LDP-EBD-EN1

Strategic Flood Consequence Assessment Flintshire

Final Report

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Contract

This report describes work commissioned by Ruairi Barry, on behalf of Flintshire County Council, by a letter dated January 2017. Flintshire County Council's representative for the contract was Ruairi Barry. Mike Williamson of JBA Consulting carried out this work.

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Purpose

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JBA Consulting has no liability regarding the use of this report except to Flintshire County Council.

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1 Introduction

1.1 Commission

As a Lead Local Flood Authority (LLFA) and a Local Planning Authority (LPA), Flintshire County Council (FCC) is required to produce a Strategic Flood Consequence Assessment (SFCA). FCC commissioned JBA Consulting in January 2017 to undertake a SFCA.

The SFCA is required to inform Flintshire's emerging Local Development Plan (LDP) and is carried out in accordance with the Welsh Government's development planning guidance, Planning Policy Wales (PPW), Technical Advice Note 15: Development and Flood Risk (TAN 15); Welsh Government Chief Planning Officers letters, published 9th January 2014; and Welsh Government (2016): FCA Climate Change allowances which, in part, discuss the necessity to take account of climate change for a 0.1% AEP fluvial or tidal flood event. This is discussed in Section 7.

The final SFCA will be used as a background document for the LDP and in support of any subsequent Sustainability Appraisal (SA), Strategic Environmental Assessment (SEA) and Appropriate Assessment under the EU Habitats Directive, as well as informing the Development Management process.

1.2 SFCA requirements

The main purpose of this SFCA is to identify the strategic flood risks to key communities in Flintshire to support the preparation of the LDP. The main requirements of the SFCA, according to the Project Brief document, include, but are not limited to, the following:

Stage 1

- Using the most up-to-date, available data to identify and assess all potential sources and mechanisms of flooding on a strategic scale and factors affecting them e.g. existing defences, assets, etc. An assessment of the potential impacts (both positive and negative) that future new development could contribute to that risk.
- To determine the potential broad effects of any increased surface water runoff from proposed development, taking into account the requirements of para.8.5 of TAN 15 and, where applicable (in consultation with the LLFA, NRW, and Dwr Cymru – Welsh Water), consider areas where the receiving system is known to be inadequate.
- An assessment and mapping of all sources of current flood risk:
  - The fluvial and tidal flood risk assessment should be based on the latest version of the Development Advice Map (associated breach modelling to be carried out in Stage 2). TAN 15 sets out a clear policy aim to identify land required for current and future flood management that should be safeguarded. Therefore, this SFCA should identify potential green space infrastructure as fluvial undeveloped rural areas within the 1 in 100-year flood event outline. This can be used to set future land use and flood management policies, to protect those, open spaces in the floodplain, where development should be avoided to reduce overall flood risk.
  - Surface water:
    - Runoff (pluvial flooding) - interactions between surface water flooding and identified areas for development need to be based on the most recent version of NRW's Surface Water Flood Maps (Risk of Flooding from Surface Water) as well the outcomes to any strategic surface water assessments previously undertaken. This appraisal should demonstrate the likely level of surface water flood

risk to future development sites and will also influence flood risk management recommendations.

- Sewer flooding – assessment of historic flood incidents and artificial drainage areas available from Welsh Water (DCWW).
- Critical Drainage Areas (CDA) / Areas of Critical Drainage (ACDP) - information used during the assessment of surface water flooding, in combination with historical records, should be used to identify any possible CDAs / ACDPs. Such identification will provide a good indication of areas, if developed, that may significantly increase flood risk downstream or to the wider community by the generation of increased surface water runoff. Identification of such critical areas should help to inform FCC on the need for future drainage assessments or surface water management plans.
- Groundwater - susceptibility of areas to groundwater flooding should be appraised based on available information and historical accounts of flooding and again this will be informed by FCC and NRW records of groundwater flooding.

- Assessment of risk from artificial sources – modelled breach scenarios. Identification of breach scenario locations with detailed modelling taking place during Stage 2.
- Assessment of current flood risk management (FRM) measures - all information on FRM measures that are now in place throughout the county should be noted and mapped, including:
  - NRW assets such as raised defences and embankments
  - NRW Flood Warning Areas (FWA)
  - Council owned assets
  - Critical structures such as bridges, defences and weirs which may affect local hydraulics and flood risk.
- Impacts of climate change - To enable FCC to take extreme events, including consideration of climate change (in accordance with the Welsh Government Letter: CL-03-16 - Climate change allowances for Planning purposes from December 2016). The vulnerability and adaptability of communities to the impacts of climate change should be highlighted as this should influence future development and how the Council manages its own estate.

- Assessment of risk to proposed development:
  - GIS analysis to assess flood risk to proposed development sites, calculating area and percentage at risk from fluvial, tidal and surface water flooding. The results of this analysis to be included within a calculational spreadsheet to enable simple application of the Sequential Test by the Local Planning Authority (LPA). This analysis should be extended to include the impacts of climate change at these sites where data is available.
  - The spreadsheet should identify those sites at high risk, which should be avoided, those which may be available for substitution and those, which are located in lower risk areas and are seen as suitable for development. The spreadsheet should also be used to identify whether site boundaries should be adjusted to reduce flood risk and identify where the Justification and Acceptability Test would need to be satisfied. Within the SFCA report,

flood risk to high-risk development sites or communities (depending on the number and proximity of sites) should be summarised thus aiding the application of the Justification Test.

- This process should also guide the scope of Stage 2, by identifying those sites, areas or communities which are at high risk but are known within FCC to provide significant regeneration potential and are required to pass the Exception Test. The results will also offer a first look at those sites, which could offer potential compensatory storage. Effective review and assessment will be required at this stage by both FCC and NRW.

Stage 2

- Stage 2 of the SFCA should build on the information, analysis and findings of Stage 1, with a more focussed assessment of flood risk, particularly in the Dee Basin area in the form of a series of breach assessments at agreed locations in accordance with standard NRW breach assessment criteria.
- Stage 2 should primarily be focused on developing the detailed understanding of flood hazard in high risk areas, which coincide with areas with development pressures. Particular focus will be given to areas within the Dee Basin area. This detailed information should support further application of the Sequential Test, identify those sites or communities which are likely to pass the Exception Test if required.
- Flood risks such as depths, velocities and hazards will be required in order for FCC to assess the sustainability of these areas, appropriate mitigation techniques for master planning and site layouts.
- Breach and overtopping modelling for targeted locations:
  - Flood outlines;
  - Maximum depths of flooding;
  - Rate of rise / speed of inundation;
  - Maximum velocity of flood waters;
  - Flood hazard
  - For the following scenarios:
  - 0.5% tidal present day
  - 0.5% tidal with 100 years climate change allowance
  - 0.1% tidal present day
  - 0.1% tidal with 100 years climate change allowance
- Assessment of high risk sites:
  - The information and guidance provided within the SFCA should be used by FCC to inform development and flood risk and to enable the LPA to apply the tests in sections 6 and 7 of TAN 15 to key sites.
  - Surface water risk should also be reviewed and recommendations made as per Section 8 and Appendix 4 of TAN 15 concerning surface water management and Sustainable Drainage Systems (SuDS).
  - At each high risk site, an assessment should be made of the current and likely future flood risk from fluvial, coastal and surface water sources, where applicable. These assessments should provide the key information required in order to answer the questions posed in TAN 15 regarding the suitability of land for development. This specifically entails whether key sites fall within the 0.1% flood outline (Zone C) though should also assess

the tolerable criteria for risks to developments associated with flood depth, rate of rise of flood waters, speed of flood water inundation and flow velocity.

It is important to highlight that this SFCA is strategic in nature and makes use of the most current available information. This SFCA should be used as a starting point for planners, developers and the public to initially consider development and flood risk and whether more detailed, site specific assessments of flood risk, such a Flood Consequence Assessment (FCA), are required. It is also worth noting that the presence of flood zones in an area, be it fluvial, tidal or surface water, does not mean that development simply cannot happen. Sites located within areas of lower risk should be considered in preference to areas at higher risk as part of the development planning process and a more detailed assessment of flood risk may be required to ensure that risks can be effectively managed.

1.3 SFCA future proofing

As discussed, this SFCA has been developed using the most up-to-date data and information available at the time of commission. The SFCA has been future proofed as far as possible though the reader should always confirm with the source organisation (FCC) that the latest information is being used when decisions concerning development and flood risk are being made. Welsh Government policy documents Planning Policy Wales and Technical Advice Note 15: Development and Flood Risk are referred to throughout this SFCA as these are the current primary documents available at the time of the finalisation of this SFCA. Also, be aware that this is a live document and can be updated by FCC as and when new information becomes available.

NRW would usually recommend updating an SFCA every three to four years, unless there is a significant flood affecting the area or a change in policy, in which case an immediate review should be undertaken. Where possible, the SFCA should be kept as a 'live' entity and continually updated when new information becomes available.

