Planning and Flood Risk

Supplementary Planning Guidance

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www.belfastcity.gov.uk/LDP

Belfast City Council

Belfast

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1 Introduction

1.1 Overview

1.1.1 Flooding is a natural phenomenon that cannot be prevented entirely. However effects are wide ranging and can impact on a wide range of human activities and interests, the most obvious being the health and wellbeing of people directly caught up in flood events and the damage caused to property by inundation of flood water. Current pressures for development are also causing an increased number of applications to develop land which is itself susceptible/vulnerable to flooding, or that could intensify existing problems elsewhere. The effects of flooding on human activity are wide ranging. Floods have the potential to cause fatalities and injury, displacement of people, pollution and health risk, damage to buildings and infrastructure, adverse environmental impacts and to severely compromise economic and social activities.

1.1.2 All types of flooding are predicted to increase because of the impact of climate change. The EU Floods Directive requires that climate change is taken into account in the assessment of flood Risk.

1.1.3 The purpose of this Flooding Supplementary Planning Guidance (SPG) is to support policies ENV4 – Flood risk and ENV5 – Sustainable drainage systems (SuDS) of the Belfast LDP Plan Strategy 2035. There is further specific guidance provided separately for SuDS.

1.1.4 It is intended that this SPG will also provide advice and guidance to applicants to ensure that new development in areas at risk from flooding are adequately protected and that the risk of flooding elsewhere is not exacerbated as a result of development.

1.1.5 This planning guidance should be read in conjunction with the Belfast LDP Plan Strategy 2035, which sets out the detailed planning policies for development within the council area. It should also be read in conjunction with the Strategic Planning Policy Statement for Northern Ireland (SPPS).

2 Policy Context

2.1 European/National Policy

The European Union Floods Directive (Directive 2007/60/EC)

2.1.1 The European Union Floods Directive (Directive 2007/60/EC) was introduced in 2007 and provided a new approach to managing flood risk on a catchment wide scale. The European Union Flood Directive provides the platform to fully implement sustainable flood management within Belfast council area. Such an approach can help deliver cost effective and sustainable solutions, protecting vulnerable homes and businesses from flooding, whilst also benefiting the environment and biodiversity within the city.

2.1.2 The European Union Floods Directive confirms that development can exacerbate the consequences of flooding and identifies the important role of the planning system in managing development so as to reduce the risks and impacts of flooding. In this regard, the Directive highlights the fundamental importance of preventing or restricting new development in flood prone areas. In addition, the Directive recognises the role of the planning system in regulating new development in existing built up areas so as to afford greater protection to people and property, where this is considered appropriate and commensurate with the flood risk.

The Water Environment (Floods Directive) Regulations (Northern Ireland) 2009

2.1.3 The European Union Flood Directive was transposed into local legislation by The Water Environment (Floods Directive) Regulations (Northern Ireland) 2009. Article 4 of the Directive requires that each member state undertakes a Preliminary Flood Risk Assessment (PFRA) for their respective territories.

2.1.4 The Floods Directive Regulations are delivered in three stages:
1. Completion of a Northern Ireland flood risk assessment (NIFRA) - this will identify Areas of Potential Significant Flood Risk (APSFR);
2. Preparation of flood hazard and flood risk maps (FHRM) for the APSFR; and
3. Preparation of the flood risk management plan (FRMP) - this will include objectives and measures to manage potential flood risks in each APSFR. .

2.1.5 Flood Risk Management Plans for Northern Ireland were produced to comply with the requirements of the Directive and the Regulations. The Directive encourages the use of non-structural flood management measures (soft engineering techniques), such as using natural flood plains and wetlands to store water during floods and makes flood management a key part of river basin management process under the Water Framework Directive. It is recognised that such measures may not sufficiently protect against extreme events but can be used to mitigate more frequent events

and to provide environmental benefits. The EU Commission encourages stronger links between Floods Directive and Water Framework Directive. The Water (Amendment) (NI) (EU Exit) Regulations 2019 ensure that the Water Framework Directive (as transposed) and the various pieces of supporting legislation continue to operate in Northern Ireland post January 2021.

2.1.6 DfI Water and Drainage Policy Division has published the Northern Ireland Flood Risk Assessment (NIFRA) 2018 which can be viewed here: www.infrastructure-ni.gov.uk/publications/northern-ireland-flood-risk-assessment-nifra-2018

2.1.7 The Northern Ireland Flood Risk Assessment (NIFRA) 2018 is a high level analysis of the potential economic, social and environmental impacts which could result from potential flooding in Northern Ireland. It included a review of the Preliminary Flood Risk Assessment (PFRA) 2011 and uses DfI's flood maps to identify what areas are potentially at risk of fluvial (river), coastal and pluvial (surface water) flooding. Assessments will be carried out on a six year cycle, which allows for the inclusion of new and improved information. The NIFRA 2018 has assessed the areas to be at the greatest flood risk, identified as 'Areas of Potential Significant Flood Risk' (APSFR). Belfast is included as an APSFR. The Second Cycle Northern Ireland Flood Risk Management Plan 2021-2027 (December 2021) includes specific measures tailored to manage flood risk in APSFRs (and other locations) and can be found at this link: Second Cycle Northern Ireland Flood Risk Management Plan 2021-2027. https://www.infrastructure-ni.gov.uk/publications/second-cycle-northern-ireland-flood-risk-management-plan-2021-2027

2.2 Regional planning policy

Regional Development Strategy (RDS) 2035

2.2.1 The RDS also recognises the need to avoid, where possible, the selection of flood prone land for employment and housing growth. It urges the planning system to adopt a precautionary approach to development in areas of flood risk and the use of the latest flood risk information that is available in order to properly manage development. It also promotes a more sustainable approach to the provision of water and sewage services and flood risk management and to integrate water and land-use planning and encouraging sustainable surface water management.

Strategic Planning Policy Statement (SPPS) for Northern Ireland (2015)

2.2.2 The aim of the SPPS in relation to flood risk is to prevent future development that may be at risk from flooding or that may increase the risk of flooding elsewhere. It acknowledges that development can increase the consequences of flooding and identifies the important role of the Local Development Plan in zoning land so as to avoid and reduce the risks of flooding.

2.2.3 The SPPS requires flood risk to be managed by adopting a precautionary approach to the identification of land for development through the LDP process and the determination of development proposals.

2.2.4 The SPPS Regional Strategic Objectives- for the management of flood risk are to:

- prevent inappropriate new development in areas known to be at risk of flooding, or that may increase the flood risk elsewhere;
- ensure that the most up to date information on flood risk is taken into account when determining planning applications and zoning / designating land for development in Local Development Plans (LDPs);
- adopt a precautionary approach to the identification of land for development through the LDP process and the determination of development proposals, in those areas susceptible to flooding where there is a lack of precise information on present day flood risk or future uncertainties associated with flood estimation, climate change predictions and scientific evidence;
- manage development in ways that are appropriate to the four main sources of flood risk in Northern Ireland, i.e. fluvial, coastal, surface water [pluvial] and water impoundment (reservoir) breach or failure;
- seek to protect development that is permitted within flood risk areas by ensuring that adequate and appropriate measures are employed to mitigate and manage the flood risks;
- promote sustainable development through the retention and restoration of natural flood plains and natural watercourses as a form of flood alleviation and an important environmental and social resource;
- promote sustainable development through encouraging the use of sustainable drainage for new development and redevelopment / regeneration schemes;
- promote public awareness of flood risk and the flood risk information that is available and of relevance to undertaking development; and
- promote an integrated and sustainable approach to the management of development and flood risk which contributes to:
    - the safety and well-being of everyone,
    - the prudent and efficient use of economic resources,
    - the conservation and enhancement of biodiversity, and the conservation of archaeology and the built heritage.

2.2.5 The SPPS sets out a number of priorities on flood risk, identifying for different types of development and locations. These form the basis of this SPG.

2.3 Other Policies

Sustainable Water- A long Term Strategy for Northern Ireland (2015-2040)

2.3.1 This Strategy presents an overarching approach to help facilitate implementation of a range of initiatives aimed at delivering the long term vision to have a sustainable water sector in Northern Ireland. One of the key aims and principles of the document is 'Principle 4 – Flood Risk Management', which supports what is said within SPPS, which is that flooding is a natural process and cannot totally be eliminated, but it is important that it is sustainably managed to help protect social, economic and environmental development.

2.3.2 Key aims in the Strategy are:

- Deliver Sustainable Flood Resilient Development
- Manage the Catchment to Reduce Flood Risk
- Provide Sustainable Integrated Drainage in Rural and Urban Areas
- Improve Flood Resistance and Resilience in high Flood Risk Areas
- Be Prepared for Extreme Weather Events

Living With Water Programme- (Department for Infrastructure)

2.3.3 While there is already considerable joint working by the various drainage organisations to address flooding problems and improve/protect water quality in the environment, there is as yet, no agreed cross-departmental infrastructure plan at a strategic level to support economic growth, provide for the long term management of flood risk and improve water quality in the wider environment. In July 2014 the Northern Ireland Executive agreed to set up an interdepartmental group to develop a Strategic Drainage Infrastructure Plan (SDIP) for Belfast to protect against flood risk, enhance the environment and support economic growth.

2.3.4 To facilitate the development of the SDIP for Belfast, the Department for Infrastructure (DfI) is taking forward the Living With Water Programme (LWWP). The Board includes senior representatives from DfI, the Northern Ireland Environment Agency (NIEA), the Utility Regulator (UR), Northern Ireland Water (NI Water) and Belfast City Council. The Living With Water in Belfast Plan was published in November 2021 and aims to deliver a long-term approach to drainage and wastewater management that will protect from flooding, provide a cleaner and greener environment and ensure that Belfast is open for business and investment. The Plan can be viewed here: Living With Water in Belfast Plan https://www.infrastructure-ni.gov.uk/publications/living-water-belfast-plan.

The Reservoirs Act (Northern Ireland) 2015

2.3.5 This legislation provides for a proportionate regulatory framework for the management and maintenance of controlled reservoirs to mitigate the potential flood risk due to reservoir failure. The legislation will apply to all reservoirs capable of

holding 10 000 cubic metres or more of water above the natural level of any part of the surrounding land. These are known as controlled reservoirs.

2.3.6 The flood risk from controlled reservoirs may have implications for the planning process. For all development proposals that are located within the potential flood inundation area of a controlled reservoir, see Section 4.10. Technical Guidance Note 25 (TGN 25) Revised, June 2020 published by Department for Infrastructure, explains the general approach DfI Rivers will follow when providing advice to Planning Authorities on all relevant applications for development within the potential flood inundation areas of controlled reservoirs as shown on Flood Maps (NI).

The TGN25 Revised, June 2020 can be accessed on the Department's website at the web link below:-
https://www.infrastructure-ni.gov.uk/sites/default/files/publications/infrastructure/tgn-25-practical-application-strategic-planning-policy-development-in-proximity-to-reservoirs-june20.PDF

Controlled Reservoir Maps for Belfast can be viewed at Reservoir Flood Map .
http://www.infrastructure-ni.gov.uk/articles/what-reservoirs-bill-northern-ireland#toc-6

3 Belfast Local Development Plan

3.1 Plan Strategy

3.1.1 Local Development Plan (LDP) preparation makes use of the latest flood risk information produced by the Department for Infrastructure and works in collaboration with relevant Departments, adjacent councils and agencies. It takes account of the potential risks from flooding over the plan period and beyond, as this will influence decisions on such matters as the zoning of land for development. The LDP also promotes sustainable drainage within the plan area.

3.1.2 The council has a number of strategic policies to tackle the issues of environmental change, part of which is to make the city more resilient to cope with increasing flood risk. Strategic Policy SP6 - Environmental Resilience aims to promote mitigation and adaption to environmental change and to ensure that new developments are away from areas where climate-related hazards are already present or predicted such as flood plains. SP6 is supported by operational policy ENV4 - Flood Risk. Policy ENV5 - SuDS is also linked to SP6 and ENV4. Both policies are set out in full below:

3.2 Policy ENV 4 - Flood Risk

Policy ENV 4 – Flood Risk

Planning applications in flood risk areas must be accompanied by an assessment of the flood risk in the form of a Flood Risk Assessment (FRA). The council will have regard to guidance publications produced by other authorities and prospective developers/applicants are advised to liaise early in the formulation of their proposals with DfI Rivers to clarify flooding or flood plain issues that may affect particular sites.

In all circumstances, the council will adopt a precautionary approach in assessing development proposals in areas that may be subject to flood risk presently or in the future as a result of environmental change predictions. All planning applications will be determined with reference to the most up to date flood risk information[1] available and in consultation with DfI Rivers and other relevant bodies as appropriate.

