain drainage infrastructure and execute a programme of flood alleviation projects, to reduce flood risk. These estimates were based on plans and a broad estimate of necessary works at the time the PEDU report was compiled. The findings of this report were presented to the NI Executive in April 2013.

The measures identified in these FRMPs would require this level of investment as a minimum to reduce flood risk. These minimum estimates in PEDU did not include operational costs in relation to emergency planning and the administration of Planning Policy. Costs of other organisations, such as Local Councils, PSNI, NIFRS and Consumer Council, who play a significant role in the emergency response to flooding were also not included.

The PEDU report also included estimates of costs to accelerate implementation and the costs of undertaking 'new activities' to address issues of exceedance and infrastructure which was not part of the public network. As part of the PEDU spending review it was recognised that investment could be

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increased annually (should funding be made available), to accelerate programmes of capital investment and improve maintenance of infrastructure, a critical aspect in the management of flood risk. An additional combined figure of £4 million resource expenditure and £36.5 million of capital investment, per year for all the Drainage Agencies was identified. It was also estimated, that in order to address vulnerabilities in infrastructure which was not part of the public network, approximately £12 million per year, of mainly capital investment, would be required.

Whilst the PEDU estimates do not directly read across to all the activities to implement the measures in these Plans, they provide broad indicative costs of managing flood risk in Northern Ireland.
Working through investment needs, particularly where more than one organisation is involved will require a strategic targeted approach. These Plans give the overall regional strategic approach to collectively managing flood risk. Cross-Departmental Groups will have a key role to play in facilitating appropriately targeted investment in areas of joint responsibility.

7.2.2.1 Impacts of Resourcing Pressures

It should however be noted that the resourcing pressures on all Departments, particularly in terms of resource funding, will impact directly on the maintenance of critical drainage infrastructure and the risk of flooding could increase as a result.

The pace of delivery of flood alleviation schemes will be linked to levels of capital investment available and this will mean that priorities for funding will need to be kept under review and reprofiling of programmes may be necessary.

The advances made in relation to flood emergency response with co-responders outside of the Drainage Agencies, particularly PSNI, NIFRS and Local Councils could regress if they also are faced with significant resourcing pressures. The effect of any stalling or regression in progressing this measure would be magnified by the fact that public expectation will not reduce.

7.2.3 Costs of Regional and River Basin District Measures

7.2.3.1 Costs associated with Drainage and Flood Risk Management Measures

The Department has prepared costs to be incurred by the Department and other organisational partners in relation to measures to address flooding. These cover both costs of measures within the 20 Significant Flood Risk Areas and costs associated with measures in areas outside SFRAs e.g. in Areas of Further Study or in other areas of Northern Ireland to address local flood risk issues, or more broadly associated with flood risk at a regional level.

It is not possible to relate these costs directly to those broad strategic costs provided within the PEDU but they do add additional detail to some of the elements. The related text also provides information as to which organisation will be responsible for the expenditure. The costs in the assessment have been compiled under the broad headings of Prevention, Protection and Preparedness.

Where possible, costs have been estimated for the measures to be undertaken to address flood risks within the 20 SFRAs during the first Plan cycle 2015-21. Where it has not been possible to allocate costs of measures directly against the 20 SFRAs, costs have been compiled on 'regional' basis..

Costs have also been estimated for:

- Measures which may be undertaken in the 2nd Plan cycle within the 20 SFRAs and;
- Measures to be undertaken during the first Plan cycle 2015-21, in other areas of flood risk which are outside the 20 SFRAs.

7.2.3.2 Prevention

Costs of Rivers Agency's liaison with planning authorities regarding new development

These are estimated running costs under the heading of 'Prevention' associated with the Department's provision of flood risk management advice to DoE Planning NI and local Councils. This advice, regarding developments and flood risk, is provided strategically during the preparation of development area plans and, in relation to individual planning applications.

Expenditure (£k)	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	TOTAL (£k)
Prevention	£500	£500	£500	£500	£500	£500	**£3,000**

7.2.3.3 Protection

Costs of measures in Rivers Agency's Capital Works Programme within the 20 significant flood risk areas during first Plan cycle

This table is a summary of costs associated with Rivers Agency's programme of Capital Works in relation to measures identified within the SFRAs during the first Plan cycle.

Expenditure (£k)	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	TOTAL (£k)
Protection	£6,005	£6,000	£4,815	£6,675	£6,025	£5,180	**£34,700**

Costs associated with Rivers Agency's proposed operation of the Homeowner Flood Protection Grant Scheme

Within the first year of the Flood Risk Management Plans, the Department proposes to commence the first Grant Scheme for Property Level Flood Protection in Northern Ireland. Funding for the Scheme over the first 3 financial years spanning 2015-18, is estimated to be of the order of £960k. Costs are under the heading of 'Protection'.

Expenditure (£k)	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	TOTAL (£k)
Protection	£0	£480	£480	tbc	tbc	tbc	**£960**

Costs associated with Stakeholder Groups formed to address the requirements of the Floods Directive

In order to implement the requirements of the Floods Directive in Northern Ireland, under Communication and Engagement (see Section 4.3), a number of groups were formed to provide opportunities for public bodies and the general public to participate in discussion and the exchange of views and information relating to the preparation of the FRMPs and related documents. Following the completion of the FRMPs, these groups will continue to meet regarding, implementation of measures in the FRMPs, development of new measures for future Plan cycles and to be informed and give views on flood-related matters. Costs associated with these groups are allocated under the 'Protection' heading since they deal predominantly with flood mitigation.

Expenditure (£k)	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	TOTAL (£k)
Protection	£30	£30	£30	£30	£30	£30	**£180**

Costs associated with drainage maintenance

These are costs associated with the routine maintenance by Rivers Agency of designated open and culverted watercourses, and by the DRD agencies of their storm drainage and road drainage systems throughout Northern Ireland. While these costs would include routine maintenance within the 20 SFRAs, much of this work is undertaken outside the 20 SFRAs. It is difficult to specifically attribute costs to SFRAs and therefore this has not been done.

Expenditure (£k) Protection	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	TOTAL (£k)
River Maintenance	**£8,000**	**£8,000**	**£8,000**	**£8,000**	**£8,000**	**£8,000**	**£48,000**

Rivers Agency expends approximately £8m per annum on river maintenance. DRD NI Water and Transport NI have routine maintenance responsibilities for major storm drainage and for road drainage networks throughout Northern Ireland. A cost estimate of £21m per annum has been obtained from NIW for base maintenance of both storm and foul systems; the proportion of cost attributable to storm drainage is not known and so is not included in the table above. Transport NI have not provided costs for their routine maintenance of road drainage but it thought to be substantial.

Costs associated with drainage and flood risk management activities by DRD Transport NI

Transport NI's capital funding is allocated through the structural maintenance budget, mainly linked to resurfacing work to renew existing drainage systems. In 2015-16 year, £3.5m was allocated and for the FRMPs it has been assumed that this level of expenditure will continue for the duration of this Plan cycle. It has been assumed that a proportion of approximately 30% will be expended on upgrading of road drainage systems to reduce susceptibility to surface-water flooding. These costs are included in the FRMPs under the heading of 'Protection'.