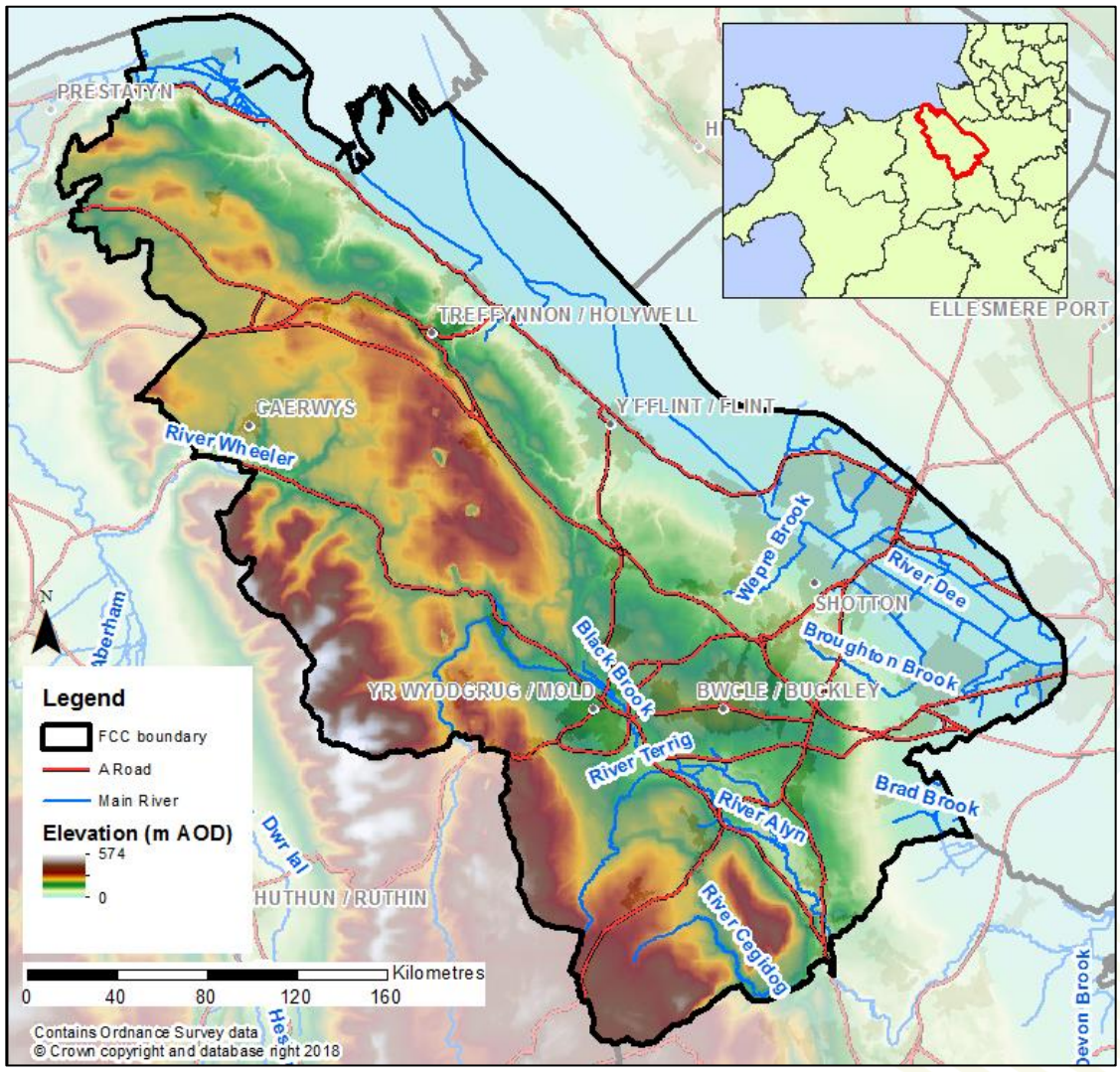
2 SFCA study area

FCC is located in North Wales (see Figure 2-1). The county covers an area of approximately 438 square kilometres and has a population of around 152,500 according to the 2011 Census.

Flintshire is bound in the north by the Dee Estuary, and by Cheshire West and Chester unitary authority in the east, Wrexham to the south and Denbighshire to the west. The coast along the Dee estuary is heavily industrialised with most northern coastline mainly developed for tourism. The Clwydian mountains occupy much of the west of the county with the highest point being Moel Famau at 554 metres. The main towns include Buckley, Connah's Quay, Flint, Hawarden, Holywell, Mold, Queensferry and Shotton. The main rivers in Flintshire are the River Dee, including the Dee Estuary and the River Alyn.

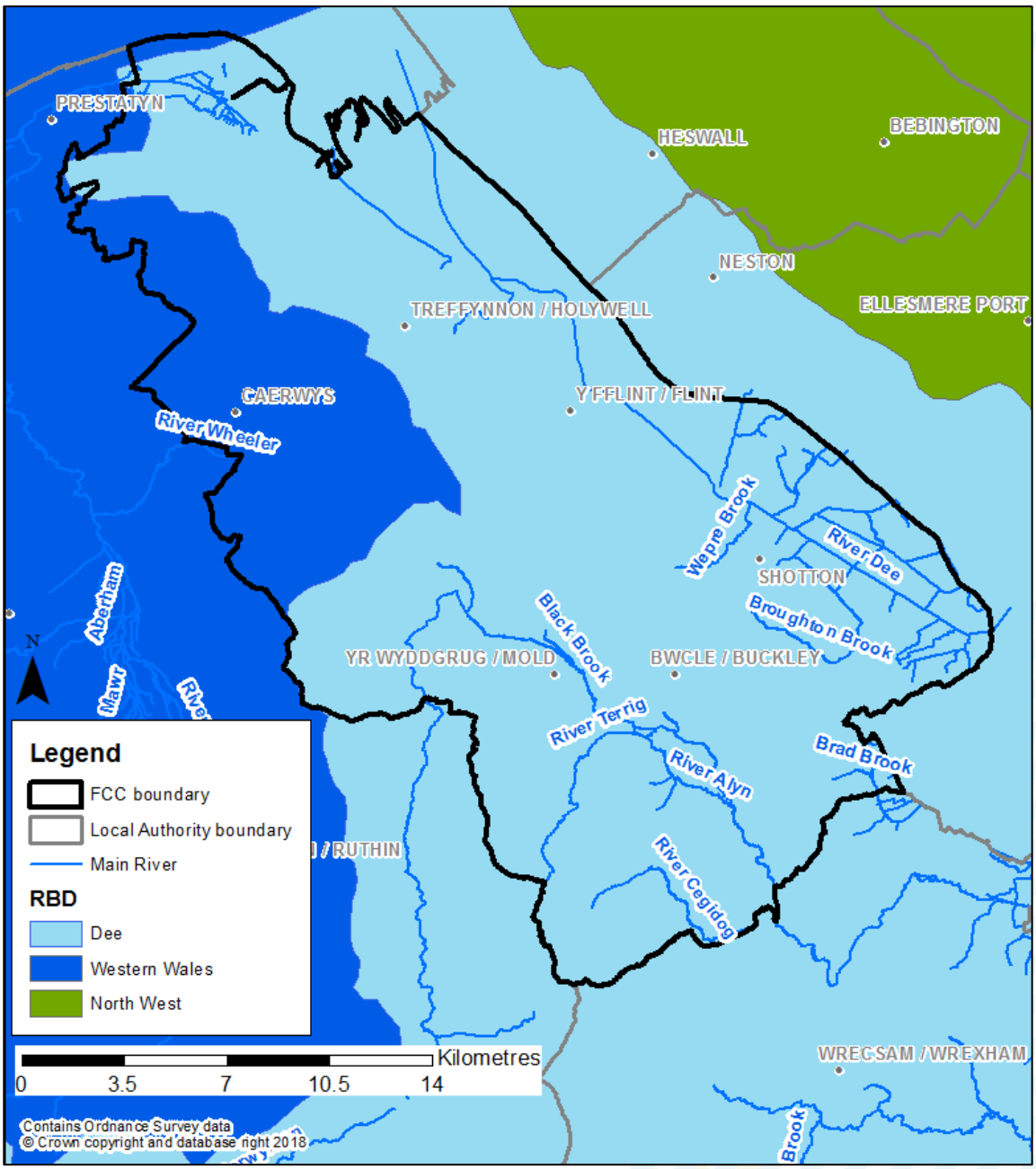
Flintshire has some significant areas which are at risk from tidal and fluvial flooding, which correspond with highly populated and developed areas where there is also significant employment land and infrastructure, such as Deeside and the Dee Basin, and the coast from Deeside to the county boundary with Denbighshire in the north, and settlements along the catchment of the River Alyn including Mold. There are several main settlements at fluvial and / or tidal flood risk, including Talacre, Mostyn, Flint, Connah's Quay, Shotton, Mold and a number of smaller settlements.

Figure 2-1: Study area



FCC is mostly within the Dee River Basin District (RBD) though the north western area of the county, which is largely rural with a number of small settlements, is within the Western Wales RBD (see Figure 2-2).

Figure 2-2: River Basin Districts



2.1 River Dee

The Dee RBD covers an area of 2,200 square kilometres, mainly in Wales but in the lower reaches the Dee often runs along the border with England. Its source is in the mountains and lakes of the Snowdonia National Park and it runs to the internationally significant intertidal and wading bird habitat of the Dee Estuary Reservoirs in the upper part of the catchment store water and regulate flows in the Dee. The reservoirs sustain abstractions for public and industrial water supply and modify flood response in the river, reducing the frequency of flooding in the Dee between Bala and Chester.

The varying landscape of the catchment results in different flooding responses in different areas. In the west the steep slopes give rise to more rapid runoff and faster flooding responses whereas in the east the land is more gently sloping therefore runoff occurs more slowly. Arable farming dominates on the east of the Dee estuary, and around Deeside and Sealand.

Following rainfall events in upstream areas, water levels in the Dee can take a few days to peak in the downstream reaches. During very high tides, tide locking can occur where the level of the incoming high tide prevents fluvial water flowing out to sea. This tidal impact affects the river beyond Chester as far upstream as Farndon.

Frequent flooding in the lower Dee between Bangor-on-Dee and Chester (to the south of Chester) has resulted in very little urban development. The area is extensively used for agriculture, particularly intensive dairy farming on the fertile land in and around Wrexham and on the Cheshire Plain.

Approximately 6% of the catchment is urban with Wrexham, Chester and Deeside being the main towns, where over 60% of the population lives. The tidal section of the River Dee downstream of Chester was straightened in the late 1700s for navigational purposes, enabling urban development on both sides of the river. Changes in land use within the catchment have led to the modification of some rivers and pollution from agricultural runoff and industry.

Parts of the Dee catchment are underlain by a Permo-Triassic Sandstone aquifer. This aquifer is used to support agricultural, industrial and public water supply abstractions, whilst also contributing to baseflows in the lower Dee and some of the tributaries. The Dee is an important source of drinking water for nearly three million people, in Wales and North West England. Risks from pollution have led to it becoming one of the most protected rivers in Europe. In 1999, the lower part of the Dee was designated as the UK's first, and to date only, Water Protection Zone.