The SPPS sets out the planning policies for flood risk to minimise flood risk to people, property and the environment. The council will take full account of these in assessing development proposals.

1 Flood Maps: www.infrastructure-ni.gov.uk/topics/rivers-and-flooding/flood-maps-ni

3.3 Policy ENV 5 – Sustainable Drainage Systems (SuDS)

Policy ENV 5 – Sustainable drainage systems (SuDS)

All built development should include, where appropriate, SuDS measures to manage surface water effectively on site, to reduce surface water runoff and to ensure flooding is not increased elsewhere. A two stage SuDS treatment should be used, where possible, in order to improve water quality. An appropriate maintenance and management plan for all SuDS will require to be agreed with the council and a s76 planning agreement may also be sought.

Developers should consider the following SuDS measures to assist in minimising flood risk:

a. Green roofs (intensive and/or extensive systems);

b. Swales;

c. Filter strips and filter drains;

d. Permeable or porous paving;

e. Detention basins;

f. Open areas, ponds and wetlands; and

g. Trees and landscaping.

4 Flooding Guidelines

4.1 Flooding Guidelines

4.1.1 A key objective of the LDP is to ensure environmental resilience for a growing and vibrant city. The LDP polices relating to environmental resilience focus on a range of mitigation and adaptation measures. This includes making the council area resilient to cope with increasing flood risk, which include the following aims:

- Manage development within areas of flood risk and ensure the sustainable design of new development reduces future risk from flooding. Encourage flood resilient design to build the city's resilience for future generations; and
- Working with natural environmental processes, for example through promoting the development of green infrastructure and also the use of SuDS, to reduce flood risk and improve water quality.

4.1.2 These policy aims are consistent with the policy approach set out in the SPPS, which provides clear 'policies' for addressing and considering development in flood risk areas. Further guidance is set out below:

4.2 Development in Flood Plains

Development will not be permitted within 1 in 100 year fluvial plain (AEP[2] of 1%) *plus the latest climate change prediction* or the 1 in 200 year coastal flood plain (AEP of 0.5%) *plus the latest climate change prediction* unless the applicant can demonstrate that the proposal constitutes an exception to the policy.

[2] AEP: Annual Exceedance Probability – The annual probability of a flood exceeding the peak floodwater level.

Flood Plain Definition

4.2.1 Flood plains store and convey water during times of flood. These functions are important in the wider flood management system. A river or fluvial flood plain is a generally flat area adjacent to a watercourse/river where water flows in time of flooding or would flow but for the presence of flood defences. A coastal flood plain is a generally flat area adjacent to the sea where water flows in a flood, attributed to the combination of high tide levels, surge, wave action and sea level rise or would flow but for the presence of coastal flood defences. Estuarine flooding can originate from a combination of both river and coastal sources. In such areas the policy will

apply to the greatest flood risk, normally the higher flood level and greater area of flood inundation. The limits of the flood plain are defined by the peak water level of an appropriate return period event. Flood risk areas are depicted on the latest version of Flood Maps NI on the DfI Rivers website at: Flood Maps (NI) (arcgis.com) (www.infrastructure-ni.gov.uk/topics/rivers-and-flooding/flood-maps-ni).

4.2.2 For planning proposes, taking into account climate change predictions based on the latest available scientific evidence, fluvial and coastal flood plains are defined below:

- **Fluvial Flood Plain**- The extent of a modelled flood event within a 1 in 100 year probability (AEP of 1%), plus the latest climate change prediction.
- **Coastal Flood Plain**- The extent of a modelled tidal event with a 1 in 200 year probability (AEP of 0.5%), plus the latest climate change prediction.

4.2.3 New development within a flood plain will not only be at risk of flooding itself but it will add to the risk of flooding elsewhere. The cumulative effect of piecemeal development within a river flood plain can also redirect flows and will also undermine its natural function in accommodating and attenuating flood water. Therefore avoiding development in flood plains is the most cost-effective and sustainable method of managing flood risk.

Exceptions to development within Flood Plains

4.2.4 The SPPS policy states built development must not be permitted within the flood plains of rivers or the sea unless the following circumstances apply:

- The development proposal constitutes a valid exception to the general presumption against development in flood plains. Exceptions for **defended** and **undefended** areas of the flood plain are set out below.
- The development proposal is of overriding regional or sub-regional economic importance; and
- The development proposal is considered as minor development in the context of flood risk.

Where the principle of development is accepted by the council through being an exception to policy as set out below under Exceptions, the applicant is required to submit a Flood Risk Assessment for all proposals. Planning permission will only be granted if the Flood Risk Assessment demonstrates that:

a) All sources of flood risk to and from the proposed development have been identified; and
b) There are adequate measures to manage and mitigate any increase in flood risk arising from the development.

Exceptions in defended areas

Subject to an Exception being granted by the council, previously developed land protected by existing flood defences, with cored earthen flood banks or hard engineered walls, constructed to the appropriate standard and height, will generally be considered acceptable for development, provided it does not fall into any of the following categories:

- **Exclusion 1- Essential infrastructure (such as Power supply, telecommunications, emergency services).**
- **Exclusion 2- Development for the storage of hazardous substances;**
- **Exclusion 3- Bespoke accommodation for vulnerable groups (such as hospitals, schools, residential/ nursing homes, sheltered housing; or**
- **Exclusion 4- Any development located close to flood defences.**
- **Exclusion 5- Proposals involving significant intensification of use will be considered on their merits and will be informed by Flood Risk Assessment.**

There is a presumption against development of green field sites in defended areas.

4.2.5 A 'Defended Area' for planning purposes is development of previously developed land protected by flood defences that are confirmed by DfI Rivers, as the competent authority, as structurally adequate and provide a minimum standard of flood protection of 1 in 100 year fluvial (1% AEP) plus latest climate change predictions or 1 in 200 year coastal (0.5 AEP) plus latest climate changes predictions.

4.2.6 Previously developed land protected by existing flood defences, either cored earthen flood banks or hard engineered walls, constructed to the appropriate standard and height, will generally be considered acceptable for development. All finished floor levels (including gardens, roads driveways and paths) should be placed at a minimum of 600mm above the flood plains so defined above.

4.2.7 It is important to recognise that whilst a flood defence system is designed to reduce the risk of flooding, it does not prevent it completely and therefore a residual risk remains. Flood defences are designed to protect land from a specific height of flood water such as a 100 year fluvial or 200 year coastal flood event. The possibility of a flood greater than this occurring and overtopping the defences (the residual flood risk) will always remain. Residual risk is that which remains after all risk avoidance, substitution and mitigation measures have been implemented, on the basis that such measures can only reduce risk, not eliminate it.

4.2.8 In addition, the potential for structural collapse and breaching of the defences remains and could result in sudden and rapid inundation of flood water. There is also potential for back drainage systems to become overwhelmed as they are unable to discharge effectively when water levels remain high during flood conditions. In all such circumstances flood water within defended areas is likely to become trapped by the defences, resulting in longer term impacts and may require evacuation and pumping or other engineering solutions to remove.

4.2.9 Because of these flood risks there are restrictions placed on the location of development relative to flood defences and this restricts certain types of development for which the consequences of a flood event could be serious: therefore the following development is not considered acceptable in defended areas:

Development NOT considered acceptable in Defended Areas:

Exclusion 1

4.2.10 Development proposals for essential infrastructure, such as for emergency services / emergency depots, power supply and telecommunications will be resisted because access and uninterrupted operation cannot be guaranteed in locations where there is a residual flood risk.

Exclusion 2

4.2.11 Development proposals involving the storage and processing of hazardous materials and potential pollutants which may be likely to give rise to significant levels of environmental pollution in the event of damage caused by flooding should be discouraged because of the residual flood risk in defended areas. Therefore such proposals will only be granted planning permission where it is demonstrated that an alternative lower risk location is not available and that adequate provision is made for pollution containment so as to prevent a pollution incident in the event of flooding.

Exclusion 3

4.2.12 Development proposals involving bespoke accommodation for vulnerable groups will be resisted. Flood warning and evacuation procedures may be difficult to implement for people with disabilities or those whose mobility is otherwise impaired, therefore their risks of injury or fatality are somewhat greater than for the general population. Accordingly, because of the residual flood risk, there is a presumption against permission being granted for development associated with vulnerable groups. This includes facilities such as children's nurseries, schools, residential care / nursing homes, sheltered housing and hospitals. This list is not exhaustive.

Exclusion 4

4.2.13 Development close to flood defences will be resisted as such land will often be low lying and therefore the most susceptible to flooding. Also, it may need to be available for temporary flood storage in a flood event. DfI Rivers will provide advice on this and developers are advised to seek guidance from DfI Rivers on acceptable separation distances from flood Defences.

Exclusion 5

4.2.14 Because of residual risk, development involving a significant intensification of use will be resisted. A typical example of significant intensification is the conversion of a single dwelling unit or commercial/industrial premises to a number of dwellings. Such intensification of use exposes more people to the residual flood risk in defended areas. However, whilst such development is not desirable in the context of flood risk, this factor must be balanced against other material considerations. Accordingly, each application will be determined on its individual merits taking account of the scope for mitigation of the residual flood risk. Nevertheless, it is understood that DfI Rivers will generally advise against significant intensification as it will expose more people to flood risk.

Flooding at Ardgowan Drive, East Belfast

Exceptions in undefended areas

New development may be permitted in the undefended coastal flood plain in specific, limited circumstances. Such development should not result in additional flood risk elsewhere in the coastal flood plain.

In order to minimise the potential incidence of coastal erosion to the development (or elsewhere as a result of it), particularly in areas of 'soft' coastline, development should only be permitted within settlements where a built footprint will have already been established.

Such proposals will need to satisfy normal planning criteria such as access, service provision and acceptable visual and amenity impacts. Importantly, such development should not generate a present or future need for flood defences nor should it exacerbate problems of coastal erosion in susceptible areas.

4.2.15 An 'Undefended Area' is an area within the flood plain that is not protected by flood defences. This applies to the vast majority of fluvial and coastal flood plains. Undefended areas are at much higher flood risk than defended areas, although the flooded areas are usually more predictable and flood water usually recedes more quickly.

4.2.16 Any built development will cause piecemeal reduction of the flood plain and potentially remove valuable flood storage area, which may cause or exacerbate flooding elsewhere. Development also has the potential to impair the conveyance function of the flood plain and its ecological integrity. For these reasons, and also the need to limit exposure of people and property to flood risk, built development and infrastructure works, particularly on green field sites, will normally not be permitted.

4.2.17 Infilling and land raising to an appropriate level above the flood plain will have a negligible effect on the extent of the coastal flood plain, now or in the future, taking account of anticipated climate change.

4.2.18 It is recognised that in certain cases, development or infrastructure has to be in such locations, as alternative lower flood risk sites would be neither practical nor available. Full list of exceptions to the policy are highlighted in Table 1, and further expanded below. Where, by exception or overriding need, built development is acceptable in principle in the flood plain, then a Flood Risk Assessment (FRA) is required - see Appendix E.

Exception to Policy	Explanation and Justification
U1 - Replacement of an existing building. Proposals that include essential infrastructure, storage of hazardous materials or bespoke accommodation for vulnerable groups or that involve significant intensification of use should be avoided.	**Essential Infrastructure - Reasons**: residual risk, need to maintain access and continuity of service in the event of a flood. **Hazardous materials - Reasons**: residual risk and flooding could lead to pollution and environmental damage. **Bespoke accommodation for vulnerable groups - Reasons:** residual risk and putting vulnerable groups at risk. Vulnerable groups may not be able to evacuate themselves and it may be difficult for emergency evacuate them. This may put emergency services themselves at greater risk.
U2 - Development for agricultural use, transport and utilities infrastructure, which for operational reasons has to be located within the flood plain.	It is important to consider the safety of the users of such facilities and that the proposed development does not increase flood risk elsewhere.
U3 - Water compatible development such as for boat mooring, navigation and water based recreational use, which for operational reasons has to be located within the flood plain.	It is important to consider the safety of the users of such facilities and that the proposed development does not increase flood risk elsewhere.
U4 - The use of land for sport and outdoor recreation, amenity open space or for nature conservation purposes, including ancillary buildings. **This exception does not include playgrounds for children.**	It is important to consider the safety of the users of such facilities and that the proposed development does not increase flood risk elsewhere. **Children's playgrounds should not be located in flood plains as this puts vulnerable groups at risk.**
U5 - The extraction of mineral deposits and necessary ancillary development.	It is important to consider the safety of the users and operators of such facilities and that the proposed development does not increase flood risk elsewhere.