Structural maintenance(£k) Protection	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	TOTALS (£k)
Structural Maintenance	£2,500	£2,500	£2,500	£2,500	£2,500	£2,500	**£15,000**
Upgrading	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	**£6,000**
TOTALS (K)	**£3,500**	**£3,500**	**£3,500**	**£3,500**	**£3,500**	**£3,500**	**£21,000**

Costs associated with drainage and flood risk management activities by Northern Ireland Water

In NI Water's PC15 business plan, the following costs have been included during the first cycle of the FRMPs associated with works to address DG5 (Internal Flooding), Storm-water Separation and SCAMP (Sustainable Catchment Area Management Planning Northern Ireland). These cost estimates are under the heading of 'Protection'. It is estimated that 100% of DG5 and Stormwater Separation costs, and 3% of SCAMP costs will contribute towards the alleviation of flooding.

Element of programme (£k) Protection	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	TOTALS (£k)
DG5 (Internal Flooding)	£5,200	£5,000	£2,960	£1,960	£1,960	£1,960	**£19,040**
Storm-water Separation	-	£1,173	£1,000	£1,000	£1,000	£1,000	**£5,173**
Sustainable Catchment Area Management Planning Northern Ireland (SCaMP NI) – 3% Costs attributable to flood alleviation	£6	£6	£6	£6	£6	£6	**£36**
TOTALS (K)	**£5,206**	**£6,179**	**£3,966**	**£2,966**	**£2,966**	**£2,966**	**£24,249**

Costs associated with drainage and flood risk management activities in the DRD 'Living with Water' Programme (LWWP)

The LWWP will be developed over the next 5 years. Estimated costs of fees for feasibility & design are included (based on the potential costs of flood alleviation elements of £90 - £190m). Essentially, alleviation works associated with LWWP may be not scheduled to commence until the final year of this FRMP cycle. Cost estimates fall under the heading of 'Protection'.

Expenditure (£k) Protection	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	TOTALS (£k)
Plan Development	£1,000	£1,000	£1,000	£1,000	£1,000	_	**£5,000**
Works	_	_	_	_	_	£3,500	**£3,500**
TOTALS	**£1,000**	**£1,000**	**£1,000**	**£1,000**	**£1,000**	**£3,500**	**£8,500**

7.2.3.4 Preparedness

Costs associated with Rivers Agency's provision of Emergency Planning Expertise, Flood Warning, Informing and Awareness activities

These are estimated costs incurred under the heading of 'Preparedness' for provision of Emergency Planning and Hydrometric services. Costs include the following:-

Expenditure (£k)	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	TOTALS (£k)
Preparedness (Flood Data Acquisition, Warning & Informing)	£350	£350	£350	£350	£350	£350	**£2,100**
New Alert Stations	£215	£200	£200	£200	£200	£200	**£1,215**
Preparedness (Emergency Planning)	£100	£100	£100	£100	£100	£100	**£600**
TOTALS (K)	**£665**	**£650**	**£650**	**£650**	**£650**	**£650**	**£3,915**

Community Resilience costs

The following are estimated costs incurred by both the Department and other organisations under the heading of 'Preparedness' associated with Community Resilience. Costs include the following:-

Expenditure (£k)	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	TOTAL (£k)
Preparedness (Regional Community Resilience Group)	£15	£15	£15	£15	£15	£15	**£90**
Preparedness (Community Resilience Programme – 10 existing + 20 new communities)	£40	£40	£40	£40	£40	£40	**£240**
TOTALS (K)	**£55**	**£55**	**£55**	**£55**	**£55**	**£55**	**£330**

7.2.3.5 Additional Protection Costs (for more detail, see Appendix J)

Costs associated with measures identified in the 20 Significant Flood Risk Areas in 2nd Plan Cycle.

Expenditure (£k) Protection	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	TOTAL (£k)
	£400	**£2,600**	**£1,800**	**-**	**-**	**-**	**£4,800**

Costs associated with measures in other areas outside SFRAs in 1st Plan Cycle.

Expenditure (£k) Protection	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	TOTAL (£k)
	£1,075	**£1,500**	**£1,935**	**£900**	**£1,350**	**£2,520**	**£9,280**

Regional Measures Cost Summary

	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Total (k)
Prevention							
Rivers Agency - PAU	£500	£500	£500	£500	£500	£500	**£3,000**
Protection							
Rivers Agency - Flood Alleviation Schemes	£6,005	£6,000	£4,815	£6,675	£6,025	£5,180	**£137,599**
Rivers Agency - Homeowner Flood Protection Grant Scheme	£10	£480	£480	TBC	TBC	TBC	
Rivers Agency - Stakeholder Groups	£30	£30	£30	£30	£30	£30	
Rivers Agency - Maintenance	£8,000	£8,000	£8,000	£8,000	£8,000	£8,000	
Transport NI - Structural Maintenance	£2,500	£2,500	£2,500	£2,500	£2,500	£2,500	
Transport NI - Upgrading	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000	
NI Water - DG5 (Internal Flooding)	£5,200	£5,000	£2,960	£1,960	£1,960	£1,960	
NI Water - Storm-water Separation	-	£1,173	£1,000	£1,000	£1,000	£1,000	
NI Water- Sustainable Catchment Area Management Planning Northern Ireland (SCaMP NI) – 3% Costs attributable to flood alleviation	£6	£6	£6	£6	£6	£6	
DRD (LWWP) - Plan Development	£1,000	£1,000	£1,000	£1,000	£1,000	_	
DRD (LWWP) - Protection (Works)	_	_	_	_	_	£3,500	
Preparedness							
Rivers Agency - Warning & Informing	£665	£650	£650	£650	£650	£650	**£4,245**
Rivers Agency - Community Resilience	£55	£55	£55	£55	£55	£55	
Total Per Year (k)	**£24,971**	**£26,394**	**£22,996**	**£23,376**	**£22,726**	**£24,381**	**£144,844**

Cost of measures in Significant Flood Risk Areas in the Next Plan Cycle

	2012-22	2022-23	2023-24	2024-25	2025-26	2026-27	Total (k)
Protection							
Rivers Agency - Flood Alleviation Schemes	£400	£2,600	£1,800	-	-	-	**£4,800**

Cost of Measures outside the Significant Flood Risk Areas

	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Total (k)
Protection							
Rivers Agency - Flood Alleviation Schemes	£1,075	£1,500	£1,935	£900	£1,350	£2,520	**£9,280**

Section 8

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This Section details the monitoring and review arrangements for the implementation of these FRMPs.

8.1 Monitoring

Progress on the implementation of these FRMPs will be reported on an annual basis to the European Commission (EC) through the normal reporting processes. Any reports presented to the EC will be made publicly available by publication on the Department's website.

8.2 Reviewing

The EU Floods Directive requires that the FRMPs are reviewed on a 6 year cycle. The time line of the next (2nd) cycle is:-

- Further Preliminary Flood Risk Assessment – 22 December 2018
- Flood Hazard and Risk Maps update – 22 December 2019
- The Flood Risk Management Plans update – 22 December 2021

The Significant Flood Risk Areas identified during the first Planning cycle were based on the coarse Strategic Flood Map information. They are already under review due to the availability of the detailed Flood Hazard and Risk Maps produced in 2014. Further reviews of the SFRAs will be ongoing as new and updated information, such as recent flood history and changes in levels of protection, becomes available.

Regular reviewing and updating of the flood maps is an ongoing process. This will include the validation of existing mapping information and updating the maps based on new hydrometric information, tide level data, historical flood events and climate change factors. Based on new information, the effectiveness of existing defences and the likelihood of overtopping for predicted design events will also be reviewed.

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Section 9

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9.1 Next Steps

The next step is to commence the Flood Risk Management Planning cycle over again beginning with the 2nd Preliminary Flood Risk Assessment to be undertaken by 22 December 2018.

9.2 Conclusion

These FRMPs will seek to build on past successes and provide a more coordinated approach to managing flood risk at the River Basin District level.