3 The Planning Framework and Flood Risk Policy

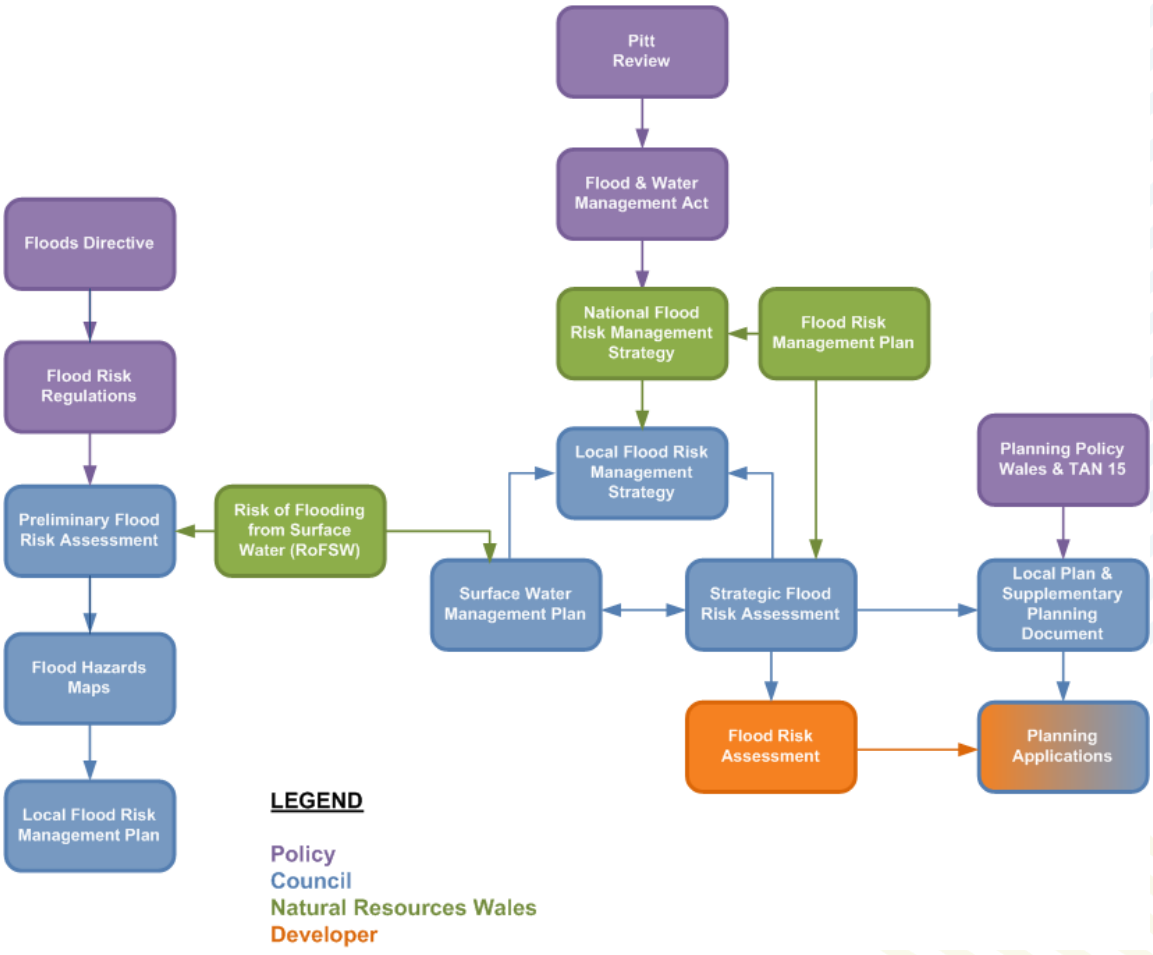
3.1 Introduction

The main purpose of this section of the SFCA is to provide an overview of the key planning and flood risk policy documents that have shaped the current planning framework. This section also provides an overview and context of the LLFA's and LPA's responsibilities and duties in respect to managing local flood risk including but not exclusive to the delivery of the requirements of the Flood Risk Regulations (FRR) 2009 and the Flood and Water Management Act (FWMA) 2010.

Figure 3-1 illustrates the links between legislation, national policy, statutory documents and assessment of flood risk. The figure shows that whilst the key pieces of legislation and policy are separate, they are closely related and their implementation should aim to provide a comprehensive and planned approach to asset record keeping and improving flood risk management within communities.

It is intended that the non-statutory SWMPs and SFCAs can provide much of the base data required to support the delivery of the LLFA's statutory flood risk management tasks as well supporting local authorities in developing capacity, effective working arrangements and informing Local Flood Risk Management Strategies (LFRMS) and LDPs, which in turn help deliver flood risk management infrastructure and sustainable new development at a local level. This SFCA should be used to support the LPA's LDP and to help inform planning decisions.

Figure 3-1: Key Documents and Strategic Planning Links – Flood Risk



3.2 Legislation

3.2.1 EU Floods Directive & the Flood Risk Regulations

The European Floods Directive (2007) sets out the EU's approach to managing flood risk and aims to improve the management of the risk that floods pose to human health, the environment, cultural heritage and economic activity. The Directive was translated into English and Welsh law by the Flood Risk Regulations which require LLFAs and the EA to produce Flood Risk Management Plans (FRMPs).

The Directive puts in place a six year cycle of producing Preliminary Flood Risk Assessments (PFRAs) with the aim of identifying significant Flood Risk Areas; preparing flood hazard and risk maps; and preparing Flood Risk Management Plans (FRMPs). The first six year cycle was completed in December 2015 and the second six year cycle is currently underway.

Figure 3-2: EU Floods Directive

PFRAs should cover the entire LLFA area for local flood risk (focusing on ordinary watercourses, surface water and groundwater flooding). Where significant Flood Risk Areas are identified using the national approach (and locally reviewed), the LLFA is then required to undertake flood risk hazard mapping and to produce Flood Risk Management Plans as illustrated in Figure 3-2. FRMPs are also completed for each RBD in Wales by NRW.

The FRMP should consider objectives for flood risk management (reducing the likelihood and consequences of flooding) and measures to achieve those objectives. Significant Flood Risk Areas were not identified in Flintshire therefore the LLFA was not required to produce a FRMP.

NRW has implemented one of the exceptions for creating PFRAs, etc. for Main Rivers and coastal flooding, as they already have mapping (i.e. EA Flood Map for Planning (Rivers and Sea), Risk of Flooding from Rivers and Sea Map) and plans (i.e. CFMPs, SMPs) in place to deal with this. The EA has therefore focused their efforts on assisting LLFAs through this process. A FRMP was however completed by the EA for the Dee RBD (see 3.2.5).

3.2.2 Flintshire Preliminary Flood Risk Assessment 2011 and 2017

The first cycle PFRA for Flintshire was submitted to EA Wales (now NRW) in June 2011. The PFRA provides a high level overview of local flood risk, from sources including surface water, groundwater and ordinary watercourses.

Based on NRW's Flood Map for surface water (FMfSW), which at the time was the primary surface water flood map for England Wales, the total number of properties at risk from surface water flooding in Flintshire to a depth greater than 0.1 metres was 16,800 and 5,800 to a depth greater than 0.3 metres.

Due to lower population densities in Wales, compared to England, the methodology for identifying flood risk areas within Wales were reduced. New local thresholds were used to identify where flood risk is an issue i.e. where flooding to a depth greater than 0.3 metres by a rainfall event with a 1:200 annual return period based on the following criteria:

- Where more than 200 people are affected; or
- More than 20 businesses affected; or

- More than 1 critical service affected

For a discrete area to be designated as a Flood Risk Area using the Welsh Government (WG) guidance, there must be a population of over 5,000 people in a community at risk of flooding. No Flood Risk Areas were therefore identified in Flintshire.

The second cycle PRFA, reviewed during 2017, used all relevant current flood risk data and information to update the 2011 version, and was agreed with the NRW in December 2017.

The PFRA included a review of flooding experienced since the publication of the first PFRA Report in 2011 and this found that the following flood events led to locally significant harmful consequences: June 14th 2016 – Flooding at Penlon Bagillt flooding from ordinary watercourse. Additionally, there has been no new information identified since the publication of the first Preliminary Flood Risk Assessment Report in 2011 that has led to a change in understanding of future flood risk. Finally, regarding Flood risk areas (FRAs) The cycle 1 FRAs in Wales will be reviewed as part of a detailed consolidated PFRA that will cover all sources of flood risk by 22nd December 2018.

3.2.3 Water Framework Directive & Water Environment Regulations

The purpose of the Water Framework Directive (WFD), which was transposed into English and Welsh Law by the Water Environment Regulations (2003), is to deliver improvements across Europe in the management of water quality and water resources through the aforementioned RBMPs.

NRW is responsible for monitoring and reporting on the objectives of the WFD on behalf of WG. They work with WG, Ofwat, local government, non-governmental organisations (NGOs) and a wide range of other stakeholders including local businesses, water companies, industry and farmers to manage water.

The second management cycle of the WFD has begun and the second RBMPs were completed in 2015, building upon the first set completed in 2009. RBMPs are designed to address the pressures facing the water environment in the river basin management plan districts and the actions that will address them. The plans describe required objectives and measures to protect and improve the water environment over the next 20 years and aim to achieve WFD targets from 2015 onwards to 2021.

The RBMPs, like the CFMPs, are important documents relevant to the development of the SFCA. The SFCA should take into account the wider catchment flood cell aims and objectives and understand how it can potentially contribute to the achievement of them.

The main responsibility for FCC is to work with NRW to develop links between river basin management planning and the development of local authority plans, policies and assessments. In particular, the general programme of actions (measures) within the RBMPs highlight the need for:

- Surface Water Management Plans (for more information see Section 3.4.2),
- Consideration of the WFD objectives (achieving good status or potential as appropriate) in the spatial planning process, including LDDs and Sustainable Community Strategies, and
- Promotion of the wide scale use of SuDS in new development (see Section 7.6.5).

3.2.4 Catchment Flood Management Plans (CFMP)

The CFMPs were carried out by EA Wales in 2009 and were designed to establish flood risk management policies which will deliver sustainable flood risk management for the long term. The CFMPs were used by EA Wales to help direct resources to where the areas of greatest risk.

The CFMPs contain useful information about how the catchments work, previous flooding and the sensitivity of the river systems to increased rainfall. The EA draw on the evidence and previous measures and proposals set out in the CFMPs to help develop the FRMPs for RBDs. Flintshire is mostly within the Dee CFMP area, with the exception of the north western area that is within the West Wales RBD which is included within the Conwy and Clwyd CFMP.

3.2.5 Flood Risk Management Plans

Following on from the CFMPs, FRMPs are designed to set out the risk of flooding from rivers, sea, surface water, groundwater and reservoirs within each RBD and to detail how Risk Management Authorities (RMA) will work with communities to manage flood risk up to 2021 for this current cycle, at the time of writing. Both the River Basin Management Plans (RBMP) and FRMPs have been developed by the EA in tandem to ensure that flood defence schemes can provide wider environmental benefits during the same six-year cycle. Both flood risk management and river basin planning form an important part of a collaborative and integrated approach to catchment planning for water. Each EU member country must produce FRMPs as set out in the EU Floods Directive 2007.

The Dee River Basin District Flood Risk Management Plan 2015-2021

As discussed in Section 2, Flintshire is primarily within the Dee RBD therefore the management measures and policies put in place in the Dee catchment will have significant implications on flood risk management in Flintshire. Section 10 of the Dee RBD FRMP report summarised various EA and NRW measures that may help manage flood risk in the Dee catchment. Those that are applicable to Flintshire include:

- Preventing risk:
  - Provision of advice and support to the government.
  - Regulation of all 'high-risk' reservoirs in accordance with the Reservoirs Act 1975.
  - Close working relationships with local planning authorities, developers, businesses and infrastructure operators to help them understand the consequences of flood risk in the locations they choose for development. Including providing advice on how new development can be designed to be more resilient to flooding. This helps to prevent inappropriate development through the planning process and ensures there is no increase in runoff from new developments.
  - Ensuring works in, over, under and next to main rivers do not increase flood risk or cause pollution through effective consenting, using the consenting process to identify opportunities to improve the water environment.
  - A prioritised programme of mapping and modelling to ensure flood risk information remains up to date and fit for purpose and to prioritise and allocate funding in high risk locations, and to influence sustainable development and emergency response.
  - Research and development, and work with partners to identify best practice for reducing runoff through land use change, whilst contributing wider benefits where possible (biodiversity, soil conservation and water quality improvements).
- Preparing for risk:
  - Hydrometric monitoring to inform the flood warning service.