Table 1: Policy Exceptions in undefended areas

Exception U1

Replacement of an existing building may be considered on the basis that this should not normally result in any material increase in the flood risk to the development or elsewhere. Suitable flood proofing measures through resistance and resilience construction should be used.

There is a presumption against development where proposals include essential infrastructure, storage of hazardous substances, bespoke accommodation for vulnerable groups or development located close to flood defences.

4.2.19 Replacement of an existing building may be considered on the basis that this should not normally result in any material increase in the flood risk to the development or elsewhere. This is subject to the further considerations below.

4.2.20 The adoption of suitable flood proofing measures through resistance and resilience construction (Appendix F) will normally be expected.

4.2.21 The replacement of a building to provide bespoke accommodation allowing for the introduction of vulnerable groups to the flood risk area is unacceptable. Similarly, replacement of a building to accommodate essential infrastructure will be unacceptable as continual access and egress for operational activities will no longer be possible when the area has been cut off during a flood event.

4.2.22 A replacement proposal which involves significant intensification of use, for example through increasing the existing footprint or change of use, will be resisted if this would have the effect of introducing more people to a high flood risk area.

Exception U2

Development for agricultural use, transport and utilities infrastructure, which for operational reasons has to be located within the flood plain.

4.2.23 In regard to agricultural and minerals development, this exception will only apply where the unit is located wholly in the flood plain or where the use of other land outside the flood plain would not be feasible and available. It is important to

consider the safety of the users of such facilities and that the proposed development does not increase flood risk elsewhere.

Exception U3

Water compatible development such as for boat mooring, navigation and water based recreational use, which for operational reasons has to be located within the flood plain.

4.2.24 It is important to consider the safety of the users of such facilities and that the proposed development does not increase flood risk elsewhere.

Exception U4

The use of land for sport and outdoor recreation, amenity open space or for nature conservation purposes, including ancillary buildings. This exception does not include playgrounds for children.

Provision of areas for amenity open space, sports, outdoor recreation and nature conservation purposes in flood plains where justified by an acceptable flood risk assessment.

Children's playgrounds should not be permitted in flood plains as such proposals would have the effect of exposing a vulnerable group to flood risk.

Ancillary development such as changing facilities and job-related accommodation for caretakers and staff (but excluding clubhouses and social facilities) may be acceptable where justified by the flood risk assessment.

The use of synthetic sports surfaces should be resisted. Where this would increase the flood risk to the site or elsewhere. It should also be noted that such materials are prone to damage through flooding.

4.2.25 This guidance allows for the provision of areas for amenity open space, sports, outdoor recreation and nature conservation purposes on the basis that such areas are not generally occupied and are unlikely to incur major damage as a result of

flooding. In some circumstances, it may be possible to incorporate flood alleviation measures to the benefit of the wider community e.g. Connswater Community Greenway.

4.2.26 Changing rooms are intermittently occupied and can be made resilient against flooding i.e. if they flood, they can be brought back into service quickly and with minimum cost. Clubhouses and social facilities may be occupied for extended periods by many people. Flooding can put these people at risk. Post-flooding repairs can be protracted and expensive. Synthetic sports surfaces may increase the flood risk to the site or elsewhere. It should also be noted that such synthetic surfaces are prone to damage by flooding and repair can be very expensive or impossible.

Exception U4.1

Amenity and Recreation FRA and Mitigation

Even though these amenity and recreation areas are intermittently occupied, proposals will be required to demonstrate by means of a Flood Risk Assessment:

1. **Adequate mitigation measures to ensure there is no increase in flood risk elsewhere.**
2. **Provision of adequate flood warning procedures and;**
3. **Safe means of evacuation from the site.**

Open space areas in the undefended flood plain should be suitably contoured to avoid ponding and to allow for the quick recession of flood water.

4.2.27 It is important to consider the safety of the users and operators of such facilities and that the proposed development does not increase flood risk elsewhere.

Exception U4.2
Use of public open space for flood storage

Where a proposal for residential development includes land adjacent to or partially within a flood plain, it will normally be acceptable to utilise the flood plain land for public open space associated with the housing. This will only be acceptable where there is no infilling of the flood plain and suitable mitigation measures such as signage are in place to facilitate safe access and egress.

4.2.28 It is important to consider the safety of the users and operators of such facilities and that the proposed development does not increase flood risk elsewhere.

Exception U4.3
Publicly funded and constructed flood defences

New hard engineered or cored earthen bank flood defences, publicly funded and constructed, are seen as a necessary and acceptable flood mitigation method to protect existing property that is already in the flood plain and is liable to repeated flooding and resulting damage.

4.2.29 Publicly funded and constructed flood defences are provided for the wider benefit of society to alleviate flooding problems only in circumstances where there is a positive benefit to cost ratio. Such works are not used to facilitate commercial or private development.

4.2.30 New hard engineered or earthen bank flood defences, proposed by the applicant, will not be seen as justification to allow development in the flood plain to proceed. This is because the defences will remove valuable flood storage from the flood plain, which may put other locations at increased flood risk, and also introduce people to an area where the threat of residual flooding by overtopping or collapse will always remain.

Exception U5

The extraction of mineral deposits and necessary ancillary development.

4.2.31 It is important to consider the safety of the users and operators of such facilities and that the proposed development does not increase flood risk elsewhere.

4.3 Development Proposals of Overriding Regional or Sub-Regional Economic Importance

A development proposal within the Flood Plain that does not constitute an exception to the policy may be permitted where it is deemed to be of overriding regional or sub regional economic importance and meets both of the following criteria:

- **Demonstration of exceptional benefit to the regional or sub-regional economy;**
- **Demonstration that the proposal requires a location within the flood plain and justification of why possible alternative sites outside the flood plain are unsuitable.**

Where the principle of development is established through meeting the above criteria, the Council will steer the development to those sites at lowest flood risk.

The applicant is required to submit a Flood Risk Assessment for all proposals.

4.3.1 It is recognised that in certain exceptional circumstances development in a flood plain may be justified. It is the responsibility of the Council to ensure that both criteria are met and then to steer the development to those sites at lowest flood risk.

4.3.2 While most economic development is best located outside of flood plains, it is accepted that certain projects because of their nature, size or site specific requirements, may require a site that happens to fall within a flood plain. In such circumstances the policy allows for development that is demonstrated to be of significant regional or sub- regional economic importance. Normally, such a proposal will be expected to demonstrate its particular contribution to the regional economy. However, a proposal may also be considered acceptable if it is of significant sub-regional economic importance, for example, in providing employment for a substantial number of people living in one or more district council areas.

4.3.3 In regard to such proposals, developers must justify the need for a location within the flood plain. As part of this process, there will be a requirement to demonstrate that a thorough search for sites outside the flood plain has been undertaken and to justify why these are considered unsuitable. Subject to the principle of development in the flood plain being accepted by the planning authority, the developer will be prompted

to identify a suitable site in the least vulnerable parts of the flood plain. The development of Greenfield sites in the undefended fluvial flood plain will rarely be acceptable as these areas pose the greatest flood risk.

4.4 Minor Development

Minor development will be acceptable within defended and undefended flood plains subject to a satisfactory Flood Risk Assessment.

4.4.1 Minor development such as non-residential extensions with a footprint less than 150 sq. metres, alterations to buildings and householder development will generally have a negligible effect on flood risk.

- *Alterations*: development that does not increase the size of buildings, e.g. alterations to external finishes;

- '*Householder*' development: e.g. sheds, garages, games rooms etc. within the curtilage of the existing dwellings in addition to extensions to the existing dwelling. This excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of a dwelling house into flats.

4.4.2 The detail and complexity of the Flood Risk Assessment should be commensurate with the size and complexity of the development. It should be noted that while this type of construction may not have a significant effect on its own, if many such constructions take place, there may be a cumulative effect on the degree of permeability of the catchment (sometimes referred to as 'urban creep').

4.5 Unacceptable Flood Protection/ Management Measures

The following flood protection and management measures proposed as part of the planning application, in order to facilitate development within flood plains, will not be acceptable:

- **New hard engineered or earthen bank flood defences;**
- **Flood compensation storage works (Note- such works may be acceptable in limited circumstances);**
- **Land raising (infilling) to elevate a site above the flood level within the undefended fluvial flood plain.**

4.5.1 New flood defences cause loss of flood plain storage, increase in flood risk elsewhere, potentially putting more people at risk of flooding (where there was no such risk previously) and residual risk.

Compensatory Flood Storage

4.5.2 Compensatory flood storage is a means of mitigating the loss of flood plain storage caused by development i.e. flood plain in-filling. However, compensatory flood storage must become effective at the same point in a flood event as the lost storage would have done. It should also provide the same volume, and be at the same level relative to flood level, as the lost storage. This requirement is often referred to as "level for level" or "direct" compensation.

4.5.3 If the compensatory storage is provided at another level, it will already be full (if lower) or still be empty (if higher), when the storage is required, and the characteristics of flood storage at this location will, therefore, be altered. For this reason, the compensatory flood storage must be created adjacent to and be hydraulically connected with the area of development.

4.5.4 Compensatory flood storage should only be acceptable as a mitigation measure after the proposed development has been deemed an Exception to the Policy and the principle of development has been established. When developing policy, it is important to emphasise that compensatory flood storage should not be used to justify or facilitate development in the flood plain .A typical example of where compensatory storage may be acceptable is on strategic road improvement schemes.

Flood Storage and flood plain infilling

4.5.5 SPPS states "Land raising (also known as infilling), which involves permanently elevating a site to an acceptable level above the fluvial flood plain in order to facilitate development will not be acceptable within the fluvial flood plain, where displacement of flood water would be likely to cause flooding elsewhere".

4.5.6 A flood plain is part of the natural topography of a river system. Its purpose is to occasionally store and convey flood water. River flood plains have a finite capacity to store flood water and this is known as "flood storage".

4.5.7 If any built development was to occur in a flood plain, this will cause piecemeal reduction of the volume of flood storage available. This has the effect of displacing flood water which will cause or exacerbate flooding elsewhere. Development in river flood plains can also cause damage to river channels and structures due to increased flow velocities and it also has the potential to impair the conveyance function of the flood plain and its ecological integrity.

4.5.8 Development in the coastal flood plain differs, SPPS states that permitting infilling in certain circumstances may be acceptable: "Such operations within the coastal flood plain will have a negligible effect on its extent and therefore much less likely to cause flooding elsewhere. Land raising to facilitate development at an appropriate level above the coastal flood plain may therefore be possible. However, this should normally be restricted to settlements and proposals will need to satisfy normal planning criteria such as access, service provision and acceptable visual and amenity impacts. Importantly, such development should not generate a present or future need for flood defences nor should it exacerbate problems of coastal erosion in susceptible areas".

Where, by exception or overriding need, built development is acceptable in principle in the flood plain, then a Flood Risk Assessment (FRA) is required.

4.5.9 An FRA must demonstrate the measures that shall be taken to manage and mitigate the identified risks. These measures will be proportionate to the flood risk and generally will be more rigorous in undefended areas than in defended areas where the flood risk is lesser.

4.6 Protection of Flood Defence and Drainage Infrastructure

The Council will not permit development that would impede the operational effectiveness of flood defence and drainage infrastructure or hinder access to enable their maintenance.

4.6.1 Where a new development proposal is located near a flood defence, control structure or watercourse it is essential that it should not compromise the function of that structure or the ability to maintain it.

Maintenance Requirements for Flood Defence and Drainage Infrastructure

4.6.2 Flood defence and drainage infrastructure are critical in providing a level of flood protection to people and property and adequate land drainage. Where a new development proposal is located beside a flood defence, control structure or watercourse, it is essential that an adjacent working strip is retained to facilitate future maintenance by DfI Rivers, other statutory undertakers or the riparian landowners. It is important to consider the following when formulating policy:

Flood Defences & Control Structures

4.6.3 The working strip should have a minimum width of 5 metres, but up to 10 metres where considered necessary, and be provided with clear access and egress at all times. Any variation from the 5 metre wide working strip must be agreed in advance with the relevant local DfI Rivers Area Office.

Open channel watercourses

4.6.4 In the majority of cases, the working strip should extend 5 metres from top of bank on an open watercourse. The working strip should be wide enough to give adequate space from the top of the bank for suitable sized plant to carry out maintenance. Occasionally, there may be reasons for increasing the width of a working strip up to 10 metres, e.g. to facilitate a long reach excavator or where excavator mats are required. On occasion, there may be instances with small urban watercourses where less than 5 metres may suffice. Any variation from the 5 metre wide working strip must be agreed in advance with the relevant DfI Rivers Area Office.