Using the Flood Hazard and Risk Maps it is now possible to identify, not only historical flooding, but also future flooding which can be predicted with more accuracy. This has facilitated the development of a range of measures to mitigate flooding in the Significant Flood Risk Areas. Rivers Agency will continue to build on relationships with others with a role in flood risk management. The forming of inter-departmental groups on flood risk management, such as the Flood Investment and Planning Group, (FIPG) and the Strategic Drainage Infrastructure Programme Board means that roles and responsibilities can be agreed, as well as funding arrangements and approaches to joint solutions and responses. There have been significant developments in improving collaboration between agencies and other organisations in relation to flooding emergency response, and this is welcome. The amalgamation of the agencies with drainage and flood risk management responsibilities into the new Department for Infrastructure will assist in this collaborative process. The recent changes in Planning and the new 2-tier Planning process will also play a key role in managing development and flood risk. Development of the Living with Water Programme will unfold during this Plan cycle and will highlight the capital investment needs particularly in Belfast to deliver not only flood risk objectives but also an improved water and economic environment.

These FRMPs will now be recognised as being a key source of information in taking forward the business of flood risk management in Northern Ireland and driving the activities necessary to manage the risk. It will also help provide focus in bidding for resources and setting targets.

During the 6 year life of these Plans our knowledge and understanding of flood risk will continue to change and improve as new information emerges and new technologies are embraced. This will inform the development and delivery of the associates measures and objectives of these FRMPs and will help us to start to repeat the process towards the delivery of the 2nd 6 year cycle of Flood Risk Management Plans by 2027.

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Appendices

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Appendix A

List of consultees

General

Association of British Insurers
Ballinderry Fish Hatchery
Bann Systems Ltd
Belfast City Centre Management
Belfast Harbours Commission
Canoe Association of NI
Chartered Institution of Water and Environmental Management(CIWEM)
Coleraine Harbour Commissioners
Council for Nature Conservation and the Countryside
Countryside Alliance
DCAL Inland Fisheries
DOE NI Ireland Environment Agency
Drainage Council
DRD Water Policy Unit
DSD Weir Manager
Federation of Lough Neagh and Lough Beg Wildfowlers
Engineers Ireland
Freshwater Taskforce
GMB (Trade Union)
HSENI
Inland Waterways Association
Institution of Civil Engineers
Invest NI
Irish Amateur Rowing Union
Irish Water Ski and Wakeboard Association
Kilrea Angling Club
Lands Tribunal
Lough Neagh Fisheries Co-operative Society
Lough Neagh Rescue
Lough Neagh Sand Traders Association
Loughs Agency
Met Office
National Trust
NI Authority for Utility Regulation
NI Chamber of Trade
NI Environment Link
NI Fire and Rescue
NI Tourist Board
NIPSA Trade Union
Northern Ireland Agriculture Producers Association
Northern Ireland Housing Executive
Northern Ireland Water
OFMDFM Civil Contingencies Policy
PSNI
Public Health Agency
River Bann and Lough Neagh Association
Royal Yacht Association
RSPB
Rural Development Council
Rural Support
Shaftesbury Estate of Lough Neagh
Sports Council NI
Strangford Lough Wildfowlers and Conservation Association
The Honourable The Irish Society
Ulster Angling Federation
Ulster Coarse Fishing Federation
Ulster Farmers Union
Ulster Wildlife Trust
Waterways Ireland
World Wildlife Trust

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OFMDFM GUIDANCE

Belfast Solicitors Association
CBI
Citizens Advice Bureau
Civil Law Reform Division
Departmental Library
District Judge (Magistrates Court)
Equality Commission
Federation of Small Businesses
General Consumer Council
HM Council of County Court Judges
Human Rights Commission
Law Centre
Law Society
Legal Deposit Libraries
National Library of Ireland
NI Chamber of Commerce and Industry
NI Council for Voluntary Action
NI Court Service (2)
NI Local Government Association
Northern Ireland Law Commission
Northern Ireland Ombudsman
Northern Ireland Publications
Resource (NIPR).
Queen's University, School of Law
University of Ulster, School of Law
The British Library.
The Executive Council of the Inn of Court of NI
The Library, Queen's University Belfast.
TSO Bibliographic Department.
Food Standards Agency
NIC/ICTU (Trade Union)
Society of Local Authority Chief Executives
HM Revenue & Customs
Ministry of Defence
Northern Ireland Judicial Appointments Commission
Catholic Bishops of Northern Ireland
Community Relations Council
Participation and the Practice of Rights Project

District Councils (26)

NI Executive

OFMDFM
Dept of Social Development
Dept of Enterprise Trade and Investment
Dept of Education
Dept of Regional Development
Dept of Employment and Learning
Dept of Environment
Dept of Health, Public Safety and Social Services
Dept of Agriculture and Rural Development
Dept of Culture, Arts & Leisure
Dept of Finance and Personnel
Dept of Justice
The Speaker of the Assembly
Assembly Departmental Committee
Assembly Business Office
Members of the Northern Ireland Assembly
Assembly Bill Office
Northern Ireland Assembly Library
Office of the Legislative Counsel
Northern Ireland Affairs Committee
Northern Ireland Office
Central Management Unit (CMU)
Legislative Programme Secretariat
Machinery of Government Division

All Political Parties in NI Assembly
All Political Parties not represented in NI Assembly
All Northern Ireland MPs and MEPs who are not MLAs
All Political Parties Spokespersons
All MLAs

Section 75 Groups
Floods Directive Steering Group Members
Local Flood Forum Members

Appendix B

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Changes to draft FRMP & SEA arising from the Public Consultation Exercise		
	Issue Raised	**Change to FRMP**
1	It is unclear from the stated Plan objectives regarding the reduction of economic losses if this includes the cost of flood damage to infrastructure.	Plan objectives revised to make it clear the cost of flood damage to infrastructure is included in the objective to reduce economic losses.
2	The Plans do not reflect the recently introduced changes to the development planning system in Northern Ireland	Plan substantively revised to reflect the fundamental reforms to the planning system which were introduced on 1 April 2015. The new two-tier planning system saw the vast majority of the planning functions (including individual applications and Local Development Plans)transfer from DOE to the 11 Councils with DoE retaining responsibility for planning legislation, oversight and guidance , regional planning policy and regionally significant applications.
3	Lack of clarity around the purpose of Sustainable Drainage Infrastructure Programme, the Strategic Investment Infrastructure Programme and the Flood Investment Planning Group and the linkages.	Plan revised to ensure that the linkages between the various flood management groups and programmes are more clearly defined.
3	The Plan does not contain adequate reference to the use of SuDS .	Plan revised to clearly describe the current position with SuDS and outline the ongoing work to promote and support their wider use.
4	It was suggested that the Plan would benefit from the inclusion of a single table that summarises the key flood risk data and mitigation measures proposed for each of the SFRA.	Plan includes an Appendix within each plan that contains a summary table as suggested.
5.	Para 2.3.1. on Page 11 of draft Plan incorrectly states that Natural Flood Management is *'key feature'* of the Directive.	The Floods Directive does not state that *'Promoting the use of natural measures'* should be a *'key feature'* of the Flood Risk Management Plans (FRMPs). The actual wording in Article 7.3. of the Floods Directive (which is reflected in the NI Regulations) is that *'Flood Risk Management Plans shall address all aspects of flood risk management*