- Flood forecasting and alerting of households and individuals of potential flood events.
- Work to maintain and improve flood forecasting, flood warning and flood incident management services.
- A risk-based programme is in place to increase awareness of flood risk, what actions need to be taken in the event of a flood and encourage registration to Floodline.
- Consideration of climate change.
- Review of Asset System Management Plans regularly with regard to maintenance, funding requirements and asset condition related works.
- Provision of a flood incident response service 24 hours a day, 7 days a week, 365 days a year.
- On-site reservoir plans are in place for all 'high-risk' reservoirs.
- Working collaboratively with partners to find innovative approaches to managing flood risk.

- Protecting from risk:
  - Maintenance of high risk flood and coastal risk management assets, prioritising those at highest risk.
  - Asset inspection programmes to ensure flood risk management assets are at the appropriate standard.
  - Maintenance programmes to replace / refurbish flood risk management assets, including pumping stations and outfalls, prioritising efforts on those which have the highest flood risks.
  - The Flood and Coastal Risk Management Capital Programme includes building flood defences and implementing innovative ways of managing the landscape to hold and slow down water to help reduce flood risk to communities.
  - Seeking of opportunities to undertake Natural Flood Management by using all appropriate tools available, such as Woodland Creation maps.

3.2.6 Flood & Water Management Act

The FWMA was passed in April 2010. It aims to improve both flood risk management and the way we manage our water resources.

The FWMA has created clearer roles and responsibilities and helped to define a more risk-based approach to dealing with flooding. This included the creation of a lead role for LAs, as LLFAs, designed to manage local flood risk (from surface water, ground water and ordinary watercourses) and to provide a strategic overview role of all flood risk for NRW.

The content and implications of the FWMA provide considerable opportunities for improved and integrated land use planning improved and integrated land use planning and flood risk management by LAs and other key partners. The integration and other key partners. The integration and synergy of strategies and plans at national, regional and local scales, is increasingly regional and local scales, is increasingly important to protect vulnerable communities and deliver sustainable regeneration and deliver sustainable regeneration and growth.

Table 3-1 provides an overview of the key LLFA responsibilities under the FWMA.

Table 3-1: Key LLFA responsibilities under the FWMA

FWMA responsibility	Description of responsibilities and powers	LLFA status
Local Strategy for Flood Risk Management	The LLFA has a duty to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategy will build on information such as national risk assessments and will use consistent risk based approaches across different LA areas and catchments. The local strategy should not be secondary to the national strategy; rather it will have distinct objectives to manage local flood risks important to local communities.	Final version produced December 2013 (see Section 3.4.1)0
Duty to contribute to sustainable development	The LLFA has a duty to contribute towards the achievement of sustainable development.	Ongoing
Duty to comply with national strategy	The LLFA has a duty to comply with national flood and coastal risk management strategy principles and objectives in respects of its flood risk management functions.	Ongoing
Investigating Flood Incidents	The LLFA, on becoming aware of a flood in its area, has (to the extent it considers necessary and appropriate) to investigate and record details of "locally significant" flood events within its area. This duty includes identifying the relevant risk management authorities and their functions and how they intend to exercise those functions in response to a flood. The responding RMA must publish the results of its investigation and notify any other relevant RMAs.	Ongoing
Asset Register	The LLFA has a duty to maintain a register of structures or features, which it considers to have a significant effect on flood risk, including details on ownership and condition as a minimum. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.	Ongoing
Duty to co-operate and Powers to Request Information	The LLFA must co-operate with other relevant authorities in the exercise of their flood and coastal erosion management functions.	Ongoing
Ordinary Watercourse Consents	The LLFA has a duty to deal with enquiries and determine watercourse consents where the altering, removing or replacing of certain flood risk management structures or features that affect flow on ordinary watercourses is required. It also has provisions or powers relating to the enforcement of unconsented works.	Ongoing

FWMA responsibility	Description of responsibilities and powers	LLFA status
Works Powers	The Act provides the LLFA with powers to undertake works to manage flood risk from surface runoff, groundwater and ordinary watercourses, consistent with the LFRMS for the area.	Ongoing
Designation Powers	The Act provides the LLFA with powers to designate structures and features that affect flooding or coastal erosion. The powers are intended to overcome the risk of a person damaging or removing a structure or feature that is on private land and which is relied on for flood or coastal erosion risk management. Once a feature is designated, the owner must seek consent to alter, remove, or replace it.	Ongoing
Emergency Planning	The LLFA is required to play a lead role in emergency planning and recovery after a flood event.	Resilience Forum (Section 0**Error! Reference source not found.**)
Community Involvement	The LLFA should engage local communities in local flood risk management issues. This could include the training of community volunteers, the development of local flood action groups and the preparation of community flood plans, and general awareness raising around roles and responsibilities.	Various ongoing (Section 8.1)
SuDS Approving Body	The Act establishes each LLFA as a SuDS Approving Body (the "SAB"). The SAB would have responsibility for the approval of proposed drainage systems in new developments and redevelopments, subject to exemptions and thresholds. Approval must be given before the developer can commence construction. The SAB would also be responsible for adopting and maintaining SuDS, which serve more than one property, where they have been approved. Highways authorities will be responsible for maintaining SuDS in public roads, to National Standards.	On hold (Awaiting outcome of current WG Consultation 2018)
Latest changes to FWMA legislation[1]		

1 http://www.legislation.gov.uk/ukpga/2010/29

3.2.7 Future Generations & Wellbeing Act (2015)[2]

This Act is about improving the social, economic, environmental and cultural well-being of Wales. This new law will mean that, for the first time, public bodies listed in the Act must do what they do in a sustainable way.

Public bodies need to make sure that when making their decisions they take into account the impact they could have on people living their lives in Wales in the future.

It will expect them to:

- work together better
- involve people reflecting the diversity of our communities
- look to the long term as well as focusing on now
- take action to try and stop problems getting worse - or even stop them happening in the first place.

The Act establishes a statutory Future Generations Commissioner for Wales, whose role is to act as a guardian for the interests of future generations in Wales, and to support the public bodies listed in the Act to work towards achieving the well-being goals.

The Act also establishes Public Services Boards (PSBs) for each local authority area in Wales. Each PSB must improve the economic, social, environmental and cultural well-being of its area by working to achieve the well-being goals.

3.2.8 Environment Act (Wales)[3]

The Environment (Wales) Act puts in place the legislation needed to plan and manage Wales' natural resources in a more proactive, sustainable and joined-up way.

In Wales, the nature, land, water and air are the ultimate resource. But, demands on these natural resources are increasing and one of the greatest challenges is to find a way to secure healthy, resilient and productive ecosystems for the future whilst still meeting the challenges of creating jobs, housing and infrastructure. The Environment Act helps us to meet this challenge.

Sustainable management of natural resources is about managing these resources in a joined up way that delivers real outcomes for the environment, people, the economy and communities.

The aim is to make the most of the opportunities that Wales' natural resources present while safeguarding and building the resilience of natural systems to continue to provide these benefits over the long term.

The Act also provides NRW with new tools to help manage our natural resources sustainably. Land management agreements allow NRW to work with landowners to manage their land in a sustainable way. Experimental schemes allow NRW to trial new ways of working. A new biodiversity duty included in the Act helps to reverse the decline and secure the long-term resilience of biodiversity in Wales.

For flood mitigation, government will focus on using more natural flood management (see Section 6.2) solutions; increasing the uptake of SuDS, especially in new

2 https://gov.wales/topics/people-and-communities/people/future-generations-act/?lang=en
3 https://gov.wales/topics/environmentcountryside/consmanagement/natural-resources-management/environment-act/?lang=en

development (see Section 7.7.3); and improving the resilience of properties at risk of flooding and the time it takes them to recover should flooding occur.

3.3 Planning Policy

3.3.1 Planning Policy Wales (PPW)

The PPW Edition 9[4] document was published in November 2016, and sets out the land use planning policies of the Welsh Government. The document is supported by Technical Advice Notes (TANs), including TAN 15: Development and Flood Risk[5].

The Wales Spatial Plan – People, Places, Futures[6] (2004, updated 2008) sets a strategic framework to guide future development and policy interventions. It integrates the spatial aspects of national strategies for social inclusion and economic development, health, transport and environment, translating the Welsh Government's sustainable development duty into practice.

PPW, the TANs, circulars and policy clarification letters comprise national planning policy. National planning policy and the Wales Spatial Plan should be considered in the preparation of development plans. They may be material to decisions on individual planning applications and will be taken into account by Welsh Ministers and Planning Inspectors in the determination of called-in planning applications and appeals.

The PPW document acts as guidance for LPAs to help them prepare their LDPs and take development management decisions. Detailed advice on the preparation of LDPs is contained in PPW and the Local Development Plan Manual – Edition 2[7] (2015). Section 3.3.5 of this report summarises LDP requirements and also the preparation of the Flintshire LDP.

At the time of writing, Welsh Government is in the process of consulting on a revised PPW which will become Edition 10[8]. Edition 10 will be restructured into policy themes around the wellbeing goals of the 'Well-being of Future Generations (Wales) Act 2015'[9] and policy will be updated to reflect new Welsh Government strategies and policies.

3.3.2 National Development Framework for Wales

The Planning Directorate has begun work on the production of a National Development Framework[10] (NDF). The NDF will set out a 20 year land use framework for Wales and will eventually replace the Wales Spatial Plan discussed above. Once adopted, the NDF will be subject to review every five years.

Welsh Government state that the NDF will:

- Set out where nationally important growth and infrastructure is needed and how the planning system, nationally, regionally and locally, can deliver it;
- Provide direction for Strategic and Local Development Plans and support the determination of Developments of National Significance;
- Sit alongside PPW to provide the context for land use planning;

4 http://gov.wales/topics/planning/policy/ppw/?lang=en
5 http://gov.wales/docs/desh/publications/040701tan15en.pdf
6 http://gov.wales/topics/planning/development-plans/wales-spatial-plan/?lang=en
7 http://gov.wales/topics/planning/policy/policy-and-guidance-on-development-plans/ldpmanual/?lang=en
8 https://beta.gov.wales/planning-policy-wales-edition-10
9 http://gov.wales/topics/people-and-communities/people/future-generations-act/?skip=1&lang=en
10 http://gov.wales/topics/planning/national-development-framework-for-wales/?lang=en

- Support national economic, transport, environmental, housing, energy and cultural strategies and ensure they can be delivered through the planning system.

3.3.3 Technical Advice Note 15: Development and Flood Risk

TAN 15 provides technical guidance supplementing the policy set out in PPW in relation to development and flooding. It provides a framework within which risks arising from both river and coastal flooding, and from additional runoff from development in any location, can be assessed.

The overarching aim of TAN 15 is to take a precautionary approach and direct development away from areas at high risk of flooding, where possible. Where development must be considered in high risk areas, these developments must be justified using the applicable tests set out in TAN 15.

Wales has been divided into three flood risk zones, ranging from Zone A, at little or no risk, to Zone C at high risk. Zone C is further subdivided into C1 and C2 indicating whether the area is subject to flood defence infrastructure or not. Collectively, these risk zones form the Welsh Government's Development Advice Map (DAM). The zones of the DAM are described in Table 3-2.