Culverted watercourses

4.6.5 A working strip of minimum 5 metres width is required over the line of the pipe but frequently, more is required, (up to the 10 metres) depending on pipe size and depth of the culvert, in order to give sufficient scope to allow maintenance including replacement or upgrading to a larger culvert or potential future removal / 'daylighting' or re-naturalisation of a watercourse.

4.6.6 In addition to the above, the retention of a working strip along watercourses will have further benefits, including general amenity, enhanced biodiversity and increased control over water pollution, the latter assisting in the implementation of the Water Framework Directive.

4.6.7 It is noted that there is a general presumption against the erection of buildings or other structures over the line of a culverted watercourse in order to facilitate replacement, maintenance or other necessary operations.

Presumption against building over the line of culvert

The Council has a general presumption against the erection of buildings or other structures over the line of a culverted watercourse in order to facilitate replacement, maintenance or other necessary operations.

4.6.8 Constructing buildings over culverts could cause structural problems in both the building and the culvert. Structural damage to the culvert could increase flood risk to the building and elsewhere. Constructing buildings over culverts could cause problems when carrying out maintenance or effecting repairs.

4.7 Development and Surface Water (Pluvial) Flood Risk

4.7.1 Pluvial or surface water flooding occurs as a result of high intensity 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 (e.g. roofs, roads and car parks). Such development inhibits the natural run-off process, often by removing opportunities for surface water storage and restricting infiltration of water into the ground. Surface water runoff and flooding has increased steadily with the expansion of urban areas, the infilling of green spaces and the cumulative effects of minor development such as house extensions and the paving of gardens to provide for patios and car parking.

4.7.2 All of these factors have combined to intensify surface water runoff and place additional pressures on the drainage network, particularly during prolonged periods of high intensity rainfall. It is not uncommon for drainage systems to be overwhelmed during such rainfall events, particularly where blockages occur. The problem is exacerbated in many areas by an outdated drainage infrastructure that has not been upgraded to cope with the rate of development. However, even modern urban drainage systems are designed only to cope with a 1 in 30 year rainfall event while older parts of the network will invariably be operating to a much lower standard.

4.7.3 Damage from pluvial flooding has been a major factor in recent significant flood events in Northern Ireland. In recent flood events it is estimated that up to 80% of the respective total economic damages were attributable to surface water flooding. Although generally localised, this type of flooding may be extended in duration through water being trapped in low lying areas, thus causing more damage to property and greater hardship to the people affected. A flood event caused by an artificial drainage system surcharge can also pose public health risks through foul water contamination.

4.7.4 Areas of predicted surface water flooding and where there is a history of surface water flooding are detailed on the Planning Portal and Flood Maps (NI). Flood Maps (NI) can also assist developers in identifying broad locations where surface water flooding could be a potential problem.

4.7.5 Flood Maps (NI) indicates that approximately 20,000 or 2.5% of the properties in Northern Ireland are sited in an area that is shown to be at risk of flooding from a 1 in 200 year (0.5% AEP) pluvial event greater than 300 mm deep, albeit that many of these properties would already be at risk from fluvial and / or coastal flooding. As a consequence of the predicted increase in the frequency and intensity of extreme

rainfall events due to climate change, urban areas are susceptible to an increasing risk of this type of flooding.

4.8 Thresholds for provision of a Drainage Assessment

A Drainage Assessment will be required for all development proposals that exceed any of the following thresholds:

- **A residential development comprising of 10 or more dwelling units**
- **A development site in excess of 1 hectare**
- **A change of use involving new buildings and / or hard surfacing exceeding 1000 square metres in area.**

4.8.1 DfI Rivers intend to publish a Drainage Assessment Specification.

4.8.2 Development with the associated increase in impermeable surfaces increases the amount of surface water runoff which can lead to surface water flooding to both the proposed development and elsewhere if not properly addressed at design stage. The purpose of a Drainage Assessment is to consider these risks and provide appropriate mitigation.

A Drainage Assessment will also be required for any development proposal, except for minor development, where:

- **The proposed development is located in an area where there is evidence of a history of surface water flooding.**
- **Surface water run-off from the development may adversely impact upon other development or features of importance to nature conservation, archaeology or the built heritage.**

4.8.3 It is important not to exacerbate existing surface water flooding problems or increase flood risk elsewhere. Unrestricted additional run-off due to development of a site discharging to a watercourse will increase flows and may increase flood risk downstream.

4.8.4 A Drainage Assessment will be required when evidence of drainage problems is presented to the Planning Authority, even if the development does not meet the above criteria for a Drainage Assessment.

Drainage Assessment must demonstrate adequate mitigation

Development should only be permitted where it is demonstrated through the Drainage Assessment that adequate measures will be put in place so as to effectively mitigate the flood risk to the proposed development and from the development elsewhere.

4.8.5 Adequate mitigation measures are required not to exacerbate existing surface water flooding problems or increase flood risk elsewhere.

Developer's responsibility to assess and mitigate flood risk.

Where a Drainage Assessment is not required by policy but there is potential for surface water flooding as indicated by the surface water layer of the Flood Maps (NI), it is the developer's responsibility to assess the flood risk and drainage impact and to mitigate the risk to the development and any impacts beyond the site.

4.8.6 Even if a proposed development does not meet the above criteria for a Drainage Assessment, it is the Developer's responsibility to take into account flooding from all sources including surface water.

Fluvial and/or coastal flood risk takes precedence.

Where the proposed development is also located within a fluvial or coastal flood plain, then the fluvial and/or coastal policies will take precedence.

4.8.7 Fluvial and Coastal flooding pose a higher risk and thus should take precedence over surface water flooding.

Consultation with DFI Rivers

In assessing the need for a drainage assessment the Council may consult with DfI Rivers. This may be necessary in order to establish whether there is evidence of a history of surface water flooding at a particular location. Areas which may be prone to surface water flooding are indicated by the surface water layer of the Flood Maps NI.

Consultation will also be carried out as necessary in appraising the drainage assessment. This is necessary not only to assess the adequacy of the proposed control and mitigation measures in the context of the policy, but also to afford the opportunity for such bodies to assess the impact of the measures upon their infrastructure.

4.8.8 Areas which may be prone to surface water flooding are indicated by the surface water layer of the Flood Maps NI. Only DfI Rivers has the necessary knowledge and skills to advise on and assess Drainage Assessments.

Long term maintenance of mitigation measures.

Where a Drainage Assessment for a proposal is acceptable, the Planning Authority will need to be satisfied that suitable arrangements are in place in regard to the long term management and maintenance of the infrastructure on which mitigation depends.

4.8.9 Many mitigation measures require regular maintenance and if that is not provided they will quickly become ineffective thus increasing flood risk to the development and elsewhere.

4.9 Artificial Modification of Watercourses

The Council will only permit the artificial modification of a watercourse, including culverting or canalisation operations, in either of the following exceptional circumstances:

- **Where the culverting of short length (maximum 10 m) of a watercourse is necessary to provide access to a development site or part thereof;**
- **Where it can be demonstrated to the satisfaction of DfI Rivers that a specific length of watercourse needs to be culverted for engineering reasons and that there are no reasonable or practicable alternative courses of action.**

4.9.1 A culvert is defined as an enclosed structure that channels water with integral sides, soffit and invert, including a pipe that contains a watercourse as it passes through or beneath a road, railway, building, embankment etc., or below ground.

4.9.2 The artificial modification of watercourses is likely to have impacts which run contrary to the objectives of sustainable development as embodied in the Water Framework Directive, the Floods Directive and the Northern Ireland Sustainable Development Strategy. Artificial modification of a watercourse, including culverting or canalisation operations should be resisted as such works can have a significant adverse impact on the environment and can increase flood risk.

4.9.3 Culverting and canalisation are generally considered to be environmentally unsustainable as such operations can adversely impact upon visual amenity in the built environment and can damage or impair the landscape quality, ecological integrity and biodiversity of watercourses. Culverting creates barriers to the passage of fish, while the higher flow velocities generated cause the unnatural movement of sediment, increased erosion downstream and hinder the future recovery of the watercourse

4.9.4 Whilst culverting may in some instances alleviate local flood risk, it can increase flood risk downstream by the accumulation of higher flows. The installation of protective grilles at culvert inlets may reduce the incidence of blockages within the culvert, but can often become blocked themselves and cause flooding as a result of a high intensity rainfall event or lack of maintenance. Culverting therefore does not completely remove the potential for local flooding. The length and number of access culverts should be kept to a minimum.

4.9.5 All new development should aim to be in harmony with the water environment. Good layout and design should promote the retention of open watercourses as a central amenity feature, although re-alignment or diversion to enhance the quality of the site layout will normally be acceptable where there are no overriding environmental concerns. Incorporating watercourses into the open space requirements for new residential development will be preferred to locating them to the rear of properties where they are difficult to maintain or can become dumping grounds contributing to flood risk. Councils may wish to reinforce that where possible the removal of culverts and the re-introduction of the natural watercourse should be encouraged.

4.9.6 The council will seek the use of sustainable drainage solutions (SuDS) for the disposal of storm water as it may be a much more sustainable alternative than culverting or other options involving the artificial modification of watercourses. The use of SuDS source control solutions such as ponds and swales and their integration into new development schemes as amenity features should therefore be encouraged. Such solutions, by negating increased site discharges may reduce the need for flood alleviation/culverting works downstream and any associated maintenance.

4.9.7 It is acknowledged that in exceptional circumstances, culverting of a section of a watercourse may be unavoidable. This may apply where there are insurmountable inherent structural problems such as slope stability and land slippage. However, even in such circumstances, other solutions such as bank reinforcement, gabion wall construction and underpinning should be considered first, as they will usually have lesser long term environmental / ecological impacts. Similarly, where there are health and safety concerns arising from open access to watercourses or hazardous riverbanks, the construction of solid barriers such as fencing, or planting of 'soft' landscape barriers, should be considered as alternatives to culverting.

4.9.8 Culverting of short lengths of the watercourse (usually less than 10m) is acceptable to enable access to and from the development as required. The site design however should aim to keep the number of crossings to a minimum.

4.10 Development in Proximity of Controlled Reservoirs

Water impounding structures such as reservoirs are a recognised source of flood risk because of the potential for downstream flooding which may ensue if the structure fails, is overtopped, or in the event of a controlled release of water from the reservoir as part of the normal management regime. In any of these circumstances there is potential for rapid inundation of downstream areas and response times to flooding are likely to be short.

New development

New development will only be permitted within the potential flood inundation area[3] of a controlled[4] reservoir, as shown on the Flood Maps NI if:
It is demonstrated that the condition, management and maintenance regime of the reservoir is appropriate to provide sufficient assurance regarding reservoir safety, so as to enable the development to proceed; or

Where assurance on the condition, management and maintenance regime of the relevant reservoir/s is not demonstrated, the application is accompanied by a Flood Risk Assessment, or other analysis, which assesses the downstream flood risk in the event of an uncontrolled release of water due to reservoir failure as being acceptable to enable the development to proceed.

There will be a presumption against development within the potential flood inundation area of a controlled reservoir for proposals that include:
- **Essential infrastructure;**
- **Storage of hazardous substances; and**
- **Bespoke accommodation for vulnerable groups.**

Replacement Buildings

Where assurance on the condition, management and maintenance regime of the relevant reservoir/s is not demonstrated, planning approval will be granted for the replacement of an existing building(s) within a potential flood inundation area of a controlled reservoir provided it is demonstrated that there is no material increase in the flood risk to the development or elsewhere.

[3] As defined by DfI Rivers for individual reservoirs.

[4] Reservoirs with an individual or combined capacity greater than 10000 cubic metres above the natural level of any part of the surrounding land as defined by the emerging Reservoirs Act (NI) 2015.

4.10.1 Water impounding structures such as reservoirs or dams constitute a potential source of flood risk that can have serious consequences. Flooding of downstream areas within what is known as the area of inundation may ensue if the structure fails or is overtopped. Downstream flooding may also arise from the controlled release of water from the reservoir, for example via spillways during periods of high flows due to weather conditions. This is normal practice to avoid capacity exceedance and overtopping.

4.10.2 In any of these circumstances there is potential for rapid inundation of downstream areas and response times to flooding are likely to be short. This is especially the case where failure of reservoir structures triggers land slips resulting in a sudden uncontrolled release of water.