Changes to draft FRMP & SEA arising from the Public Consultation Exercise		
	Issue Raised	**Change to FRMP**
		focusing on prevention, protection and preparedness ..... and may include the promotion of sustainable land practices, improvement of water retention as well as the controlled flooding of certain areas in the case of a flood event.' As there is no specific reference to, or requirement to promote natural flood management. This misleading statement on page 11 has been revised to reflect the actual requirements of the Directive.
6.	Plan does not contain enough detail in regard to Natural Flood Management (NFM).	Plan updated to include details of the current position in relation to potential contribution that NFM measures could make within the sustainable catchment based approach to flood risk management.
7.	Plan refers to role of the Local Government Emergency Management Group which apparently no longer exists.	Plan revised to ensure that it accurately reflects the current position in relation to Government's emergency planning structures and any changes that flow from the ongoing review of the local government civil contingencies arrangements.
8.	Plan infers that work to develop community emergency plans relates only to warning and informing. This description is insufficient and doesn't adequately reflect other important aspects this work including education and awareness.	Plan revised to ensure that all of the important elements and benefits of community emergency planning are more fully described within the Plan.
9.	Plan does not contain sufficient detail or commitments in relation to flood warning and informing.	Plan revised to include commitments in relation to publishing contemporaneous water-level data on Rivers Agency's website and exploring options for extending text alert services to additional at risk communities where appropriate.
10.	Public should be able to access capital works and flood study programmes so that they can have some appreciation of the time it takes to develop and implement solutions and the prioritisation	Revise Plan to commit to the publication of Rivers Agency's Capital Works and Flood Study Programmes on the website. Text inserted to describe how projects are developed and prioritised and a web-link to the Programmes provided.

Changes to draft FRMP & SEA arising from the Public Consultation Exercise		
	Issue Raised	**Change to FRMP**
	process.	
11.	Plan should identify and explain the rational for the 49 Areas for Further Study.	Plan changed to identify the locations of the 49 Areas for Further Study (AFS) and explain how they were selected and have been modelled and mapped to the same standards as the SFRA. Plans commit to reassess the level of risk within these areas on the basis of the new mapping and, where it can be justified and resources permit, flood studies will be undertaken to determine if flood mitigation measures (including flood defences) are appropriate. Where appropriate, some AFS may be elevated to SFRA status in the next plan cycle.
12.	Due to the time that has lapsed since the publication of the draft Plan, it doesn't reflect fully reflect the progress of the Connswater Community Greenway Project. The benefits of the scheme and in particular the reduction in flood risk to residential housing should be more explicit.	Plan details in respect of the ongoing Connswater Community Greenway Project have been revised to reflect progress at the time of its publication and the planned outcomes/benefits more clearly described.
13.	Due to the time that has lapsed since the publication of the draft Plan, it does not record details of flooding that occurred in 2014/15	Plan updated to include details of any significant flooding that occurred in 2014/15
14.	Plan does not make it clear that the Lagan Weir was not constructed as a flood control structure.	Plan revised to describe the reason for the construction of the Lagan Weir and highlight the limited role that it plays in reducing fluvial flooding through its current operating regime.
15.	Difficult to navigate document without page numbers	Insert page numbers – review and update index
16.	Plan doesn't make it clear if and when, the Homeowner Flood Protection Grant Scheme will be introduced and the level of funding that will be	Provide greater detail on Grant Scheme, date it will be introduced, funding levels and annual targets.

Changes to draft FRMP & SEA arising from the Public Consultation Exercise		
	Issue Raised	**Change to FRMP**
	available.	
STRATEGIC ENVIRONMENTAL ASSESSMENT COMMENTS AND REVISIONS		
17.	Table 5 in Clause 4.2 does not list the significant sources of information on baseline fishery data (i.e. DCAL, Loughs Agency and AFBI)	Table 5 updated to identify significant sources for baseline fishery data.
18.	The pages which relate to the Republic of Ireland are blank	Information for ROI is included in SEA.

Appendix C

Department of Agriculture and Rural Development

Equality and **Human Rights** Screening Template

December 2014

DARD Equality and Human Rights

Department of Agriculture and Rural Development
www.dardni.gov.uk

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Screening Template

DARD has a statutory duty to screen. This includes our strategies and plans, policies, legislative developments; and new ways of working such as – the introduction, change or end of an existing service, grant funding arrangement or facility. This screening template is designed to help business areas consider the likely equality and human rights impacts of their proposed decisions on different groups of customers, service users, staff and visitors.

Before carrying out an equality screening exercise it is important that you have received the necessary training first. To find out about the training needed, contact - equalitybranch@dardni.gov.uk. All screening exercises must be supported by evidence and cleared at Grade 3 level.

The accompanying **Screening Guidance** note provides straightforward advice on how to carry out equality screening exercises. Detailed information about the Section 75 equality duties[1] and what they mean in practice is available on the Equality Commission's website.

The screening template has 4 sections to complete. These are:

Section A - asks you to provide details about the policy / decision that is being screened.

Section B - has 4 key questions that require you to outline the likely impacts on equality groups, and all supporting evidence.

Section C - has 4 key questions in relation to obligations under the Disability Discrimination Order and the Human Rights Act.

Section D - is the formal record of the screening decision.

[1] ECNI 'Section 75 of the NI Act 1998: A Guide for Public Authorities' April 2010. www.equalityni.org

Section A

Details about the policy / decision to be screened

Title of policy / decision to be screened:- Draft Flood Risk Management Plans

These policy proposals will help meet the Programme for Government, Priority3: Protecting our People, Environment and Creating Safer Communities by contributing to the Floods Directive building block supporting this priority.

Brief description of policy / decision to be screened:-

The Draft Flood Risk Management Plans are part of the process towards the implementation of the European Directive on the Assessment and Management of Flood Risks (2007/60/EC). The Draft Plans apply only to areas within NI that have been identified as being at significant flood risk. The Draft Plans set objectives for the purpose of managing flood risk and then identify a range of measures/actions that can be taken to achieve these objectives.

Aims and objectives of the policy / decision to be screened:-

The Draft Plans objectives are aimed at reducing the risk to human health, the environment, cultural heritage and economic activity. The Draft Plans measures fall into 3 main headings, Flood Prevention through the implementation of appropriate land use planning policies; Flood Protection by structural and non-structural measures and Flood Preparedness through flood forecasting, flood warning and emergency response procedures. Coordination with the Water Framework Directive and engagement with interested parties and the public is also a requirement of the Directive.

On whom will the policy / decision impact?

Consider the internal and external impacts (both actual or potential)

- Staff
- service users
- rural community
- other public sector organisations
- voluntary / community groups / trade unions
- others, please specify

The implementation of the policy will mainly impact on government departments who have roles and responsibilities for managing flood risk.
The Draft Plan measures when applied will reduce the impact of flooding to all communities that have been identified as being within significant flood risk areas in NI, irrespective of their type or background.

Are there linkages to other NI Departments / NDPBs?

Yes. There are a number of other NI Departments and public bodies that have flood risk management interests and responsibilities. These include DRD – NI Water, Transport NI; DOE – Northern Ireland Environment Agency, Planning NI; DHSSPS – Blue Light Services, OFMDFM – Civil Contingencies Planning and Local Councils.
Thoughout the implementation of the Directive, these bodies have attended informal stakeholder group meetings with their views/information reflected in the Draft plans proposals.

Section B

1. What is the likely impact on <u>equality of opportunity</u> for those affected by this policy, for each of the Section 75 equality categories? What is the level of impact?