Table 3-2: Flood risk zones of the DAM as defined by TAN 15

Description of zone	Zone	Use within the Precautionary Framework
Considered to be at little or no risk of fluvial or coastal / tidal flooding	A	Used to indicate that justification test is not applicable and no need to consider flood risk further
Areas known to have been flooded in the past evidenced by sedimentary deposits	B	Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further
Based on NRW extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal)	C	Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the justification test including assessment of consequences. In accordance with The Welsh Government letter to Chief Planning Officers of 9 January 2014, DCC will need to now also consider the impaction of climate change into account in terms of development planning.
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences	C1	Used to indicate that development can take place subject to application of justification test, including acceptability of consequences
Areas of the floodplain without significant flood defence infrastructure	C2	Used to indicate that only less vulnerable development should be considered subject to application of a justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered

As well as the risk of flooding, the type of development proposed is important when assessing flood risk. The three categories of development used in TAN 15 are shown in Table 3-3.

Table 3-3: Development Categories from Tan 15

Development Category	Types
Emergency services	Hospitals, ambulance stations, fire stations, police stations, coastguard stations, command centres, emergency depots and buildings used to provide emergency shelter in time of flood
Highly vulnerable development	All residential premises (including hotels and caravan parks), public buildings (e.g. schools, libraries, leisure centres), especially vulnerable industrial development (e.g. power stations, chemical plants, incinerators), and waste disposal sites
Less vulnerable development	General industrial, employment, commercial and retail development, transport and utilities infrastructure, car parks, mineral extraction sites and associated processing facilities,

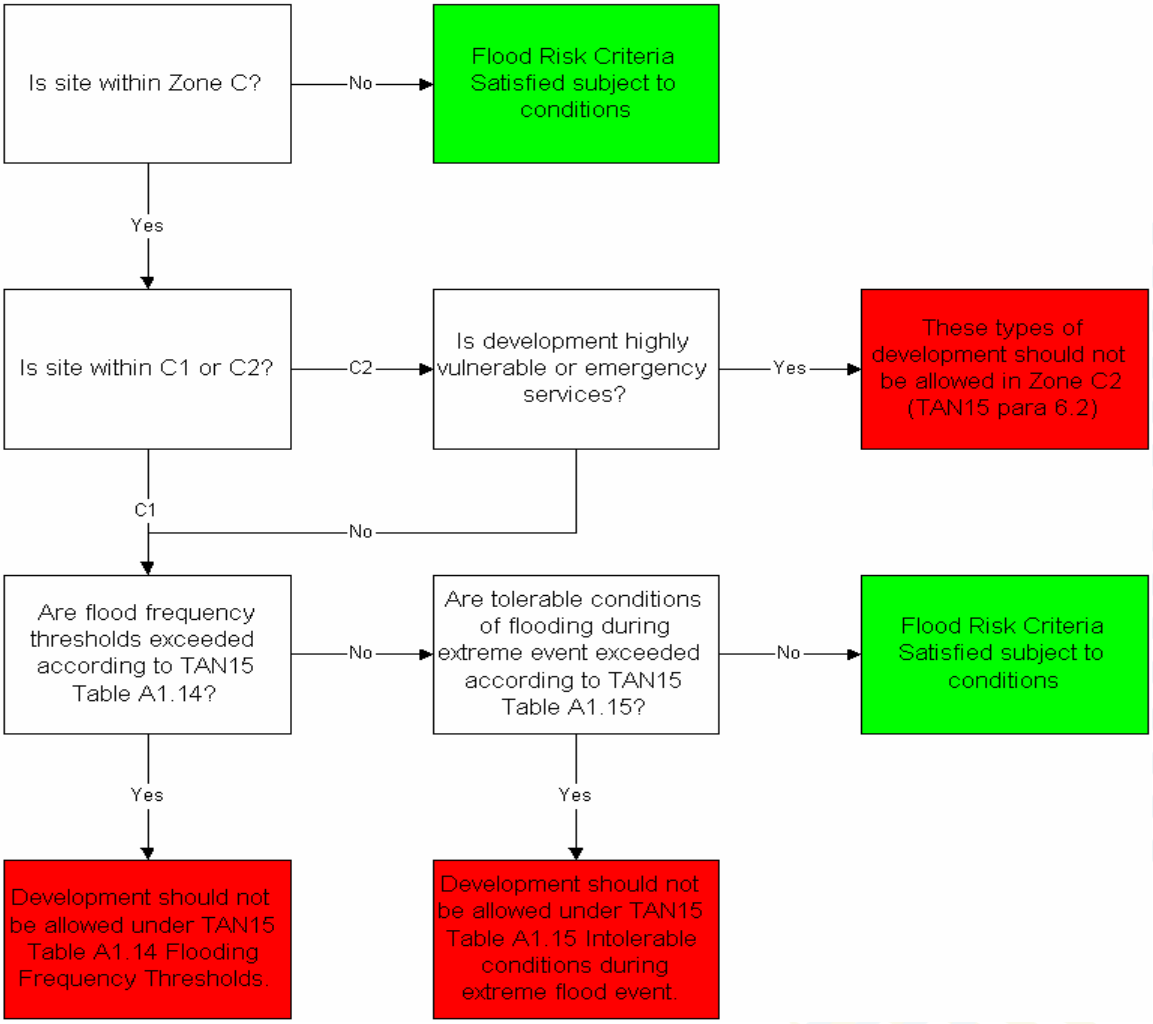
	excluding waste disposal sites

Following the precautionary approach, the central policy aim of TAN 15 for development states that:

"New development should be directed away from zone C and towards land in zone A, otherwise to zone B, where river or coastal flooding will be less of an issue. In zone C the tests outlined in sections 6 and 7 will be applied, recognising, however, that Highly Vulnerable development and Emergency Services in zone C2 should not be permitted. All other new development should only be permitted within zones C1 and C2 if determined by the planning authority to be justified in that location."

Figure 3-3 presents a flow chart of the TAN 15 procedure for assessing suitability of areas for development. These considerations are those that should be used during site specific FCAs and through this SFCA.

Figure 3-3: Flow Chart of the TAN 15 procedure for assessing acceptability of development in relation to flood risk



The presence of flood defences complicates understanding of risk (becomes residual risk) as the actual risk may be reduced. However, where residual risk exists, if defences are breached or overtopped for example, then areas may be considered to be

extremely vulnerable due to the speed of flooding. In such cases, TAN 15 suggests that NRW should advise the LPA on likely flooding consequences and the LPA must then decide on the acceptability of the proposed development.

Where development is allowed, measures to manage the risk must be put in place which may include developers taking responsibility for the ongoing maintenance of flood defences (TAN 15 paragraph 7.5). Detailed assessment of the flood limiting impacts of defences should be carried out by completing site specific FCAs. This will allow informed decisions to be made.

Justification test

The justification test is required to justify locating development within in zone C. Section 6 of TAN 15 explains that development, including transport infrastructure, can only be justified if the following criteria can me met:

i. *Its location in zone C is necessary to assist, or be part of, a local authority regeneration initiative or a local authority strategy required to sustain an existing settlement[11]; or,*

ii. *Its location in zone C is necessary to contribute to key employment objectives supported by the local authority, and other key partners, to sustain an existing settlement or region; and,*

iii. *It concurs with the aims of PPW and meets the definition of previously developed land (PPW fig 2.1); and,*

iv. *The potential consequences of a flooding event for the particular type of development have been considered, and in terms of the criteria contained in sections 5 and 7 and appendix 1 (of TAN 15) found to be acceptable.*

Section 7 relates to the consequences of flooding and is applicable to those sites that have passed the justification test of Section 6. The first three parts of the justification test should be applied by the LPA whilst the fourth part can be informed by the outcomes of this SFCA for those sites in zone C. The distinction between zones C1 and C2 is critical. Within zone C2, allowable development is restricted to less vulnerable development types (see Table 3-3) whereas this restriction does not apply for sites located in zone C1. However, any development type in either C1 or C2 must pass the fourth part of the justification test, using the criteria, described in Section 7 on flooding consequences, to justify the development in terms of flood risk.

Assessing Flood Consequences

Where development in zone C can be justified under Section 6, assessment must be made to establish whether suitable mitigation measures can be incorporated to ensure minimal risk to life, property, infrastructure and the natural environment (see Section 7 of TAN 15).

There are certain acceptability criteria for flooding consequences (Appendix A1.11 – A1.15) whereby a flooding frequency threshold for different development types should be met to ensure developments are flood free up to the appropriate threshold frequency. This may include mitigation measures where appropriate which may reduce the frequency of flooding from that which may occur naturally. However, there are limitations of data and estimations, with issues of uncertainty.

Beyond the threshold frequency, proposed developments would be expected to flood under extreme conditions. To protect people and property at these locations TAN 15

11 Regeneration initiatives will be comprehensive, multi-approach and form part of an integrated suite of initiatives which have been subject to public consultation. Local authority strategy will be the development plan for the area (deposit version as minimum).

lays down tolerable criteria for the anticipated flooding during an extreme event. Again, this can be assessed to include appropriate mitigation measures.

Policy requirements

Section 9 of TAN 15 contains a table summarising the policy requirements of development and flood risk, based on what DAM zone a proposed development is in. this table should be used by the LPA when allocating development to include in the LDP or by developers at the planning application stage.

Surface water

Section 8 of TAN 15 discusses how surface water runoff from new development should be dealt with and how SuDS should be implemented, where suitable, in all new development, irrespective of what fluvial or tidal DAM zone the development is located in. The policy requirements summary table of Section 9 of TAN 15 states that surface water for proposed new developments should be accounted for as a planning requirement.

FCC has produced a Supplementary Planning Guidance (SPG) note concerning surface water flood risk – 'LPGN 29 – Management of Surface Water for New Development', which states that this SPG should be afforded considerable weight as a material planning consideration. The note includes details on surface water design criteria and SuDS for new development, including the minimum surface water discharge limits from new developments. Also included is an indicative drainage proposal which contains the minimum requirements for surface water management to be included within a planning application. This SPG can be found online via:

http://www.flintshire.gov.uk/en/PDFFiles/Planning/Adopted-SPGNs/SPGN-No-29.-Management-of-Surface-Water-for-New-Development.pdf

There is also a draft SPG that is specific to SuDS – 'No. 19 Water Conservation and Sustainable Drainage Systems' –

http://www.flintshire.gov.uk/en/PDFFiles/Planning/Revised-LPGNs/LPGN-19.pdf

Paragraph 8.5 of TAN 15 states:

"Planning authorities may consider imposing a condition requiring developers to examine the SuDS option and provide the planning authority with details and options. If it is demonstrated that SuDS could work on a site, and subject to the appropriate agreements being in place with regard to adoption, then the planning authority would require SuDS to be implemented. Developers will need to give good reason why SuDS could not be implemented. If a conventional drainage system does not improve the status quo or has a negative impact then this can be a valid reason for refusal."