4.10.3 The Reservoirs Act (Northern Ireland) 2015 (the Act) provides a proportionate regulatory framework for the maintenance and management of controlled reservoirs in order to protect people, economic activity, the environment and cultural heritage from flooding caused by an uncontrolled release of water due to reservoir failure. The introduction of this regulatory framework is dependent upon the commencement of relevant sections of the Act and the making of subordinate legislation.

4.10.4 A controlled reservoir is defined by the Act as any structure or area that is capable of holding 10,000 cubic metres or more of water above the natural level of any part of the surrounding land.

4.10.5 Any new reservoirs that are constructed or existing reservoirs altered, for whatever purpose, and are capable of holding 10,000 cubic metres or more of water above natural ground level, for example hydroelectric power generation or amenity purposes such as boating or fishing, will be subject to the provisions of the Act when commenced.

4.10.6 Paragraphs 6.119 to 6.122 of the SPPS outline the strategic planning policy for development anywhere in the inundation area of a controlled reservoir. There are two main considerations when determining planning applications for such development. These are:

1) **Condition Assurance** - With regard to proposed new development the Council must be assured that the condition, management and maintenance regime of the reservoir are appropriate regarding reservoir safety.
2) **A Flood Risk Assessment** - This, among other things, considers the depth and velocity of flood water at the proposed development site in the event of a dam failure and the measures proposed by the applicant to mitigate the depth and velocity of the flood water.

4.10.7 This may result in restrictions on future development within the inundation zone of the controlled reservoir.

4.10.8 When obtaining assurance regarding the management and maintenance regime of a controlled reservoir with regard to reservoir safety, the developer should engage with the reservoir manager (if it is a different party). This will also provide an opportunity for the manager and developer to jointly consider any structural improvement works required to make the reservoir safe or other implications the development may have for the reservoir manager. The funding of such works is a private matter between the developer and the reservoir manager.

4.10.9 Even in circumstances where a reservoir does not fall within the policy, because it is not capable of holding 10,000 cubic metres or more of water above any part of the surrounding land, it remains the responsibility of the applicant (or suitably qualified person with demonstrable experience in flood risk management) to consider and assess the flood risk and drainage impact of the proposed development and to mitigate the risk to the development and that beyond the site.

4.10.10 DfI Rivers have provided a technical advice note TGN 25 on the Practical Application of Strategic Planning Policy for Development in Proximity to Reservoirs. The guidance is to provide further information on the requirements of this Policy and clarification on its application. Reservoir flood extent maps may be viewed at:
Reservoir Flood Map
(www.infrastructure-ni.gov.uk/articles/what-reservoirs-bill-northern-ireland)

The TGN25 Revised, June 2020 can be accessed on the Department's website at the web link below:-
https://www.infrastructure-ni.gov.uk/sites/default/files/publications/infrastructure/tgn-25-practical-application-strategic-planning-policy-development-in-proximity-to-reservoirs-june20.PDF

4.11 Consideration of hydro-electric power generation schemes

4.11.1 DfI Rivers recognises and supports the need to generate electricity in a sustainable and environmentally friendly way. However, in some instances, proposals for hydroelectric power generation schemes can pose significant problems for DfI Rivers. These are set out below:

Key issues with respect to Hydro Power Schemes:

1) **Flood risk** - Generally hydro schemes require construction in the river channel such as a weir to facilitate abstraction of water. Such constructions can cause river levels and flood levels to increase for a considerable distance upstream. Increased water levels can be evident for up to 1.5 km upstream, depending on channel morphology. On occasion, such construction can also increase flood risk downstream for a considerable distance, typically up to 1.5 km.

2) **Erosion of river banks and river bed** - Impoundment structures and discharge structures may cause damage to river channels and river banks due to fast-flowing turbulent water. The length of the downstream turbulent zone is dependent on the size and nature of the scheme and gradient of the channel but typically the downstream effect is around 1.5 km.

3) **Proximity to river flow gauging stations** - DfI Rivers maintains a network of 150 river monitoring stations to collect river flow data which is used locally and nationally for a variety of uses including the assessment and management of water resources, to inform on the design of structures in and around the flood plain and also crucially in flood estimation. Hydro Power Schemes may adversely impact upon a river flow gauging station by removing and returning water at a different rate and direction than under natural conditions thus rendering potentially decades of data collection useless and compromising flood estimation capabilities both locally and nationally. The loss of this information will reduce the pool of information used for flood estimation in the United Kingdom. This has the potential to lead to less accurate flood estimations and subsequently an increase in flood risk.

4) **Creation of new reservoirs** - Creation of new reservoirs for hydroelectric power generation which are capable of holding 10,000 cubic metres or more of water above the natural level of any part of the surrounding land will be controlled reservoirs and subject to the provisions of the Reservoirs Act (Northern Ireland) 2015, when commenced. It should be noted that in addition to planning permission, many elements in the construction of Hydro Power Schemes will require approval from DfI Rivers under Schedule 6 of the Drainage (NI) Order 1973.

Appendices

Appendix A: Technical Definitions (Source DfI Rivers June 2018)

Term	Definition
Annual Exceedance Probability (AEP)	Annual Exceedance Probability – The annual probability of a flood exceeding the peak floodwater level.
Catchment	The area drained, either naturally or with artificial assistance, by a watercourse, including all drainage channels, tributaries, flood plains, estuaries and areas of water storage
Climate change	Climate change in Inter-governmental Panel on Climate Change (IPCC) usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity.
Coastal Flooding	Flooding from sea water, often arising through storm surge
Controlled Reservoir	A Controlled Reservoir as defined by the Reservoirs Act (Northern Ireland) 2015 is any structure or area that is capable of holding 10,000 cubic meters or more of water above the natural level of any part of the surrounding land.
Culvert	An enclosed structure that channels water with integral sides, soffit and invert, including a pipe that contains a watercourse as it passes through or beneath a road, railway, building, embankment etc., or below ground.
Defended area	A 'Defended Area' is that part of the flood plain where flooding would normally occur except for the presence of flood defences. The location of the flood defences and the areas benefiting from their protection are shown on Flood Maps (NI). Flood Maps (NI) can be viewed at: https://www.infrastructureni.gov.uk/topics/rivers-and-flooding/flood-maps-ni-
Drainage Assessment	A statement of the drainage issues relevant to a development proposal and the measures to provide the appropriate standard of drainage. The detail of the assessment will be proportionate to the nature of the proposal. (It may also be called a Drainage Impact Assessment).
Drainage Infrastructure	Equipment such as culverts, weirs and sluices provided to facilitate drainage.

Estuarine flooding	Estuarine flooding can originate from a combination of both river and coastal sources. In such areas the greatest flood risk, normally the higher flood level and greater area of flood inundation will be considered.
Flood Defence	A structure or works designed to prevent the inundation of land and property from watercourses and/or the sea. Such defences may take the form of floodwalls or embankments or the management of water levels through drainage works. Such flood defences must be publicly funded, constructed and maintained by a statutory body such as DfI Rivers.
Flood defence - definition of good condition	A flood defence structure assessed as Structural Grade 1, 2 or 3 by a suitably accredited person using the (UK) Environment Agency T98 methodology. A suitably accredited person is one who is certified as competent in the use of the Environment Agency T98 methodology.
Flood Hazard	The features of flooding which have harmful impacts on people, property or the environment (such as the depth of water, speed of flow, rate of onset, duration, water quality etc.).
Flood Maps (NI)	Flood Maps (NI) is an interactive map-viewer that enables users to access the latest flood hazard information available from government. (www.infrastructure-ni.gov.uk/topics/rivers-and-flooding/flood-maps-ni).
Flood plain	The generally flat areas adjacent to a watercourse or the sea where water flows in a flood, or would flow, but for the presence of flood defences. The limits of the flood plain are defined by the peak water level of an appropriate return period event (currently defined as 1 in 100 year or AEP of 1% plus the latest climate change predictions for the river or fluvial flood plain and 1in 200 year or AEP 0f 0.5% plus the latest climate change predictions for the coastal flood plain). Flood plains as so defined are depicted on Flood Maps (NI). Flood Maps (NI) can be viewed at: https://www.infrastructureni.gov.uk/topics/rivers-and-flooding/flood-maps-ni
Flood Risk	The statistical probability of an event occurring combined with the scale of the potential consequences of that event.
Flood Risk Assessment	A flood risk assessment (FRA) is an assessment of the risk of flooding from all flooding mechanisms, the identification of flood mitigation measures and should provide advice on actions to be taken before and during a flood.
Flood Storage	An area, usually within flood plain where water is stored in time of flood.
Fluvial Flooding	Flooding from a river or other watercourse.

Freeboard	Freeboard is an uncertainty allowance. It is a height (recommended minimum 600mm) added to the predicted level of flood to take account of uncertainty in flood estimation. Flood estimation uses many datasets and complex software all of which have varying degrees of inherent uncertainty. Freeboard may also allow for limited exceedance and also the uncertainty caused by some external factors which may increase flood levels e.g. blocked drainage infrastructure, inappropriate development etc. In coastal situations freeboard allows for wave action, local bathymetric conditions and changes caused by erosion and settlement.
Groundwater	Water below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.
Inundation Areas	Areas susceptible to flooding from the 4 main sources, i.e. rivers, the sea, surface water and reservoirs
Minor development	Non-residential extensions (Industrial/Commercial/Leisure etc.) with a footprint less than 150 sq. meters. Alterations: development that does not increase the size of buildings, e.g. alterations to external finishes. 'Householder' development: e.g. sheds, garages, games rooms etc. within the curtilage of the existing dwelling in addition to extensions to the existing dwelling. This excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of a dwelling house into flats.
Pluvial Flooding	Usually associated with convective summer thunderstorms or high intensity rainfall cells within longer duration events, pluvial flooding is a result of rainfall-generated overland flows which arise before run-off enters any watercourse or sewer. The intensity of rainfall can be such that the run-off totally overwhelms surface water and underground drainage systems.
Precautionary Approach	The approach to be used in the assessment of flood risk which requires that lack of full scientific certainty, shall not be used to assume flood hazard or risk does not exist, or as a reason for postponing cost-effective measures to avoid or manage flood risk.
Reservoir	Any structure or area that is capable of holding water above the natural level of any part of the surrounding land. See also "Controlled Reservoir".

Resilience	Sometimes known as 'wet-proofing', resilience relates to how a building is constructed in such a way that, although flood water may enter the building, its impact is minimized, structural integrity is maintained, and repair, drying & cleaning and subsequent re-occupation are facilitated.
Resistance	Sometimes known as 'dry-proofing', this relates to how a building is constructed to prevent flood water entering the building or damaging its fabric.
River Basin	See catchment.
Run-off	That proportion of rainfall which is not absorbed into the ground and finds its way, by surface water drainage systems or overland flow, into watercourses and eventually discharges into the sea.
Sea level rise	A sea level rise is an increase in the volume of water in the world's oceans, resulting in an increase in global mean sea level. Sea level rise is usually attributed to global climate change by thermal expansion of the water in the oceans and by melting of ice sheets and glaciers on land.
Significant intensification	A proposal that exposes significantly more people to flood risk than the present use of the site. As a general rule, proposals should be equal or less vulnerable than the existing land use. Typical examples of significant intensification are replacing a single dwelling with ten apartments or conversion of commercial/industrial premises to housing. As there is no precise definition or quantification of significant intensification, the Council should determine each application on its individual merits taking account of the scope for mitigation of the residual flood risk.
Storm surge	The increase in sea level caused by the combined effects of low atmospheric pressure and wind.
Storm water	Surface water in abnormal quantities resulting from heavy falls of rain or snow. Storm water that does not infiltrate into the ground becomes surface runoff.
Surface water flooding	Surface water flooding is caused when the volume of rainwater falling does not drain away through the existing drainage systems or soak into the ground, but lies on or flows over the ground instead. This type of flooding is usually short lived and associated with heavy downpours of rain, thunder storms etc.
Sustainable Drainage Systems (SuDS)	A form of drainage that aims to control run-off as close to its source as possible using a sequence of management practices and control structures designed to drain surface water in a more sustainable fashion than some conventional techniques such as storm water networks.

Undefended Area	An 'Undefended Area' is an area within the flood plain that is not protected by flood defences. This applies to the vast majority of fluvial and coastal flood plains. Undefended areas are at much higher flood risk than defended areas, although the flooded areas are usually more predictable and flood water usually recedes more quickly.
Vulnerable groups	Vulnerable groups include children under the age of 18 years old, the elderly and those with limited mobility and/or special needs. Flood warning and evacuation procedures may be difficult to implement for people with disabilities or those whose mobility is otherwise impaired, therefore their risks of injury or fatality are somewhat greater than for the general population. Accordingly, because of the residual flood risk, there should be a presumption against permission being granted for development associated with vulnerable groups. This includes facilities such as children's nurseries, schools, residential care / nursing homes, sheltered housing and hospitals. This list is not exhaustive.
Watercourse	A river, stream, canal, ditch, culvert and surface water drainage systems. Water mains and sewers are not included in this definition.