Section 75 category	Details of likely impact	Level of impact? Minor/Major/None
Religious belief	Flooding is indiscriminate. The plans provide flood mitigation measures to predicted flooding from the 4 main sources of flooding, rivers, seas, surface water and reservoirs. The measures undertaken will reduce the flood risk to people and property, irrespective of the Section 75 category, living or working in the flooded area. The plans therefore do not make any distinction between the different Groups.	None
Political opinion	As above	None
Racial group	As above	None
Age	As above	None
Marital status	As above	None
Sexual orientation	As above	None
Men and women generally	As above	None
Disability	As above	None
Dependants	As above	None

2. Are there opportunities to better promote <u>equality of opportunity</u> for people within the Section 75 equalities categories?

Section 75 category	**If Yes, provide details**	**If No, provide reasons**
Religious belief		There is no opportunity in the Draft Plans proposals to better promote equality of opportunity.
Political opinion		As above

Racial group		As above
Age		As above
Marital status		As above
Sexual orientation		As above
Men and women generally		As above
Disability		As above
Dependants		As above

3. To what extent is the policy likely to impact on <u>good relations</u> between people of different religious belief, political opinion or racial group? What is the level of impact?

Good relations category	Likely impact?	Level of impact? Minor/Major/None
Religious belief	None	None
Political opinion	As above	As above
Racial group	As above	As above

4. Are there opportunities to better promote <u>good relations</u> between people of different religious belief, political opinion or racial group?

Good relations category	If Yes, provide details	If No, provide reasons
Religious belief	The plans may have a positive impact on good relations through the reduction in flooding by recommending flood protection measures and the opportunity for people to work together through community engagement and planning to manage the threat of flooding.	
Political opinion	As above	
Racial group	As above	

Available evidence

What evidence / information (both qualitative and quantitative) have you gathered to inform this policy? Set out all evidence below along with details of the different groups you have met and / or consulted with to help inform your screening assessment.

Section 75 category	Details of evidence / information and engagement
Religious belief	None. The Plan measures are applied to all people and properties at flood risk and take no account of any or all of the Section 75 Groups.
Political opinion	As above
Racial group	As above
Age	As above
Marital status	As above
Sexual orientation	As above
Men & women generally	As above
Disability	As above
Dependants	As above

No evidence held? Outline how you will obtain it:

The Draft Plan proposals and this initial screening document will be subject to the public consultation process. All Section 75 groups will have the opportunity to make comment and to influence the proposed measures outlined. The consultation will be take place over a 6 month period in the first half of 2015.

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Section C

DARD also has legislative obligations to meet under the Disability Discrimination Order and Human Rights Act (insert links) Questions 5 -9 relate to these two areas.

Consideration of Disability Duties

5. Does this proposed policy / decision provide an opportunity for DARD to better **promote positive attitudes** towards disabled people?

Explain your assessment in full **Yes**

The measures on preparedness in regard to flood resilience to property and emergency access and egress will give designers and community planners the opportunity to consider suitable arrangements for disabled people.

The policy should indirectly increase the safety of all Section 75 Groups including disabled people.

6. Does this proposed policy / decision provide an opportunity to actively **increase the participation** by disabled people in public life?

Explain your assessment in full **Yes**

The plans measures when implemented should give disabled people the opportunity to participate in community engagement and contribute to local emergency flood plans and resilient construction measures. The policy should increase the safety of all Section 75 Groups.

Consideration of Human Rights

7. The Human Rights Act (HRA) 1998 brings the European Convention on Human Rights (ECHR) into UK law and it applies in N Ireland. Indicate below (place an X in the appropriate box) any potential *adverse impacts* that the policy / decision may have in relation to human rights issues.

Right to Life	**Article 2**	☐
Prohibition of torture, inhuman or degrading treatment	**Article 3**	☐
Prohibition of slavery and forced labour	**Article 4**	☐
Right to liberty and security	**Article 5**	☐
Right to a fair and public trial	**Article 6**	☐
Right to no punishment without law	**Article 7**	☐
Right to respect for private and family life, home and correspondence	**Article 8**	☐
Right to freedom of thought, conscience and religion	**Article 9**	☐
Right to freedom of expression	**Article 10**	☐
Right to freedom of peaceful assembly and association	**Article 11**	☐
Right to marry and to found a family	**Article 12**	☐
The prohibition of discrimination	**Article 14**	☐
Protection of property and enjoyment of possessions	**Protocol 1 Article 1**	☐
Right to education	**Protocol 1 Article 2**	☐

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Right to free and secret elections	**Protocol 1 Article 3**	☐

Consideration of Human Rights (cont)

8. **Please explain any adverse impacts on human rights that you have identified.**

None

9. **Please indicate any ways which you consider the policy positively promotes human rights**

The plan positively promotes human rights. Protocal1, Article 1 and Article2 ; Protection of property and the enjoyment of possessions and the Right to Life will be enhanced through the reduction in the flooding impact. Implementation of the Draft Plans will ultimately protect people and property from the risk of flooding through Prevention, Protection and Preparedness measures.

Monitoring Arrangements

Section 75 places a requirement on DARD to have equality monitoring arrangements in place in order to assess the impact of policies and services etc; and to help identify barriers to fair participation and to better promote equality of opportunity.

Outline what data you will collect in the future in order to monitor the impact of this policy / decision on equality, good relations and disability duties**.**

Equality	**Good Relations**	**Disability Duties**
No specific data will be collected	No specific data will be collected	No specific data will be collected

Section D

Formal Record of Screening Decision

Title of Proposed Policy / Decision being screened – Floods Directive Draft Flood Risk Management Plans.

I can confirm that the proposed policy / decision has been screened for –

☒	equality of opportunity and good relations
☒	disabilities duties; and
☒	human rights issues

On the basis of the answers to the screening questions, I recommend that this policy / decision is –

*place an X in the appropriate box below

☐	***Screened In** – Necessary to conduct a full EQIA

☒	***Screened Out** – No EQIA necessary (no impacts) The Draft Flood Risk Management Plans identify a range of measures, namely Prevention, Protection and Preparedness that aim to remove or reduce the impact of flooding to people and property. All these measures would be considered as having a positive effect on people and are applied indiscriminatingly to all areas that are at significant flood risk across NI, and irrespective of what Section 75 equality group that people belong to.

☐	* **Screened Out -** Mitigating Actions (minor impacts)

Formal Record of Screening Decision (cont)

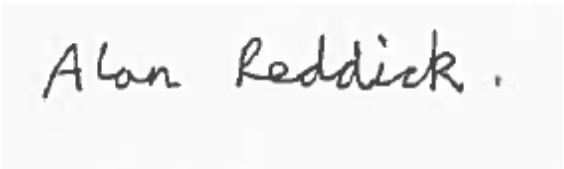
Screening assessment completed by (Staff Officer level or above) -

Name: Alan Reddick Grade: 7

Date: 24th November 14

Branch: Rivers Agency

Signature:



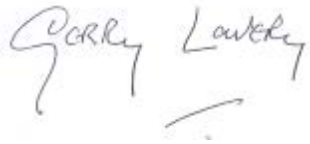
Screening decision approved by (must be Grade 3 or above) -

Name: Gerry Lavery Grade: 3

Date: 25 November 2014

Branch: Central Services Group

Signature: please insert a scanned image of your signature below



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Please save the final version of the completed screening form in the TRIM container below as soon as possible after completion and forward the TRIM link to Equality Branch at equalitybranch@dardni.gov.uk. The screening form will be placed on the DARD website and a link provided to the Department's Section 75 consultees.