FCC believes that, in practice, there are likely to be very few sites in Flintshire where SuDS would not be technically possible. **FCC will require details of SuDS schemes to be part of all planning applications and for solutions to be identified at an early stage.** This will ensure that conditions are not attached to a planning permission requiring a SuDS scheme which is later proven to be impossible to implement for technical reasons. Removing such conditions can require a new application and delay the start of the development. FCC expect that **where a SuDs scheme is possible, the guidance in TAN15 as set out above would apply.**

Section 3.3.6 provides more detail on the Council's SPG notes. Section 4.5 of this report discusses surface water flood risk, in the context of this SFCA, in more detail. Section 7.6.5 provides more detail on SuDS.

Implementing SuDS within Wales

On 19 May 2017, the Welsh Government published a Consultation on the Implementation of Sustainable Drainage Systems on New Developments.

This consultation sought views on the Welsh Government's proposed approach for delivering effective sustainable drainage systems (SuDS) on new developments. Specifically, this was an opportunity to discuss the content of Schedule 3 to the Flood and Water Management Act 2010 (the Act) which has not been enacted. It was also an opportunity to discuss the Regulations and Orders, including the National Standards for the Implementation of Sustainable Drainage (the SuDS Standards), needed to implement Schedule 3 of the Act.

In order to implement the requirements of Schedule 3, further consultation on the draft statutory instruments and statutory SuDS standards which provide the framework for its introduction was open from 16 November 2017 until the 15 February 2018. Subject to the outcome of this further consultation, the legislation will be introduced into the Assembly in May 2018, with a view to it coming into force early 2019[12].

3.3.4 Applying TAN 15 for the SFCA

Application of TAN 15, as part of this SFCA, should, in the first instance, advocate moving development out of areas of high risk to areas of lower risk. Following this approach, any development within Zone C (the 0.1% AEP flood extent) should be avoided. To limit the occurrence of flooding issues in planning decisions, land within Zone C (in particular Zone C2) should not be allocated for development where possible. The SFCA Maps, in Appendix A, show both the 0.1% flood extent (Flood Zone 2) and Zone C of the Welsh Government Development Advice Map (DAM).

It is, however, accepted that there may be instances where development within Zone C (in particular Zone C1) may be required, justifying the conditions in Section 6 of TAN 15. The development must also pass the flooding frequency and tolerable condition criteria discussed in the previous sections. Consideration of detailed and specific mitigation measures are beyond the scope of the SFCA as these are site specific and can be complex. However, consideration of the unmitigated flooding criteria will give a good indication of whether mitigation is likely to be effective. For example, it is less likely that a site, which is at frequent risk from deep and fast flowing water can be successfully mitigated, can achieve the tolerable criteria and limiting wider impacts are likely to be difficult to achieve.

The SFCA does not remove the need for site specific FCAs for individual developments as more detailed assessments would be required to produce a greater understanding of flood risk at any particular site. This would include detailed proposals for mitigating flood risk and achieving the flood risk tolerable criteria.

The information provided in this SFCA allows the LPA to have a good understanding of flood risk across the key areas of the County. This information should inform spatial planning decisions, ideally to avoid Zone C areas or, where it is necessary, to look at development in Zone C with a better understanding of achievable mitigation.

3.3.5 Local Development Plan

LDPs provide guidelines as to what type of development can be built and where it can be located over a 15 year period. Each LPA in Wales is required to produce a LDP for its area. In determining where new development can take place, consideration must be given as to the need for employment land, housing, leisure facilities whilst also safeguarding the local environment.

Once prepared, the LDP is subject to examination by an independent Planning Inspector to consider the 'soundness' of the Plan, including public hearings. Once the LDP is adopted, the LPA must prepare an Annual Monitoring Report (AMR) demonstrating how the Plan is delivering against its objectives. A full review must be carried out every

12 http://gov.wales/about/cabinet/cabinetstatements/2017/sustainabledrainage/?lang=en

four years to ensure the Plan remains current. Community engagement is vital to the plan making process. LPAs publish a Delivery Agreement at the start of the LDP process setting out the key stages and when people can get involved.

As discussed in Section 3.3.1, the LDP preparation process is set out in the Local Development Plans Edition 2 (2015) document and PPW.

Flintshire Local Development Plan

Following the adoption of the Flintshire Unitary Development Plan (UDP), the Council is now embarking on the preparation of a Local Development Plan (LDP) for the County. Flintshire's LDP will contain policies and proposals which together will provide for the development needs of the County over the Plan period (2015-2030) as well as protecting the social and environmental assets of the County.

The Flintshire LDP will focus on delivering sustainable development in the County through:

- Policies which will help guide decisions on planning applications;
- Proposals for the development of housing, retail, employment and other land uses; and
- Policies which seek the protection and enhancement of the natural and built environment.

FCC is in the initial stages of preparation of its LDP, and the various stages are set out in the Council's Delivery Agreement. The Council consulted on the Strategic Options document at the end of 2016, which considers Growth Options for the Plan (the amount of growth to be provided) and Spatial Options (how growth is to be distributed across the County). The outcome of this consultation assisted the Council in drawing up the Preferred Strategy for the Plan i.e. the amount of growth to be provided by the Plan and how that growth is to be distributed spatially across the County, as well as key strategic policies and proposals. The Preferred Strategy document was subject to consultation in November 2017[13].

The latest news on the development of the LDP can be found online via:

http://www.flintshire.gov.uk/en/Resident/Planning/Flintshire-Local-Development-Plan.aspx

3.3.6 Supplementary Planning Guidance

SPG notes provide detailed guidance on a range of development issues and topics. FCC has a number of adopted SPG notes providing additional advice on particular topics or policy areas (such as those discussed in Section 3.3.3, and also by expanding upon statutory policies, for example, guidance on the design of roof extensions in a specific locality. The SPG notes have been used to support the Unitary Development Plan (UDP) and will also support the LDP, which will supersede the UDP, once adopted.

All development proposals should take account of the adopted SPG note where relevant, which includes detailed guidance concerning individual sites, development issues, and particular types of development and will be a material consideration in determining planning applications. In terms of material considerations, greater weight can be attached to a guidance note if it has been formally adopted as a SPG.

The currently adopted SPG notes, at the time of writing, are available online via:

http://www.flintshire.gov.uk/en/Resident/Planning/Supplementary-planning-guidance.aspx

13 http://www.flintshire.gov.uk/en/Resident/Planning/Preferred-Strategy-Pre-Deposit-Public-Consultation.aspx

3.4 Flood Risk Management Policy

3.4.1 National and Local Flood Risk Management Strategies

As presented in Figure 3-1, the FWMA establishes how flood risk will be managed within the framework of national strategies for Wales and local strategies for LLFAs.

The National Strategy for Flood and Coastal Erosion Risk Management in Wales[14] (2011) has been developed by the Welsh Government under the terms of the FWMA. It sets out principles for how flood risk should be managed and provides strategic information about different types of flood risk and which organisations are responsible for their effective management. The FWMA requires risk management authorities (RMAs), i.e. local authorities, NRW, wastewater and sewerage companies and highways authorities, to work together and act consistently with the National Strategy in Wales in carrying out their flood and coastal erosion risk management functions effectively, efficiently and in collaboration with communities, businesses and infrastructure operators to deliver more effective flood risk management.

LLFAs have responsibility for developing a LFRMS for their area covering local sources of flooding (see Table 3-1). The Local Strategy produced must be consistent with the National Strategy. The Local Strategy should set out the framework for local flood risk management functions and activities and should raise awareness of local organisations with responsibilities for flood risk management in the area. The strategy should also facilitate partnership arrangements to ensure co-ordination between local organisations and an assessment of flood risk and plans and actions for managing risk, as set out under Section 9 of the FWMA.

The following link provides links to guidance for RMAs, including local authorities, on various subjects of flood risk management, including tools to support LLFAs in developing their LFRMS:

http://gov.wales/topics/environmentcountryside/epq/flooding/nationalstrategy/guidance/localstrategy/?lang=en

Flintshire Local Flood Risk Management Strategy, 2013[15]

The Flintshire LFRMS was adopted in December 2013, following public consultation. The Local Strategy sets out how FCC will manage risk from all types of flooding such as surface water runoff, groundwater and ordinary watercourses for which the Council has a responsibility as LLFA, and other types of flooding where local agents can play a supporting role to lead agencies.

The LFRMS contains ten strategic objectives for managing flood and coastal risk in Flintshire, as shown in

14 http://gov.wales/docs/desh/publications/111114floodingstrategyen.pdf
15 http://www.flintshire.gov.uk/en/PDFFiles/Flooding-and-Drainage/Flintshire-Local-Flood-Risk-Management-Strategy.pdf

Figure 3-4.

Figure 3-4: FCC strategic objectives (extract from Flintshire LFRMS document)

Ten Objectives for Flintshire County Council

1. To improve the understanding of flooding (surface water, groundwater and ordinary watercourses) and coastal risks;
2. Increasing individual and community awareness and preparedness for flood and coastal erosion events and the impacts of climate change on flood risk;
3. To work together (RMA, stakeholders and public) to reduce flood and coastal risks, sharing data and resources to the greatest benefit;
4. To reduce the impact and consequences for individuals, communities, businesses and the environment from flooding and coastal erosion;
5. To ensure that Flood Risk Management issues are considered when planning decisions regarding development are made;
6. Improve and/or maintain the capacity of existing drainage systems by targeted maintenance;
7. Take a sustainable approach to flood risks management balancing economic, environmental and social benefits;
8. Increase the use of approaches that utilise the natural environment;
9. Ensure the development of skills required to implement effective and innovative flood risk management; and
10. Identify projects and programmes which are affordable, maximising capital funding from internal and external sources.

FCC is also required to report on progress as to how it is responding to the FWMA duties every quarter to the Regional Flood and Coastal Committee for Wales (RFCC). The whole LFRMS should be formally reviewed every six years, meaning that the next Local Strategy is due to be published in 2019.

3.4.2 Surface Water Management Plans

In June 2007, widespread extreme flooding was experienced in the UK. The UK Government review of the 2007 flooding, chaired by Sir Michael Pitt recommended that…

"…Local Surface Water Management Plans (SWMPs) … coordinated by local authorities, should provide the basis for managing all local flood risk."

The UK Government's SWMP Technical Guidance document[16], 2011, defines a SWMP as:

- *A framework through which key local partners with responsibility for surface water and drainage in their area, work together to understand the causes of*

16 Surface Water Management Plan Technical Guidance - https://www.gov.uk/government/publications/surface-water-management-plan-technical-guidance

surface water flooding and agree the most cost-effective way of managing surface water flood risk.

- *A tool to facilitate sustainable surface water management decisions that are evidence based, risk based, future proofed and inclusive of stakeholder views and preferences.*
- *A plan for the management of urban water quality through the removal of surface water from combined systems and the promotion of SuDS.*

As a demonstration of its commitment to SWMPs as a structured way forward in managing local flood risk, Defra announced an initiative to provide funding for the highest flood risk authorities to produce SWMPs.