Appendix B: Impacts of Flooding and Climate Change

There is an almost universal acceptance amongst leading scientists and governments that climate change caused by human activity is taking place. Worldwide, there is much research taking place to try and establish the impact of climate change and how it will affect our world.

Flooding is part of the natural cycle of rivers and the sea. The primary causes of flooding are many and varied and sometimes involve a complex interaction of several contributory factors. Flooding is mainly weather-driven, but can be exacerbated by infrastructure deficiencies and inappropriate development. At present, climate change is not the primary cause of flooding. Climate change is a factor that will exacerbate flooding. As climate change has an increasing impact on weather systems over time, it will have more impact on flooding in the future.

DFI Water and Drainage Policy Division has provided Technical Flood Risk Guidance in relation to Allowances for Climate change in Northern Ireland. (https://www.infrastructure-ni.gov.uk/publications/technical-flood-risk-guidance-relation-allowances-climate-change-northern-ireland). It is noted that this Guidance is based on the UKCP09 research, this will remain so for the foreseeable future until this Guidance beds in to Planning processes. However, UKCP09 has been superseded by a new set of climate change projections UKCP18 in November 2018. The recommendations of UKCP18 are currently being considered and new guidance of allowances for climate change will become available in due course

Climate Change flood maps have been updated from 2030 Epoch to 2080 Epoch, these maps have been used in the Local Development Plan preparation and for development management purposes.

Information about Introduction UKCP18

Taken from the UKCP18 Science Overview Report November 2018 (Updated March 2019)

UKCP18 provides a new set of climate projections and tools to access climate data. UKCP18 climate projections consist of: updated probabilistic projections, giving estimates of different future climate outcomes; a new set of global climate model projections, comprising simulations from both the latest Met Office Hadley Centre climate model and global climate models from around the world; and a set of regional climate model projections on a finer scale (12km) for the UK and Europe. (2.2km local resolution will be available late 2019 Need to check)

UKCP18 projections for the seas around the UK comprise: new estimates of the time-mean sea level rise around the UK coastline; exploration of the possible changes in future storm surge and tides and new information on the change in sea surface waves. Alongside the projections are new observations of UK climate, which are described in the State of the UK Climate 2017 report. These observations and linked attribution studies show that the UK climate has already changed, with evidence that some changes over the UK are at least partly connected to increases in greenhouse gas concentrations in the atmosphere.

The main findings from an initial analysis of UKCP18:
The UKCP18 projections form an update of the UKCP09 products and have been produced because of user demand for new capability and the opportunities for improved simulations provided by the latest generation of climate models and advances in the capacity of supercomputers. The climate information products available in UKCP18 are summarised below:

Observations for the UK show that the most recent decade (2008-2017) has been on average 0.3 °C warmer than the 1981-2010 average and 0.8 °C warmer than 1961-1990. All of the top ten warmest years have occurred since 1990.

In the past few decades there has been an increase in annual average rainfall over the UK, particularly over Scotland for which the most recent decade (2008–2017) has been on average 11% wetter than 1961–1990 and 4% wetter than 1981-2010. However, natural variations are also seen in the longer observational record. The observations made in the future will be dependent on both long-term climate trends and natural variability.

Projected future changes over land areas:
Overall the probabilistic projections in UKCP18 show ranges that have a large overlap with those from UKCP09, but with some notable differences in the tails of the projected distributions. Over land the projected general trends of climate changes in the 21st century are similar to UKCP09, with a move towards warmer, wetter winters and hotter, drier summers. However, natural variations mean that some cold winters, some dry winters, some cool summers and some wet summers will still occur and users may need to factor this into decision-making.

In UKCP18, the probabilistic projections provide local low, central and high changes across the UK, corresponding to 10%, 50% and 90% probability levels. These local values can be averaged over the UK to give a range of average warming between the 10% and 90% probability levels. By 2070, in the high emission scenario, this range amounts to 0.7°C to 4.2°C in winter, and 0.9°C to 5.4°C, in summer. For precipitation, corresponding ranges of UK average changes are -1% to +35% for winter, and -47% to +2% for summer, where positive values indicate more precipitation and negative values indicate reduced precipitation.

Hot summers are expected to become more common. In the recent past (1981-2000) the probability of seeing a summer as hot as 2018 was low (<10%). The probability has already increased due to climate change and is now estimated to be between 10-25%. With future warming, hot summers by mid-century could become even more common (with probabilities of the order of 50% depending on the emissions scenario followed). Additionally, UKCP18 simulates sub-seasonal and sub-monthly extremes of climate and their changes, such as daily extreme temperature and rainfall. There is also the potential for future changes in the time spent experiencing different types of weather regimes. These can be examined using the new global and regional projections.

Future changes at the coast and in the sea:
UK coastal flood risk is expected to increase over the 21st century and beyond under all emission scenarios considered. This means that it can expect to see both an increase in the frequency and magnitude of extreme water levels around the UK coastline. This increased future flood risk will be dominated by the effects of time-mean sea level rise, rather than changes in atmospheric storminess associated with extreme coastal sea level events. There may also be changes in tidal characteristics.

21st century projections of time-mean sea level change around the UK vary substantially by emissions change scenario and geographic location. The very likely ranges for UK capital cities at 2100 are summarised below for each scenario included in this report.

	Sea level change at 2100 (m) relative to 1981-2000 average		
	RCP2.6	RCP4.5	RCP8.5
London	0.29-0.70	0.37-0.83	0.53-1.15
Cardiff	0.27-0.69	0.35-0.81	0.51-1.13
Edinburgh	0.08-0.49	0.15-0.61	0.30-0.90
Belfast	0.11-0.52	0.18-0.64	0.33-0.94

The risk of coastal flood events will rise with the projections of increase in time-mean sea level. However, based on storm surge modelling work, it is suggested that a best estimate of no significant additional increase in the statistics of extreme water levels associated with atmospheric storminess change. The largest trend found in our set of surge simulations of this additional component corresponds to a change of approximately 10 cm per century for the 1-year return level, which is considerably less than the time mean sea level change under the same emission scenario. However, cannot rule out larger trends in storm surge due to this additional component. The additional component could be either positive (augmenting the mean sea level change) or negative (partially offsetting the mean sea level change).

21st century projections of average wave height suggest changes of the order 10-20% and a general tendency towards lower wave heights. Changes in extreme waves are also of order 10-20%, but there is little agreement in the sign of change among the model projections. High resolution wave simulations suggest that the changes in wave climate over the 21st century on exposed coasts will be dominated by the large-scale response to climate change. However, more sheltered coastal regions are likely to remain dominated by local weather variability.

Exploratory, time-mean sea level projections to 2300 suggest that UK sea levels will continue to rise over the coming centuries under all emission scenarios considered. For London the projection ranges at 2300 are approximately 0.5 - 2.2m and 1.4 - 4.3m for the lowest and highest emission scenarios, respectively. The values for Edinburgh and Belfast are lower. The projections extending beyond 2100 should be considered as illustrative of the potential future changes.

Appendix C: Impact of Flooding on People and Property

Introduction

The effects of flooding can impact on a wide range of human activities and interests, the most obvious being the health and wellbeing of people directly caught up in flood events and the damage caused to property by inundation of flood water.

Related socio-economic impacts can also affect the well-being of the wider community. These may range from loss of homes and personal possessions, to the disruption of key infrastructure and services and the local economy, the loss of business confidence and damage to cultural heritage and the environment. Additionally, repeated flooding of properties is likely to impact on property prices, the ability to get a mortgage agreement and the availability of affordable property insurance.

When considering new development in flood risk areas it is important to understand all the impacts that the flooding may bring, direct and indirect impacts, tangible and intangible losses and the immediate and long term damage and disruption.

The multiple impacts of inappropriate development in flood risk areas means that government may be compelled at a later stage to provide hard-engineered flood defences. This invariably involves significant costs which may not be affordable.

The Impact on Health and Well Being

Loss of life from drowning or physical injury arising from being swept away by floodwater is very rare in Northern Ireland. However, there is growing concern about the potential adverse health effects associated with the trauma of a flood event. Living in a damp and dirty environment that such events cause and the anxiety that living in an area liable to flooding can create are increasingly recognized. Table 1 highlights the possible health implications flooding can have.

Table 1: Health Implications of Flooding

Direct Effects Causes	Health Implications
Stream flow velocity; topographic land features; absence of warning; rapid speed of flood onset; deep floodwaters; landslides; risk behaviour; fast flowing waters carrying debris.	Drowning Injuries
Contact with water	Respiratory diseases; shock; hypothermia; cardiac arrest.
Contact with polluted waters	Wound infections; dermatitis; conjunctivitis; gastrointestinal illnesses; ear, nose and throat infections; possible serious waterborne disease.
Increase in physical and emotional stress	Increase of susceptibility to psychosocial disturbances and cardiovascular incidences

Indirect Effects Causes	Health Implications
Damage to water supply systems; sewage and sewage disposal damage; insufficient water supply	Possible waterborne infections (e.g. enterogenic E coli, shigella; hepatitis A; leptospirosis)
Disruption to transport systems	Food shortages; disruption of emergency services.
Underground services disruption; contamination from waste sites; release of chemicals, oil, petrol storage etc.	Potential acute or chronic effects from chemical pollution.
Standing waters; heavy rainfall, expanded range of vector (disease carrying organism – especially insects) habitats	Vector borne diseases.
Rodent migration	Possible diseases caused by rodents.
Disruption of social networks; loss of property, jobs and family members/ friends	Possible psychosocial disturbance
Post flood clean-up activities	Electrocutions; other injuries
Damage to or disruption of health services	Decreases in standard of or insufficient access to health care

Source: Floods: Climate Change and Adaptation Strategies for Human Health (WHO 2002)

The Impact on Property

The severity of damage to buildings is often dependent on the depth and duration of the flood event. Table 2 illustrates flood damage to a typical residential property. Flood proofing of property is addressed in **Appendix F**.

Table 2: Flood Damage to a Typical Residential Property

Depth of Flood	Damage to Building	Damage to Services/ fittings	Loss of Personal Possessions
Below ground level	Minimal damage to main building. Flood water enters basements, cellars and under floor voids. Possible erosion under foundations.	Damage to electrical sockets and other services. Carpets in basements and cellars may need replaced	Possessions and furniture in basements and cellars damaged.
Up to half a metre above ground floor level (GFL)	Damages to internal finishes, plaster, wall coverings etc. Floors and walls become saturated requiring cleaning and drying. Flooring may require replacement. Damage to external and internal doors, skirting, etc.	Damage to electricity meter and fuse-box. Damage to gas meter, low level boilers and telephone services. Carpets and floor covering may need replaced. Kitchen units and electrical appliances may need replaced	Damage to furniture and electrical goods. Damage to small personal possessions. Food in low cupboards contaminated
More than half a metre above GFL.	Increased damage to walls. Possible structural damage	Damage to higher units, electrical services and appliances	Damage to personal possessions

Source: Preparing for Floods (DTLR, 2003?)
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/11485/2187544.pdf

Implications on Property Insurance

Flood insurance in Northern Ireland was previously provided for under the Statement of Principles (SoP) which was a temporary agreement between the insurance industry represented by the Association of British Insurers (ABI) and the Northern Ireland Assembly.

The SoP has been superseded by the introduction of 'Flood RE' (https://www.floodre.co.uk/) Flood RE is a joint initiative between the Government and insurers. Its aim is to make the flood cover part of household insurance policies more affordable

Nevertheless, the accessibility of affordable insurance should be an important consideration for those proposing new development or purchasing property within flood risk areas. Property insurance premiums will be proportionate to the flood risk and the application of flood mitigation measures such as flood proofing of buildings and the establishment of "self-help" procedures in preparation for flood emergencies. Developers should always consider alternative site locations outside the flood risk area. However, where the principle of development within a flood risk area has been established, the developer should liaise with the insurance industry at an early stage so as to ascertain if the proposed means of mitigation of the flood risk is sufficient to enable affordable flood insurance to be made available for subsequent property owners and tenants.