Strategic Management DARD - Equality Promotion & Implementation - Equality Schemes - Equality Screening of Departmental Policies.tr5

For more information about equality screening, go to -

http://dardintranet/coord_intranet/EqualityBranch/index.shtml

Or contact –

DARD Equality Branch
Room 509
Dundonald House
Upper Newtownards Road
Belfast BT4 3SB
Telephone 028 9052 4435
Textphone 028 9052 4420

equalitybranch@dardni.gov.uk.

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Appendix D

Flood Warning and Informing initiatives for Northern Ireland

Flood warning and informing activities suitable for Northern Ireland commenced in 2013. Northern Ireland does not have a flood forecasting centre, unlike the rest of the UK. The reason for this is that catchments here are smaller and any warning time would be much shorter. This would greatly reduce the benefit of such a centre in Northern Ireland. However there are improvements in this area that have been made.

Flood Warning and Informing provision suitable for Northern Ireland is being progressed via 4 stage strategy summarised as follows:-

I. <u>Formal engagement with the Met Office in a 'partnering' approach to better inform the impact assessment of National Severe Weather Warnings for heavy rainfall.</u>

An MOU between Rivers Agency and Met Office has been established. This MOU allows for contact between the Met Office and Rivers Agency at the consideration stage of a severe weather warning for heavy rainfall. Consideration is given to river levels and ground saturation conditions which enables a better assessment of the potential flood impacts of a significant rainfall event and informs the level and detail of the heavy rain warning. This allows communities and responders to tailor their responses.

II. <u>Ensuring adequate 'Informing' in relation to flood risk to enable responders and the public to be effective in dealing with flooding.</u>

In order to ensure that the 'Informing' aspect of this initiative is delivered effectively, a standardised, regional strategy is necessary. This involves input from a wide range of public and voluntary sector organisations and, to this end, the Regional Community Resilience Group (RCRG) has been formed. This Group is co-chaired by Local Government and Rivers Agency. Detail on the work of the RCRG is found in Appendix E.

Through the auspices of the RCRG, work is now complete in relation to:-

- Identification of communities, using pre- agreed criteria, to be initially engaged in relation to flood warning and informing;
- Preparation of standard community resilience plans and household pack templates;
- Agreement on information to be communicated e.g. sharing of weather warning and river level information, assistance in relation to Individual Property Protection initiatives, and education on the limitations of any flood warning capability, response provision and infrastructure capacity.

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III. Public dissemination of water level information. This includes the use of River level text warnings, where these are likely to be beneficial.

Following the successful pilot with community groups, the third stage will be to provide flood alert station and gauging station data as close to real time as possible on the Rivers Agency website.

IV. Review and Development

Stage 4 will involve a review of progress and the effectiveness of the 3 previous stages and will also consider the need for further refinement, taking into account national advances in this area and feedback from community groups and the wider public.

These staged improvements will be of benefit mainly in terms of river flood warning and informing to both responders and the public. The limitations of any flood warning needs to be recognised. Effective warning for heavy thundery downpours, which often result in surface water flooding, is not yet possible.

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Appendix E

Regional Community Resilience Group and Outline of Group Activities

Despite the improvements made in developing emergency plans and in providing improved levels of response during significant flood events, because of finite resources, the emergency response of Government and the emergency services can become over-stretched. This means that not all calls for assistance during a major flood event may be responded to in a timely manner. With this in mind it is important that households and communities, that are subject to known flood risk, are better prepared to deal with flooding.

To facilitate this, a pilot Regional Community Resilience project was carried out during 2014 to engage with flood risk communities to help them be better prepared for flooding. A review of the pilot project was carried out by the Consumer Council and Red Cross which recommended that the work of the RCRG to should continue. The RCRG is preparing to engage with a further 6 of the communities identified in Appendix I during 2016, and the Group plans to engage with the remaining communities on the list over the period of the Flood Risk Management Plans. **This Community Resilience work is not Government withdrawing from any undertaking to respond in emergencies but an additional layer of support to ensure Government Departments and the public work together to reduce the overall impacts of flooding.**

The detail of preparedness actions including flood warning and informing activities planned from a regional perspective are in Appendix D.

Regional Community Resilience Group

The Regional Community Resilience Group (RCRG) was formed in January 2013 under the Joint Chairmanship of Rivers Agency and Local Government to bring partner organisations together to develop a Community Resilience Delivery Programme across the region. The membership of the Group includes Rivers Agency and Sub Regional Civil Emergency Preparedness Group (SCEP) (Joint Chairs); Belfast City Council; the four district council groupings responsible for civil contingencies matters at a sub-regional level (EPCOs); Belfast Resilience; PSNI; NIFRS; NI Water; the Met Office; Transport NI; Red Cross, the Consumer Council, MoD and NIE.

The purpose of the RCRG is to work on a multi-agency basis to facilitate consistent, prioritised and focussed planning and preparation for community response and recovery activities that will help pre-identified

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communities deal with emergency incidents. The Group has adopted flood risk as the initial topic on which to engage communities but will look to address a broader range of risks as their work develops.

Experience shows that the benefits of this type of initiative are to help individuals and communities to be better prepared and more self-reliant during emergencies. In that context, enhanced community resilience has the potential to contribute significantly to the overall effectiveness of the response and to wider resilience to the impacts of civil emergencies.

A four stage Community Engagement Plan has been developed with the objectives of:-

- explaining the potential and limitations of Community Resilience to communities;
- raising awareness in communities on available information such as Met Office warnings or watercourse level text alerting and the facilitation of self-help initiatives.
- reviewing and validating all elements of the community engagement activities.

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Appendix F

Reservoirs Bill – Background and Legislative Development

Background

1. The Floods Directive requires member states to identify, manage and assess potential flood risks. The resulting preliminary flood risk assessment for Northern Ireland estimated that 66,000 people would be at risk from total dam failure of the 156 impounding reservoirs capable of holding 10,000m³ or more of water. The number of reservoirs has since been revised downwards to 132.

2. The Northern Ireland Executive at its meeting on 11 November 2011 agreed that the Minister for the Department of Agriculture and Rural Development should bring forward primary legislation to regulate reservoir safety in Northern Ireland. This primary legislation completed the Northern Ireland Assembly legislative process on 24th June 2015, received Royal Assent one month later on 24th July, and is known as the Reservoirs Act (Northern Ireland) 2015.

Reservoirs Bill – Main Components

3. The main components of the Reservoirs Act are as follows:

- **Controlled Reservoirs**

  The Act will introduce the term 'controlled reservoirs'. The definition of a 'controlled reservoir' will include structures or areas designed or used for collecting and storing water, artificial or partly artificial lakes, or other artificial areas which are capable of holding 10,000 cubic metres or more of water above the natural level of any part of the surrounding land.

- **Reservoir Managers**

  Responsibility for managing or operating a controlled reservoir will be placed on persons or organisations referred to as 'the reservoir manager'. Controlled reservoirs may be managed by one or more reservoir managers.

- **Registration**

  Reservoir managers will be required to register a controlled reservoir with the Department. The Department will maintain this register and make it available for public inspection. The register will include the name and location of the reservoir, its maximum capacity, the name and address of the reservoir manager as well as copies of any reports or certificates relating to the reservoir.

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- **Reservoir Designation**

  The Department will be required to give a controlled reservoir a designation as soon as reasonably practicable after the reservoir is registered. The Department will also be required to undertake a periodic re-assessment of the reservoir's designation. Controlled reservoirs will be designated as High Consequence, Medium Consequence, or Low Consequence depending on the impact that an uncontrolled release of water from the reservoir would have on people, economic activity, the environment, or cultural heritage.

- **Reservoir Supervision**

  The Act provides for controlled reservoirs that are designated as either High or Medium Consequence to be supervised by a reservoirs engineer. The engineer will be required to give the reservoir manager an annual written statement of the steps that they have taken together with any measure taken by the reservoir manager, in the interests of safety.