FCC has not developed a SWMP for Flintshire, nor for any areas or communities within Flintshire. It is recommended that the LLFA uses information from this SFCA to ascertain whether certain locations at high surface water flood risk may benefit from a SWMP.

3.4.3 Flood risk partnerships and partnership plans

FCC has been involved in the development of a number of partnerships designed to provide collaboration between public agencies, businesses and the community. Partnerships and plans that affect the County (see Section 0 on Emergency Planning for more information) include:

- Regional Flood and Coastal Committee RFCC – only one in Wales; namely the Flood Risk Management Wales Group (FRMW), established by NRW under the FWMA to bring together members appointed by the LLFAs and independent members. Responsible for reviewing flood defence across Wales and determining how defence infrastructure will be managed in the future.
- North Wales Local Resilience Forum (LRF) - see Section 0.

3.5 Roles and responsibilities

The responsibilities for the RMAs under the FWMA and FRR are summarised below.

3.5.1 NRW as a RMA

- Has a strategic overview role for all forms of flooding;
- Has the power to request information from any partner in connection with its risk management functions;
- Must exercise its flood or coastal erosion risk management functions in a manner consistent with the National Strategy and local strategies;
- Must be consulted on Local Strategies, if affected by the strategy, by the LLFA;
- Must help advise on sustainable development.

3.5.2 LPA as a RMA

- Has a duty to act in a manner that is consistent with the National Strategy and have regard to local strategies;
- Must be consulted on local strategies, if affected by the strategy, by the LLFA;
- Has a duty to be subject to scrutiny from the LLFA;
- Has a duty to cooperate and share information with other RMAs.

3.5.3 LLFA as a RMA

- Must develop, maintain, apply and monitor a strategy for local flood risk management. This must be consulted on with all RMAs, the public and all other partners with an interest in local flood risk, and must comply with the National Strategy;
- Is required to coordinate and share information on local flood risk management between relevant authorities and partners;
- Is empowered to request information from others when it is needed in relation to its flood risk management functions;
- Must investigate significant flooding incidents in its area where it considers it necessary or appropriate;
- Has a duty to establish and maintain a record of structures within its area that it considers to have a significant impact on local flood risk;
- Is empowered to designate structures and features that affect flooding;
- Has powers to undertake works to manage flood risk from surface runoff, groundwater and ordinary watercourses;
- Must exercise its flood and coastal erosion risk management functions in a manner consistent with the National Strategy and its own Local Strategy;
- Is permitted to agree the transfer of responsibilities for risk management functions (except the production of a Local Strategy) to other RMAs;
- Must aim to contribute to sustainable development;
- Should consider flooding issues that require collaboration with neighbouring LLFAs and other RMAs.

3.5.4 Water companies as a RMA

- Has a duty to act in a manner that is consistent with the National Strategy and have regard to local strategies;
- Must be consulted on local strategies, if affected by the strategy, by the LLFA;
- Has a duty to be subject to scrutiny from LLFA;
- Has a duty to cooperate and share information with other RMAs;
- Is responsible for managing the risks of flooding from water and foul or combined sewer systems providing drainage from buildings and yards.

3.5.5 Highways Authority (FCC) as RMA

- Has a duty to act consistently with the National Strategy and Local Strategy;
- Has responsibility for ensuring effective drainage of local roads in so far as ensuring drains and gullies are maintained;
- Must be consulted on the Local Strategy, if affected by the Strategy, by the LLFA;
- Has a duty to be subject to scrutiny from LLFA.

3.5.6 The local community

- Must be consulted on the Local Strategy by the LLFA;
- Has a key role in ensuring the Local Strategy is capable of being successfully delivered within the community. They should actively participate in this process and be engaged by the LLFA.

3.5.7 Riparian owners

A riparian owner is someone who owns land or property alongside a river or other watercourses. A watercourse is any natural or artificial channel through which water flows including flow through a culvert, ditch, drain, cut, dyke, sluice or private sewer.

Riparian owners have statutory responsibilities, including:

- Maintaining watercourses;
- Allowing the flow of water to pass without obstruction;
- Controlling invasive alien species.

Further guidance for riverside property owners in Wales can be found via:

https://naturalresources.wales/media/680422/living-on-the-edge-final-jan-2017.pdf

3.5.8 Developers

Have a vital role in ensuring effective local flood risk management by avoiding development in areas at risk of flooding. The Local Strategy and this SFCA should form a key element of local planning guidance for developers.

4 Understanding Flood Risk

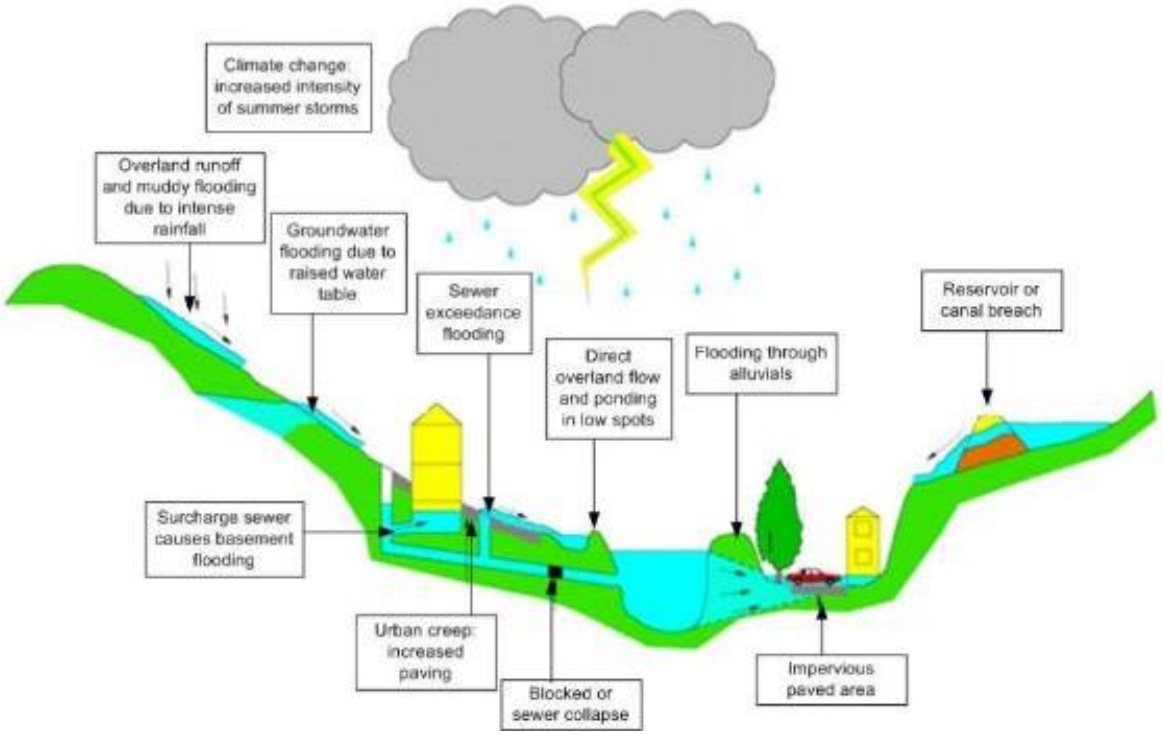
4.1 Sources of flooding

Flooding is a natural process and can happen at any time in a wide variety of locations. It constitutes a temporary covering of land not normally covered by water and presents a risk when people and human or environmental assets are present in the area that floods. Assets at risk from flooding can include housing, transport and public service infrastructure, commercial and industrial enterprises, agricultural land and environmental and cultural heritage. Flooding can occur from many different and combined sources and in many different ways. Major sources of flooding (also see Figure 4-1) include:

- **Fluvial (main rivers and ordinary watercourses)** - inundation of floodplains from rivers and watercourses; inundation of areas outside the floodplain due to influence of bridges, embankments and other features that artificially raise water levels; overtopping or breaching of defences; blockages of culverts; blockages of flood channels/corridors.
- **Tidal** - sea; estuary; overtopping of defences; breaching of defences; other flows (e.g. fluvial surface water) that could pond due to tide locking; wave action.
- **Surface water** - surface water flooding covers two main sources including direct run-off from adjacent land (pluvial) and surcharging of piped drainage systems (public sewers, highway drains, etc.)
- **Groundwater** - water table rising after prolonged rainfall to emerge above ground level remote from a watercourse; most likely to occur in low-lying areas underlain by permeable rock (aquifers); groundwater recovery after pumping for mining or industry has ceased.
- **Infrastructure failure** - reservoirs; canals; industrial processes; burst water mains; blocked sewers or failed pumping stations.

Different types and forms of flooding present a range of different risks and the flood hazards of speed of inundation, depth and duration of flooding can vary greatly. With climate change, the frequency, pattern and severity of flooding are expected to change and become more damaging.

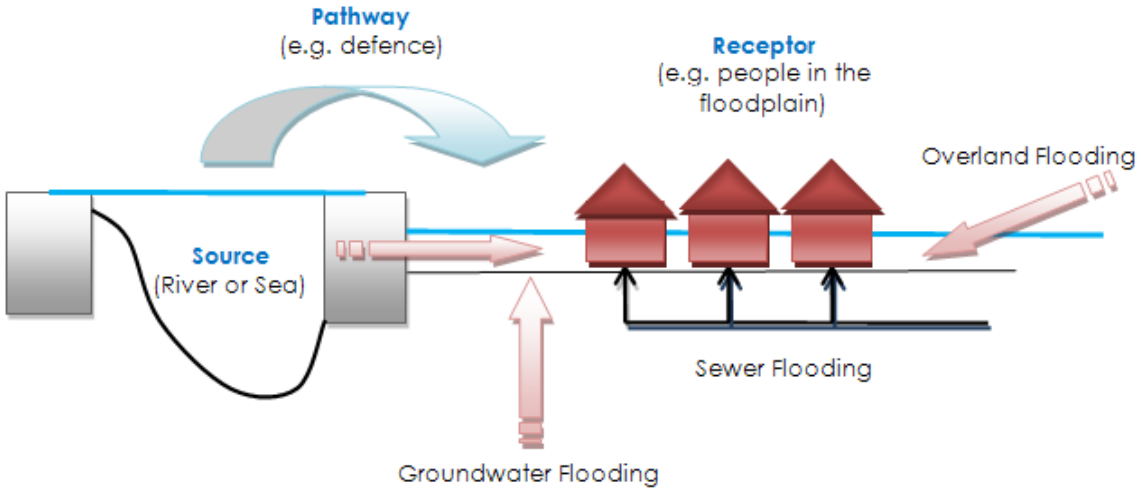
Figure 4-1: Flooding from all sources



4.2 Likelihood and consequence

Flood risk is a combination of the likelihood of flooding and the potential consequences arising. It is assessed using the source – pathway – receptor model as shown in Figure 4-2 below. This is a standard environmental risk model common to many hazards and should be the starting point of any assessment of flood risk. However, it should be remembered that flooding could occur from many different sources and pathways, and not simply those shown in the illustration below.