Impact on the Environment

River and coastal flood plains are valuable ecological resources which provide habitat for a wide range of plants and animals, many of which are rare. A number of the priority habitats identified in the Northern Ireland Biodiversity Strategy are associated with flood plains. In addition, flood plains are often important landscape assets and the location of features of the archaeological and built heritage. Flood events can damage ecosystems, habitats, archaeological / built heritage assets and landscape features, and development can exacerbate such damage. The natural regulation of floodwater limits ecological damage caused by flooding, while pondage areas provide for the trapping and deposition of sediments and recycling of the nutrients from run-off.

Conclusion

Human activity can therefore have a significant impact in increasing flood risk and new development that is constructed without regard to flood risk may serve only to endanger life, increase property and environmental damage and require wasteful expenditure on remedial works.

Appendix D: Sustainable Drainage

Note: Separate SPG available for Sustainable Drainage Systems (SuDS)

Development and Drainage

Development inevitably results in hard, impermeable surfaces such as roofs, roads, footpaths and parking areas which traditionally drain surface water to pipes and sewers and thence to rivers. With development, the area of green space decreases and the volume and velocity of drainage water from the development site increases. Our existing engineered drainage network serving Northern Ireland is under considerable capacity pressures. Sustainable drainage offers a solution to support future development while avoiding increased pressure on the existing infrastructure. The use of sustainable drainage (SuDS), particularly for new developments, will provide drainage solutions while not adding more pressure to the existing drainage network.

Taking into consideration the latest research findings on climate change, which predicts more frequent and higher intensity rainfall events, it is imperative that the increased flood risk, particularly in urban and built up areas, is properly managed. Sustainable drainage is a key element in future climate change adaptation planning.

Traditionally, drainage has involved the installation of underground pipes to convey water away as quickly as possible. Although this approach may prevent local flooding it can simply transfer flood risk to other parts of the catchment. Piped drainage systems can become overwhelmed during prolonged periods of high intensity rainfall, particularly where drainage bottle-necks occur in urban centres. Additional water quality problems will occur where surface water and sewage are transported in the same pipes and flooding occurs.

When accompanied by ongoing urban development and the projected changes to rainfall patterns resulting from climate change, the climate change predictions, if realised, will significantly increase both the volume and flow rate of storm water, thus increasing the risk of flooding in the future. An alternative approach widely used in other parts of the United Kingdom and European Union to address these problems involves the embedding of sustainable drainage measures into new development through the planning system. 2017 figures suggest 40% of developments requiring A161 agreements had SuDS included.

Sustainable Drainage and the Planning Process

Paragraph 6.118 of the SPPS states the Planning authorities should encourage developers to use sustainable drainage systems (SuDS) as the preferred drainage solution. In 2016 DfI changed the legislation regarding connection to the public sewer network, to provide a new power for NI Water to refuse a surface water connection if alternative means of dealing with surface water have not been considered. Consultation has taken place on the provision of an enabling power to introduce future guidance/ legislation to set out arrangements for approval and maintenance of SuDS.

Notwithstanding the current legislative position, development proposals that facilitate sustainable drainage while meeting broader planning objectives or requirements will usually be considered favourably by the planning authority. It is recognised for example that sustainable drainage offers much potential for providing amenity open space and enhancing quality in residential environments. The planning authority will therefore encourage early engagement with the developer and also between the developer and other relevant agencies and disciplines (e.g. architects, drainage engineers, landscape architects, ecologists). This will inform the planning and design of a sustainable drainage system that is suitable for the particular characteristics of the site and its surroundings. It will also influence the layout of the site and identify the potential for the drainage system to deliver planning and environmental benefits. Other considerations such as safety issues and long term operation and maintenance arrangements are also best addressed at an early stage.

The Future for Sustainable Drainage in Northern Ireland

In regard to the implementation of sustainable drainage, progress in Northern Ireland lags behind the other UK jurisdictions where legislation[7] is in place that makes SuDS a requirement for most new development schemes and designates specific bodies with statutory responsibility for approval and oversight of the SuDS elements. Legislation exists in Wales and Scotland. In England, planning policy places an expectation on planning authorities that larger development will include SuDS unless demonstrated to be inappropriate.

In Northern Ireland, the legislation has been changed to encourage the use of SuDS as a form of drainage. NI Water will adopt hard engineered SuDS where an Article 161 agreements has been entered into. However, it is government intention that sustainable drainage practices will ultimately be implemented as an integral part of the development process wherever possible. In September 2011 an inter-departmental / agency working party chaired by the Northern Ireland Environment Agency (NIEA) published the final version of "Managing Stormwater – A Strategy for Promoting the Use of Sustainable Drainage Systems (SuDS) within Northern Ireland". This report, which has been endorsed by the Assembly Environment Committee, promotes the use of SuDS as the preferred drainage option for new development. It also advocates the retrofitting of SuDS through joint action by DAERA, DfI Rivers, NI Water and DfI Transport NI, on those existing surface water drainage schemes which have a significant adverse effect on the environment, where this is practicable and economically viable.

In June 2011 the Stormwater Management Group (SMG) was set up to implement the recommendations published in the Strategy document. In November 2015, representatives of the SMG provided evidence on SuDS to the Committee for Regional Development in relation to the Water and Sewerage Services Bill. The Committee was supportive of the progress made.

To facilitate further progress, participation in the group was extended to include representatives from local government and others. In 2015, the SMG also refocused the priorities of the group. The revised objectives of the SMG are to:

1) Promote clear Planning Policy;
2) Consider and develop effective delivery mechanisms and approval processes:-
    a. Review how SuDS (both hard and soft components) are currently delivered in Northern Ireland ;
    b. Develop and promote consistent delivery mechanisms and approval processes.

It is anticipated that changes to legislation and guidance may be required to support the future delivery of sustainable drainage in NI and the planning authority currently requires the consideration of such systems in line with Paragraph 6.118 of the SPPS and Policy ENV5 of the Belfast Local Development Plan.

Please see separate SPG on SuDS for more details and guidance.

Appendix E: Assessing Flood Risk and Drainage Impact

Introduction

Proposals that accord with the policies set out in the Belfast LDP and this guidance must be accompanied, depending on the sources of flooding, by a Flood Risk Assessment (FRA) and / or a Drainage Assessment (DA). The detail of the Assessment should be proportionate to the scale and nature of the proposed development and the risks involved. The applicant should appoint a suitable qualified and competent professional to carry out the assessment. This Appendix provides guidance on relevant considerations and information requirements concerning both types of assessment.

An FRA must consider the flood risk from all sources of flooding where the proposed development is located within or in proximity to the fluvial (river) flood plain, the coastal flood plain or the flood inundation area of a reservoir. It should then identify measures that can be adopted to control and mitigate the flooding to the development or elsewhere as a result of the development. The main sources of flooding (under the implementation of the Water Environment (Floods Directive) Regulations (Northern Ireland) 2009)) are:

- **Fluvial** – flooding from watercourses, either natural or man-made and either open or culverted. Such flooding is normally caused when channel or culvert capacity is exceeded and water flows out-of-bank onto the natural flood plain.
- **Coastal** – flooding from the sea when water levels exceed the normal tidal range and flood onto low lying areas along the coastline.
- **Pluvial** – flooding which results from excessive rainfall, generating overland flow that overwhelms existing drainage systems and / or collects in low lying areas.
- **Reservoirs** – flooding which occurs to the surrounding area as a result of reservoir failure, overtopping or the controlled release of water via spillways during periods of high flows.

A Drainage Assessment should consider the flood risk mainly from pluvial flooding where the proposed development is located beyond the fluvial and / or coastal flood plain or a reservoir flood inundation area. It should then identify measures that can be adopted to control and mitigate the risk of flooding to the development or elsewhere as a result of it and include for the safe disposal of surface water runoff from the site.

When is a Flood Risk Assessment required?

<u>When a more accurate definition of the Flood Plain and Extents is needed</u>

Due to the nature of the Strategic Flood Map for NI the geographical extent of predicted flood areas cannot be precisely defined. In some cases reservoir inundation maps may not be available. An FRA to determine a more accurate extent of flooding is therefore necessary for development proposals located in proximity to the margins of the predicted flood plain, irrespective of whether the site lies just outside or just inside (wholly or partially) the extent as depicted on the Strategic Flood Map. In these circumstances it is sufficient for the FRA to identify the sources of flooding and the resulting flood extents.

For some sites the applicant may be able to demonstrate through a combination of local knowledge, photographs of historic flood events or a level survey that the site or part of the site lies outside the flood plain and would be suitable for development from a flood risk aspect. For other sites, a more detailed river model may be required. Preliminary discussion with DFI Rivers is advisable to ascertain the type of information required. Should the outcome of this exercise confirm that the development site or part thereof lies within the flood plain, then the applicant should consider a more suitable alternative location.

When the proposed development is within the (fluvial / coastal flood plain / reservoir flood inundation area) and is otherwise acceptable under the policy

In circumstances where the proposed development is acceptable in principle under the policy, this still requires an FRA to be submitted to the planning authority as part of the planning application, so as to ensure the identification of all sources of flooding, the resulting flood extents and the means by which flooding is to be controlled and mitigated. An FRA should not be undertaken when a proposal is clearly unacceptable in principle under the policy as this will invariably result in nugatory work and expense on the part of the developer

What information should be in a Flood Risk Assessment?

When a more accurate definition of the Flood Plain and Extents is needed
For this purpose, the FRA will typically be required to contain the following information:

- A location plan to a suitable scale, which clearly illustrates geographical features and identifies the catchment, watercourses in the vicinity and the built development;
- A site plan (and where appropriate, cross sections) showing existing levels related to Ordnance Datum Belfast), existing structures, watercourses in or bounding the site, internal site drainage and drainage outfalls;
- Data on historical flooding events, including photographs and media reports, supported by information on rainfall, flood return periods and the probability of storm surge occurrences, where appropriate. Evidence on trends in flood occurrences and changes in the local environment since the last event is particularly valuable;
- A plan of the site showing the extent of the predicted Q100 / Q200 flood plain, and / or in the case of a reservoir, the extent of the predicted flood inundation area. This may require a local hydraulic model based on the topographical information, historical flood events and the assessment of design flow discharges at the site using industry standard methodologies.

When the proposed development is within the fluvial / coastal flood plain
The FRA in these circumstances will typically be required to contain the following information relating to the Assessment of the Flood Risk:

- A location plan as detailed above;
- A site plan (and where appropriate, cross sections) showing pre-development and post-development levels related to Ordnance Datum Belfast, existing structures, development proposals, watercourses in or bounding the site, internal site drainage and drainage outfalls;

- Details of any existing or proposed flood alleviation measures or flood defence structures that may influence the site including information on their structural condition, level of protection and maintenance regime;
- The identification of all sources of flooding pre and post- development;
- An assessment of the hydraulic capacity and structural integrity of all drains and sewers within or bounding the site. The methodologies for assessment must be clearly identified;
- Data on historical flooding events accompanied by supporting information as detailed above;
- A plan of the site showing the extent of the predicted Q100 / Q200 flood plain and / or in the case of a reservoir, the extent of the predicted flood inundation area. This will involve the production of hydraulic models requiring longitudinal / cross sections of the watercourse and the site, assessment of flood discharges using industry standard methodologies, and the inclusion of information such as finished floor levels, access road and car park levels, estimated flood water levels, flood depths and velocities and associated probability of flooding;
- A plan and description of features which may influence local hydraulics. For example, bridges, pipes or ducts crossing watercourses, culverts, embankments and walls;
- An assessment of the likely speed of potential flooding, the sequence in which various parts of the site may flood, the likely duration of a flood event, the potential consequences of a flood event, the depth and velocity of flood water;
- Where appropriate, the likely impact of any displaced water or increased run-off from the development site should be estimated and the consequences for neighbouring or other locations assessed.

Where the proposed development is located within the fluvial / coastal flood plain (or reservoir flood inundation area), the FRA will also be required to provide details of flood control and mitigation measures as well as safety procedures that will address the flood risks identified. The following considerations may be relevant:

Flood Control Measures

- Infrastructure and drainage design where it may be possible to limit the flow and duration of flood water to the proposed development by diversion of flow paths, culvert upgrading and introduction of control structures such as sluices, weirs and sealed manholes;
- Management of residual flood risk through keeping development a safe distance away from flood defence structures and introducing sacrificial flood storage areas at the rear of defences;
- Suitable maintenance and management procedures;
- Ground water control and pumping.