- **Reservoir Inspection**

  A High Consequence reservoir will be inspected within one year of the date on which its designation takes effect and every 10 years thereafter unless an earlier inspection is recommended by a supervising or inspecting engineer.

  A Medium Consequence reservoir will be inspected within one year of the date on which its designation takes effect. Further inspections will only take place if recommended by the supervising or inspecting engineer.

  Inspection of reservoirs designated as Low Consequence is not required.

- **Reservoir Construction**

  The construction or alteration of controlled reservoirs will be regulated by a requirement on the reservoir manager to appoint a construction engineer to supervise any works carried out on a controlled reservoir and by imposing a system of reporting and certification in respect of the works. This will apply to all controlled reservoirs regardless of their reservoir designation.

- **Incident Reporting**

  The Department will make provision in regulations for reporting incidents which may affect the safety of controlled reservoirs. The Act provides an indicative list of the contents of the Incident Report.

- **Flood Plans**

  The Department will make provision in regulations for the preparation of flood plans for controlled reservoirs. These plans will set out the action which the reservoir manager will take to

control or mitigate the effects of flooding likely to result from any escape of water from the reservoir. The Act provides an indicative list of the contents of Flood Plans.

- **Emergency Powers**

  The Act contains provision that allows the Department to take emergency action to protect people or property against an escape of water from a controlled reservoir that may cause harm. When required the Department will commission a reservoirs engineer to make recommendations regarding actions to be taken and to supervise the required works.

- **Stop Notices**

  The Act contains provision that allows the Department, by regulations, to permit the serving of a stop notice on a reservoir manager. A stop notice is a notice prohibiting the carrying on of an activity, or permitting the carrying on of an activity by another until such steps as specified in the notice have been taken. The Act lists the conditions the Department must meet before exercising its power under the regulations.

- **Powers of Entry**

  The Act contains provision that allows the Department to authorise any person to enter land for the purposes of carrying out its functions under the legislation.

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Appendix G

Civil Contingencies Multi-Agency Preparedness Structures with a role in Flooding Emergencies

The Civil Contingencies Group (NI) is the principal strategic emergency preparedness group for the public sector and provides strategic leadership in relation to civil contingencies policy and strategy on cross cutting issues on a multi-agency basis.

The Group has a corporate governance function, identifying and agreeing civil contingencies priorities for action.

In addition there are five Sub-Regional Civil Emergency Preparedness Groups (EPGs). These multi-agency groups agree a joint approach to emergency preparedness and response for their respective areas.

Taken together these groups consider a wide range of civil contingencies issues including flooding.

When necessary, the EPGs will cooperate with neighboring emergency planners in the Republic of Ireland in preparing for and responding to emergencies of a cross-border nature.

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Appendix H

Flood Risk Management Plans – Objectives and Measures Template

Objectives	Objectives Activities		Measures	Measures Type	Measures Activities
Economic Activity	• Reduce economic damages to properties. • Reduce economic costs on business caused by the disruption to essential infrastructure and services. • Optimise economic return on Flood Risk Management investment.		**Flood Prevention**	**Keep new development outside Flood Risk Areas**.	• Try to ensure that new zonings are located outside flood risk areas. • Try to ensure that individual applications are located outside flood risk areas.
				Ensure new development within Flood Risk Areas is suitably constructed.	• In accordance with PPS 15 try to ensure that any development which is located "by exception" in flood risk areas is appropriately built with flood resistance/resilience measures. • All proposed development applications are accompanied by a Flood Risk or Drainage Assessment.
				Surface Water Management.	• Promote the application of SuDS to all new developments.
			Flood Protection	**Maintenance of the Existing Drainage and Flood Defence Network.**	• Continue to inspect and maintain designated watercourse grilles as appropriate and as funding allows. • Continue to regularly inspect the condition of all drainage and Flood Defence Assets. • Continue to implement a prioritised programme of works for the maintenance of all Drainage and Flood Defence Assets. • Continue to implement a prioritised programme of works for the maintenance of public sewers schemes.
Human Health and Social	• Reduce the risk to life. • Raise awareness of the consequences of flood risk. • Reduce risk to health and wellbeing. • Reduce the impact on people caused by the disruption to essential Infrastructure and services. • Improve recreation and public amenities.			**New Flood Alleviation Schemes**	• Continue to carry out feasibility studies to identify viable solutions. • Continue to implement a prioritised programme of works of flood defence and culvert alleviation schemes. • Continue to implement a prioritised programme of works of integrated surface water drainage schemes. • Continue to implement a prioritised programme of works to separate surface water systems from combined sewer systems.
				Catchment Based Management	• Look for opportunities to work with others through partnership arrangements.
			Flood Preparedness	**Flood Emergency Response**	• We will continue to engage with other responsible bodies on identifying local flooding hotspots and co ordination of response procedures along with Blue Light responders. • We will continue to prepare and engage with other responders on multi Agency flood emergency response plans to those areas at known flood risk, eg coastal flood response plans. • We will continue to test emergency response plans through Multi Agency

					‘Exercising’.We will continue to work with Co responders in line with Flood Emergency Response “Best Practice Guidelines”.
				Flood Warning and Forming suitable for NI	4 Stage Approach • Formal engagement with the Met Office in a ‘partnering’ approach to better inform the impact assessment of National Severe Weather Warnings for heavy rainfall. Ensuring adequate ‘Informing’ in relation to flood risk to enable responders and the public to be effective in dealing with flooding.Public dissemination of water level information. This includes the use of River level text warnings, where these are likely to be beneficial. • Review and Development.
Environmental (including cultural heritage)	• Consider the impact of Climate Change • Under the Water Framework Directive, support the achievement of good ecological potential/status for water bodies. • Reduce the risk of pollution. • Avoid or mitigate impact on priority species and habitats. • Avoid or mitigate impact on designated environmental areas, including those of cultural heritage importance.			**Community Engagement**	• Rivers Agency is working with the other drainage agencies, the emergency services, local government, NIHE, Red Cross, Consumer Council, Met Office, etc, to develop and establish a consistent approach to flood warning and informing activities across Northern Ireland.
				Communication of Flood Risk	• We will continue to engage with communities to facilitate the informing aspect of ‘Flood Warning and Information’ proposals. • We will continue to update and improve flood risk information on the Flood Maps (NI). • We will continue to improve information on flooding on the NI Direct Website. • We will continue to work with NI Direct in the development of the Flooding Incident Line (FIL). • Continue to consult and hold flood forums with stakeholders and others to make them aware of their role and responsibilities in assessing and managing flood risk. • Seek to issue timely media messages to inform the Public of significant flooding events.
				Individual Property Protection	• A proposed scheme for grant aiding Individual Property Protection is currently being progressed. Eligibility will be assessed on the likelihood of future flooding and the frequency of past flooding events. • The introduction of such a scheme would be a significant step forward and be a key ‘building block’ in enhancing community resilience to flooding.
				Flood Recovery, Welfare and Insurance Issues	• We will continue to carry out and contribute to post flood investigations to gather information and improve knowledge and action on future flood events. • We will continue to work with Councils and local communities at flood risk in providing advice and information to aid recovery after a flood event. • We will continue to engage and work with voluntary section organisations such as the Red Cross in providing Welfare Support. • We will continue to work with the insurance industry to assist them in introducing “FloodRe” to NI to help address long term flood insurance affordability issues.