Flood Mitigation Measures

- Site design and layout such as siting built development so as to avoid areas of the site liable to flooding and flood flowpaths;

- Raising finished floor levels of new buildings;
- Coastal infilling / land raising;
- Flood resistant and resilient construction (refer to Appendix F)

Safety Procedures

- Flood and weather warning systems;
- Clear communication lines between those at flood risk and those with flood risk responsibilities;
- Emergency evacuation plans and procedures including safe access and egress for emergency rescue services;
- Capacity and procedures for the rapid movement of furniture and goods to locations outwith the flood risk area;
- Safe shutdown of electrical supply for domestic and industrial use;
- Pollution control procedures.

Flood Risk Assessment – General Considerations

While it will be necessary to consider all the factors identified above, the detail necessary is likely to vary from case to case, depending on local conditions and the scale and type of development proposed.

Because of the uncertainties inherent in flood estimation and expected climate change impacts, the application of the precautionary approach to hydrological analysis of flood flows and the determination of flood event return periods requires any assessment of flood risk to incorporate the necessary allowances for increased rainfall, storminess and sea level rise specified in current UK research and guidance.

All FRAs should acknowledge that there are no circumstances in which the risk of flooding can be removed entirely. In defended areas therefore consideration should always be given to the potential impacts of extreme events on defences, the residual risks and the minimising of risks to life and property in such events.

When is a Drainage Assessment required?

The SPPS (para 6.114) requires a Drainage Assessment to be submitted to the planning authority along with the planning application, for development proposals located outside the fluvial and / or coastal flood plain, in any of the following circumstances:

- Where the proposed development exceeds the thresholds specified in the policy, for example 10 or more new dwellings;
- Where run-off from the development may adversely impact upon other development or features of importance to nature conservation, archaeology or the built heritage;
- Where there is evidence of a history of surface water flooding.

The Drainage Assessment, as well as addressing surface water flooding, may also need to identify control measures for storm water discharge from the site. The use of sustainable drainage systems to manage and limit site discharges to pre-development run-off rates is encouraged.

What information should be in a Drainage Assessment?

A Drainage Assessment will typically be required to contain the following information relating to the assessment of surface water flood risk:

- A location plan;
- A site plan;
- Confirmation as to whether the proposed development is to be located on previously developed land (that may have minimal impact on the existing drainage network);
- Indication as to whether the local area has past flooding problems, which may limit site discharge to the local drainage and watercourses to pre-development run-off rates;
- Identification of likely overland flow paths including depth, velocities, timing and sequence of inundation;
- An assessment of hydraulic capacity and structural integrity of all drains and sewers within or bounding the site, which may result in out of sewer flooding. The methodologies for assessment must be clearly identified;
- Data on historical flood events accompanied by supporting information;
- The likely impact of any displaced water or increased run-off from the development site should be estimated and the consequences for neighbouring or other locations assessed.

Flood Control Measures

- Internal drainage design, including rehabilitation of existing sewers and suitable discharge points to the local drainage and watercourse system that will encourage the safe disposal of storm water run-off away from the site and other neighbouring areas.
- On site SuDS solutions such as flood infiltration and storage that will alleviate the flooding and encourage the slow release of storm water to the local drainage and watercourse system.

- Where the upgrading / use of local drainage networks for additional extreme flows is not possible, designing for exceedance by including sacrificial flood storage areas, such as amenity areas, car parks, roads and pathways into the drainage design.
- Suitable maintenance and management procedures.

Flood Mitigation Measures

- Site design and layout to include infilling, ground re-profiling, raising of finished floor levels (FFL) and landscaping.
- Flood resistance and resilience construction, (Appendix F) where raising the building is not possible.
- Ground water control and waterproofing for basement areas.

Safety Procedures

- Safe emergency access and egress routes to safe areas.

Supplementary Information in regard to site discharge to the local drainage network and/or watercourses

In addition to planning requirements, developers will also need to ensure that the following requirements are met:

- An initial application should be made to the local DfI Rivers office for consent to discharge storm water under Schedule 6 of the Drainage (NI) Order 1973. An application form for discharge consent can be obtained at the web address below. https://www.infrastructure-ni.gov.uk/publications/schedule-6-application-consent-undertake-works-watercourse
- The completed application form should be sent to the relevant Area Office. If it is proposed to discharge storm water into an NI Water system then a Pre-Development Enquiry should be made and if a simple solution cannot be identified then a Network Capacity Check should be carried out.
- Details of how runoff from the site will be controlled and safely disposed of supported by relevant correspondence from DfI Rivers and/or Northern Ireland Water.
- It is the responsibility of the developer to satisfy the appropriate authorities that the internal site drainage complies with the appropriate legislation and includes for exceedance (refer to CIRIA document C635).

Appendix F: Flood Proofing - Resistance & Resilience Construction

The primary aim of planning policy on flood risk is to avoid new development in areas known to be at risk of flooding. However in certain cases, development within areas of flood risk may still proceed, for example where a proposal is deemed to be of overriding regional importance or is accepted as an exception to the policy for development in flood plains. Outside of flood plains, development within areas of surface water flood risk may be permitted subject to a satisfactory drainage assessment. In all such cases, consideration should be given to assessing and managing the flood risk through the adaptation of suitable flood proofing measures. For new development, permanent solutions which incorporate flood proofing into the structure of the building, such as by raised floor levels and impermeable walls will be preferred to other temporary measures. Below ground occupancy and basements should be avoided.

The Building Regulations do not currently impose mandatory requirements for flood resistance or resilience construction for either new or existing buildings in flood risk areas. There are no plans to introduce a standalone Floods Bill. The Department for Infrastructure recently completed consultation on a range of policy options, for the potential inclusion in future legislation, relating to water, flooding and sustainable drainage. Three of these policies related to flood storage and further detail on these proposals is set out below.

The first covered new powers for NI Water to enter onto private land to carry out works for flood management purposes, including construction of Sustainable Drainage Systems (SuDS). This may be taken forward through NI Water constructing Natural Flood Management (NFM) measures, such as flood storage which can capture stormwater and slowly release it over time. These NFMs can take the form of ponds, dams, and SuDS. NFMs can also have the additional benefits of reducing pollution, improving the landscape, and providing habitats for wildlife.

The second focused on the provision of an enabling power for the Department to introduce future guidance or legislation to encourage developers to use SuDS as the preferred drainage solution in new developments. This will enable the Department to issue future guidance to encourage developers to make increased use of soft SuDS such as ponds, swales, and rainwater gardens. This will help to relieve pressure on the stormwater sewerage system, reducing the need to expand existing infrastructure, or lay new, pipes. It will also help protect properties from flooding during heavy rainfall events.

The third covered flood storage powers to provide for easements and additional compensation arrangements for affected landowners to facilitate flood storage. This topic would enable the Department to pay compensation to landowners in exchange for temporarily flooding their lands. It is a measure that is particularly appropriate where hard defences are inappropriate, or as a complement to such defences, making them more resilient to climate change.

In the interim, practical guidance to developers is available in technical guidance booklet C, which gives some relevant information on safe access and egress at times of flooding, the

use of non-return valves for sewer flooding and the intrusion of groundwater through walls and floors.

Flood Proofing
There are a number of routes by which flood water can enter a property. The most common ways are through door openings, patios and windows. Water can also find its way through air bricks on exposed walls, under foundations and through gaps in floors. Less obvious ways are via drains and pipes as the pressure created by flooding can reverse the flow and cause water to back-up and enter the property through sinks, toilets and washing machines etc.

However there are a number of measures available to prevent or limit the damage and disruption caused through flooding. Buildings can be flood proofed through the use of "**flood resistance"** and/or **"flood resilient"** measures**.**

Flood resistance is a term that refers to preventing or minimising flood water from entering a building. There are two types of methods available:-

Passive resistance is where the flood mitigation is permanently in place. This is generally more feasible in new developments where the property is designed so that flood water is excluded from the building during flood events. Such mitigation methods are usually expensive as they will require structural modifications to the building. Recommended methods are:-

Raised Floor Levels
Finished floor levels of the building are designed to be above the design flood level. The levels will also include an additional height to accommodate a suitable freeboard. Driveways, paths and entrances to allow for access need to be designed accordingly.

Deeper Foundations
This may be appropriate in permeable types of ground, such as sand and gravels, where high ground water and flood water is able, under pressure, to infiltrate into the property from below the foundation level. Cut off trenches and toe walls to deeper impermeable clay / rock ground to block flow paths may also be considered.

Tanking of Internal Floors and Basement Walls
This measure may be used to prevent flood water or high groundwater entering the building. It involves the use of solid concrete walls and floors, which are then sealed with waterproof membranes / sheets. Solid floors have the added advantage that with their extra weight they are able to cope better with the uplift pressures from the flood water.

Water Resistant Walls
The building structure is designed using flood resistant materials that are able to reduce or stop the infiltration of water through the external walls. Solid walls can be constructed instead of cavity walls. Engineering bricks are preferred to concrete / aircrete bricks as they have lower water absorption rates. External joints and rendering can be designed to be more water repellent. Rigid insulation can be applied to cavity walls and internal walls can use cement based renders with a high lime content. Standard gypsum plasterboard which disintegrates when it becomes wet should be avoided.

Sealed Doors and Windows
Entrances and openings can be designed with raised thresholds. Water resistant PVC type material, which can provide better seals can replace traditional wooden frames, which can become warped. Shatterproof / double glazed windows should be considered as these are more liable to remain intact when exposed to a depth of flood water or floating debris

Non Return Valves and Covers
Flaps can be fitted to the end and junctions of drainage and sewage pipes to stop any water flowing back into the building. Manhole covers can also be sealed by being bolted down and air vents can be fitted with specialised water resistant covers.

Active resistance – involves the use of temporary flood mitigation measures and requires an effective flood warning system or a neighbourhood alert scheme to allow for a reasonable lead in time in order to have the mitigation in place. Standalone temporary and demountable defences are not normally considered appropriate for new developments due to the likelihood of them not being in place on time, being damaged by flood debris or the potential for being breached or overtopped. The main advantage of these temporary arrangements is that they would normally be less expensive than the more permanent solutions and are more practical and suitable for buildings already within the flood plain. Recommended methods are:-

Demountable Flood Guards
These guards or gates are made of suitable flood resistant material and are fitted across boundary fences, doors and windows by bolting or dropping into pre-prepared slots or channels incorporated into the framework of the structure. They are then removed soon after the flood recedes.

Temporary Flood Defences
This solution is sometimes adopted to provide protection for commercial properties such as shops and restaurants where a service or an ongoing activity may still be required outside the building. They can also be employed as a necessary short term measure that may precede a more permanent flood defence structure.

Sand Bags or Flood Sacks
This is the cheapest form of measure and is more suitable in emergency response situations, such as surface water flooding where there is little to no warning, the water is at a shallow depth and the exact flood path cannot be predicted. The sandbags can be stored in a suitable nearby location or left along previous flood paths on a temporary basis. The flood sacks have the added advantage that they are light and can be easily stored and transported. They expand and fill voids once they come into contact with water.

Flood Resilience involves designing or adapting a property so that although flood water is able to enter the building, very little or no permanent damage is caused through the use of water resistant and replaceable sacrificial materials. Structural integrity is also maintained and normal service can resume fairly rapidly after the flood has receded and clean up has taken place. This method is not usually that suitable for new property. Recommended methods are:-

Pipes and Services
Electrical wiring can be dropped down from the first floor / roof level and by ensuring that all fuse boxes and electrical sockets are kept at least 1.5m above the floor level. This would

also apply to gas, oil and water supplies so as to avoid pulled joints and leaks, which can lead to contamination and pollution.

Raising Fabrics and Appliances
Televisions, fridges and cookers can be placed on plinths at raised levels. Machinery and office equipment should also be raised. Castor type sofas and the use of movable rugs instead of fixed carpets are better options in regard to flood resilience.

Fixtures and Fittings
Popular methods in kitchens and downstairs bathrooms are to use durable water resistant materials such as stainless steel units and plastic skirting boards. Vinyl and tiled floors are preferred to wooden or chipboard floors.

Valuables and Memorabilia
Any valuables such as ornaments, pictures and photographs can be placed on high mounted shelves. Smaller furniture can be positioned in such a way that it can be easily transferred to upstairs levels.

The applicant will need to demonstrate a sound understanding of these methodologies and their application as proposed mitigation measures within the submitted Flood Risk Assessment / Drainage Assessment. Guidance and further detail on the use of flood resistance and resilience construction can be found at the following websites:-

- Flood risk management and surface water drainage (ciria.org)
- http://www.nidirect.gov.uk/flooding-in-your-area

Notwithstanding the various flood proofing measures that may be available to manage and mitigate flood risk, it is stressed that the practice of flood avoidance, by locating new buildings and infrastructure outside the flood risk area, is the most effective means of managing the flood risk. Alternative sites should always be considered.

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