Appendix I

Areas considered suitable for a programme of community engagement to deliver Flood Warning and Informing

	River Basin District	Significant Flood Risk Area	Description	Engagement
1	North East	Belfast	Clarawood Park area	
2	North East	Belfast	Stockmans Lane	
3	North East	Belfast	Finaghy Road North area	Ongoing
4	North East	Belfast	Gilnahirk Road / Kingsway Park area	
5	North East	Belfast	Greystown Avenue / Finton Gardens area	
6	North East	Newcastle	Bryansford Avenue / Shimna Road	
7	Neagh Bann	Antrim	Abbeyview and Alexandra Park	Ongoing
8	North East	Belfast	York Park / Pittsburg Street area	
9	North East	Belfast	Loopland Park area	
10	North East	Belfast	Montgomery Road	
11	Neagh Bann	Antrim	Riverside & Masserene Street	Ongoing
12	Neagh Bann	Lurgan	Westwood / Sperrin Drive	
13	Neagh Bann	Newry	Bridge Street / Cleary Crescent area	Ongoing
14	North West	Omagh	Town Centre	Ongoing
15	North East	Dundonald	Dunlady Park / Canberra Park area	
16	Neagh Bann	Lurgan	Knockramer Meadows / Silverwood Leaves	
17	Neagh Bann	Portadown	Park Road area	
18	Neagh Bann	Ballymena	Ballymoney Road	
19	Neagh Bann	Ballymena	Leighinmohr Avenue / Phoenix Fields	Ongoing
20	Neagh Bann	Glengormley & Mallusk	Sandholme Park / Sandyknowes Park	

Existing RCRG Pilot Project Communities – 2014

	River Basin District	Flood Risk Area
1	North East	Sydenham
2	North East	Sicily Park
3	North West	Fintona
4	North West	Beragh
5	North East	Braniel / Whincroft
6	North East	Cregagh
7	Neagh Bann	Broughshane
8	Neagh Bann	Ahoghill
9	Neagh Bann	Coalisland
10	Neagh Bann	Banbridge

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Rivers Agency Capital Works Programme for Significant Flood Risk Areas 2015-2021

Priority	SFRA	RIVERS AGENCY CAPITAL PROGRAMME KEY TO DELIVERY STAGES construction design feasibility pre-feasibility	Estimated Cost £'000	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	Next Cycle
				£'000	£'000	£'000	£'000	£'000	£'000	
		Drainage Infrastructure								
		Small Capital Schemes	£ 3,030							
1		Culvert Upgrading								
2	NERBD	Culvert Upgrading Kinnegar & Locksley Park	£ 590							
3	NERBD	Culvert Upgrading Taughmonagh Stream	£ 1,400							
6	NWRBD	Omagh Hunter Crescent	£ 650							
6	NBRBD	Newry - Greenbank Upgrading	£ 1,600							
10	NERBD	Belfast - Shangarry Stream	£ 200							
38	NBRBD	Lower Bann - Cutts Sluices	£ 1,100							
		Flood Alleviation								
		Small Capital Schemes	£ 1,800							
c	NERBD	Belfast - Culvert upgrading on the Knock & Loop Rivers - Project Management	£ 246							
c	NERBD	Belfast - Culvert upgrading on the Knock & Loop Rivers - Construction	£ 4,393							
c	NERBD	Belfast - Flood Alleviation Works integrated with the Greenway Project - PHASE II	£ 6,500							
3	NERBD	EBFAS - Glenbrook River	£ 550							
9	NBRBD	Newry - Review of flood protection	£ 3,000							
11	NERBD	Belfast - La Salle Stream Riverdale Park East	£ 50							
13	NBRBD	Antrim - Holywell Burn - Tesco	£ 150							
13	NERBD	Whiteabbey-Concrete Row	£ 1,200							
17	NBRBD	Mallusk - Rogan Manor	£ 550							
21	NERBD	Belfast - Tidal	£ 1,000							
22	NERBD	Belfast - Blackstaff Study	£ 2,000							
22	NWRBD	Omagh - Review of flood protection	£ 2,150							
25	NBRBD	Galgorm - Gallaghers Back Drainage	£ 150							
27	NERBD	Newcastle - Shimna River Flood Alleviation	£ 2,500							
29	NBRBD	Newry - Greenan Road	£ 150							
32	NBRBD	Portadown Significant Flood Risk Area	£ 100							
32	NBRBD	Bannbridge-Showgrounds Stream II	£ 600							
34	NBRBD	Lurgan Significant Flood Risk Area	£ 100							
36	NBRBD	Ballymena Significant Flood Risk Area	£ 100							
36	NERBD	Carrickfergus & Kilroot Significant Flood Risk	£ 100							
42	NWRBD	Londonderry Significant Flood Risk Area	£ 100							
42	NBRBD	Antrim - Riverside	£ 2,550							
Overall Expenditure 2015-2021			**£ 35,579**							
Next Plan Cycle 2021-2027										
46	NWRBD	Strabane Significant Flood Risk Area	£ 100							
50	NERBD	Dundonald Significant Flood Risk Area	£ 100							
50	NERBD	Banbridge Significant Flood Risk Area	£ 100							
50	NERBD	Bangor Significant Flood Risk Area	£ 100							
54	NBRBD	Muckamore	£ 550							
50	NERBD	Newtownabby Significant Flood Risk Area	£ 100							
50	NBRBD	Warrenpoint Significant Flood Risk Area	£ 100							
50	NERBD	Downpatrick Significant Flood Risk Area	£ 100							
59	NERBD	Carrickfergus - Sullatober Phase III	£ 500							
59	NERBD	Belfast - Ashton Park	£ 500							
60	NERBD	Newtownards Significant Flood Risk Area	£ 100							
62	NBRBD	Antrim - Meadowside	£ 500							
63	NERBD	Jordanstown - Greenisland Stream	£ 1,000							
63	NERBD	Whiteabbey-Threemile water	£ 500							
Overall Expenditure 2015-2021			**£ 4,350**							

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Rivers Agency Capital Works Programme for Areas of Further Study and Local Flooding Problems

Priority	Local Flood Risk	AFS	RIVERS AGENCY CAPITAL PROGRAMME KEY TO DELIVERY STAGES construction design feasibility pre-feasibility	Estimated Cost £'000	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	Next Cycle
			Drainage Infrastructure								
16	YES		Hillsborough Dam	£ 440							
31	YES		Lower Bann - Operating Regime	£ 100							
39	YES		Lower Bann - Sluice gate drum housings	£ 825							
44	YES		Dunminning Weir - Upgrading	£ 1,000							
48		YES	Limavady - Black Brae	£ 550							
			Flood Alleviation								
3		YES	Limavady - River Roe	£ -							
8		YES	Lisburn - Milltown Stream	£ 100							
12		YES	Coalisland-Flood Alleviation Scheme	£ 700							
13		YES	Lisburn - Flush Bridge Stream	£ 100							
17	YES		Mayobridge	£ 650							
22		YES	Limavady - Weeling Street Drain	£ -							
29	YES		Dromara - Flood Alleviation	£ 150							
34	YES		Laurelvale - Stream II	£ 870							
39		YES	Broughshane - Flood Alleviation	£ 50							
39		YES	Ahoghill	£ 1,100							
			Overall Expenditure	£ 6,635							
			Next Plan Cycle								
45			Larne - Lynn River	£ 50							
46			Greenisland - Glenisland Terrace	£ 100							
48			Ballygawley - Bocketts Road	£ 500							
50			Doagh - FAS	£ 1,500							
61			Dunadry - Clady River	£ 1,500							
			Overall Expenditure	**£ 3,650**							

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