Figure 4-2: Source-Pathway-Receptor Model



The principal sources are rainfall or higher than normal sea levels, the most common pathways are rivers, drains, sewers, overland flow and river and coastal floodplains

and their defence assets and the receptors can include people, their property and the environment. All three elements must be present for flood risk to arise. Mitigation measures have little or no effect on sources of flooding but they can block or impede pathways or remove receptors.

The planning process is primarily concerned with the location of receptors, taking appropriate account of potential sources and pathways that might put those receptors at risk. It is therefore important to define the components of flood risk in order to apply this guidance in a consistent manner.

4.2.1 Likelihood

Likelihood of flooding is expressed as the percentage probability based on the average frequency measured or extrapolated from records over a large number of years. A 1% probability indicates the flood level that is expected to be reached on average once in a hundred years, i.e. it has a 1% chance of occurring in any one year, not that it will occur once every hundred years.

Considered over the lifetime of development, such an apparently low frequency or rare flood has a significant probability of occurring. For example:

- A 1% flood has a 26% (1 in 4) chance of occurring at least once in a 30-year period - the period of a typical residential mortgage,
- And a 49% (1 in 2) chance of occurring in a 70-year period - a typical human lifetime.

4.2.2 Consequence

The consequences of flooding include fatalities, property damage, disruption to lives and businesses, with severe implications for people (e.g. financial loss, emotional distress, health problems). Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure, of the population, presence and reliability of mitigation measures etc.). Flood risk is then expressed in terms of the following relationship:

Flood risk = Probability of flooding x Consequences of flooding

4.3 Risk

Flood risk is not static; it cannot be described simply as a fixed water level that will occur if a river overtops its banks or from a high spring tide that coincides with a storm surge. It is therefore important to consider the continuum of risk carefully. Risk varies depending on the severity of the event, the source of the water, the pathways of flooding (such as the condition of flood defences) and the vulnerability of receptors as mentioned above.

4.3.1 Actual risk

This is the risk 'as is' taking into account any flood defences that are in place for extreme flood events (typically these provide a minimum Standard of Protection (SoP)). Hence, if a settlement lies behind a fluvial flood defence that provides a 1 in 100-year SoP then the actual risk of flooding from the river in a 1 in 100-year event is generally low. However, the residual risk may be high in that the impact of flood defence failure would likely have a major impact.

Actual risk describes the primary, or prime, risk from a known and understood source managed to a known SoP. However, it is important to recognise that risk comes from many different sources and that the SoP provided will vary within a river catchment. Hence, the actual risk of flooding from the river may be low to a settlement behind the

defence but moderate from surface water, which may pond behind the defence in low spots and is unable to discharge into the river during high water levels.

4.3.2 Residual risk

Defended areas, protected by flood defence infrastructure, remain at residual risk as there is a risk of overtopping or defence breach during significant flood events. Whilst the potential risk of failure may be reduced, consideration of inundation and the impact on development needs to be considered.

Examples of residual flood risk include:

- The failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system, overtopping of an upstream storage area, or failure of a pumped drainage system;
- failure of a reservoir; or
- a severe flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defence, or an intense rainfall event which the drainage system cannot cope with.

Even when flood defences are in place, there is always a likelihood that these could be overtopped in an extreme event or that they could fail or breach. Where there is a consequence to that occurrence, this risk is known as residual risk. Defence failure can lead to rapid inundation of fast flowing and deep floodwaters, with significant consequences to people, property and the local environment behind the defence. Whilst the actual risk of flooding to a settlement that lies behind a fluvial flood defence that provides a 1 in 100-year SoP may be low, there will always be a residual risk from flooding if these defences overtopped or failed that must be taken into account. Because of this, it is never appropriate to use the term "flood free".

TAN 15 (Appendix A1.17) states that, when assessing flood consequences, an assessment of the residual risks after the construction of any necessary defences should be carried out. Consideration should always be given to the behaviour of any new or modified defences in extreme events greater than those for which they are designed and information should be provided on the consideration given to minimising risks to life in such circumstances.

4.4 Fluvial and tidal flooding

Fluvial flooding is associated with the exceedance of channel capacity during higher flows. The process of flooding from watercourses depends on a number of characteristics associated with the catchment including geographical location and variation in rainfall; steepness of the channel and surrounding floodplain; and infiltration and rate of runoff associated with urban and rural catchments.

Tidal flooding is caused by storm surge and wave action in times of high astronomical tides. Such conditions can lead to the overtopping or breaching of coastal flood defences. The probability of a breach is dependent on four main factors: weather conditions (generating large waves); wind direction (on-shore); high tides (particularly during spring tides) and the condition of the coastal defences. When these conditions combine the risk of flooding can be greatly enhanced as the predicted tide level can be raised by several metres.

This SFCA includes the modelling of coastal defence breach scenarios in six targeted locations, namely; Pentre, Saltney (Mold Junction Drain), Bumper Lane (Waters Mett), Hawarden Business Park, Queensferry and Broken Bank. The outputs of the breach modelling are shown on the SFCA Maps in Appendix A.

4.4.1 Main River

NRW decides which watercourses are Main Rivers. It consults with other risk management authorities and the public before making these decisions.

NRW describes Main Rivers as usually being larger rivers and streams with other rivers known as ordinary watercourses. NRW carries out maintenance, improvement or construction work on Main Rivers to manage flood risk and will carry out flood defence work to Main Rivers only.

4.4.2 Ordinary watercourses

Ordinary watercourses are any watercourse not designated as Main River. These watercourses can vary in size considerably and can include rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows.

LLFAs, district councils and internal drainage boards carry out flood risk management work on ordinary watercourses.

4.4.3 Flood Zone 3 and Flood Zone 2

The flood zones are used by NRW to raise awareness of flood risk with the public, flood risk management partners and for strategic planning purposes for predicting the location and extent of fluvial (from Main River) and tidal flooding. The flood zones are available nationally and represent a precautionary, worst-case scenario of flooding in that they do not take account of flood defence infrastructure (which can be breached, overtopped or may not be in existence for the lifetime of development).

Flood Zone 3:

- The extent of a flood from rivers with a 1% (1 in 100) chance or greater of happening in any given year,
- The extent of a flood from the sea with a 0.5% (1 in 200) chance or greater of happening in any given year.

Flood Zone 2:

- The extent of a flood from rivers or from the sea with up to a 0.1% (1 in 1000) chance of happening in any given year,
- Contains areas recorded to have flooded in the past,
- Forms the basis of Zone C in the Welsh Government DAM and is therefore important in a planning context.

The flood zones are shown on the SFCA Maps in Appendix A.

4.5 Surface water flooding

Surface water flooding, in the context of this SFCA, includes:

- Surface water runoff (also known as pluvial flooding); and
- Sewer flooding

There are certain locations, generally within urban areas, where the probability and consequence of pluvial and sewer flooding are more prominent due to the complex hydraulic interactions that exist in the urban environment. Urban watercourse connectivity, sewer capacity, and the location and condition of highway gullies all have a major role to play in surface water flood risk.

It should be acknowledged that once an area is flooded during a large rainfall event, it is often difficult to identify the route, cause and ultimately the source of flooding without undertaking further site-specific and detailed investigations.

4.5.1 Pluvial flooding

Pluvial flooding of land from surface water runoff is usually caused by intense rainfall that may only last a few hours. In these instances, the volume of water from rural land can exceed infiltration rates in a short amount of time, resulting in the flow of water over land. Within urban areas, this intensity can be too great for the urban drainage network resulting in excess water flowing along roads, through properties and ponding in natural depressions. Areas at risk of pluvial flooding can, therefore, lie outside of the fluvial or tidal flood zones.

Pluvial flooding within urban areas across the country will typically be associated with events greater than the 1 in 30 AEP design standard of new sewer systems. Some older sewer and highway drainage networks will have a lower capacity than what is required to mitigate for the 1 in 30 AEP event. There is also a residual risk associated with these networks due to possible network failures, blockages or collapses.

Risk of Flooding from Surface Water

The Risk of Flooding from Surface Water (RoFSW) dataset, formally referred to as the updated Flood Map for Surface Water (uFMfSW), is the third generation national surface water flood map, produced by NRW, aimed at helping to identify areas where localised, flash flooding can cause problems even if the Main Rivers are not overflowing. The RoFSW, used in this SFCA to assess risk from surface water, has proved extremely useful in supplementing the DAM by identifying areas in Zone A, which may have critical drainage problems.

The RoFSW includes surface water flood outlines, depths, velocities and hazards for the following events:

- 1 in 30 AEP event (high risk)
- 1 in 100 AEP event (medium risk)
- 1 in 1000 AEP event (low risk)

The RoFSW is much more refined than the second generation map in that:

- More detailed hydrological modelling has been carried out using several design rainfall events rather than one for the second generation,
- A higher resolution Digital Terrain Model (DTM) has been used – 2 m, compared to 5 m for the second generation,
- Manual edits of DTM to improve flow routes at over 91,000 locations compared to 40,000 for the second generation,
- DTM edited to better represent road network as a possible flow pathway, this was not done for the second generation,
- Manning's n roughness (used to represent the resistance of a surface to flood flows in channels and floodplains) values varied using MasterMap Topography layer compared to blanket values for urban and rural land use applied in the second generation surface water flood map.

The National Modelling and Mapping Method Statement, May 2013 details the methodology applied in producing the map. The RoFSW map is displayed on the SFCA Maps.

4.5.2 Sewer flooding

Combined sewers spread extensively across urban areas serving residential homes, business and highways, conveying waste and surface water to treatment works. Combined Sewer Overflows (CSOs), provide an NRW consented overflow release from the drainage system into local watercourses or large surface water systems during times of high flows. Some areas may also be served by separate waste and surface

water sewers which convey waste water to treatment works and surface water into local watercourses.

Flooding from the sewer network mainly occurs when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes blocked or it cannot discharge due to a high water level in the receiving watercourse. Pinch points and failures within the drainage network may also restrict flows. Water then begins to back up through the sewers and surcharge through manholes, potentially flooding highways and properties. It must be noted that sewer flooding in 'dry weather' resulting from blockage, collapse or pumping station mechanical failure (for example), is the sole concern of the drainage undertaker.

Welsh Water (DCWW) is the wastewater and sewerage company responsible for the management of the majority of the drainage network across Flintshire. Dee Valley Water supplies water to some eastern parts of Flintshire. Water companies have a duty to prevent flooding occurring from their systems, including burst pipes, burst water mains or system failure.

4.5.3 Groundwater flooding

Groundwater flooding is caused by the emergence of water from beneath the ground, either at point or diffuse locations. The occurrence of groundwater flooding is usually local and unlike flooding from rivers and the sea, does not generally pose a significant risk to life due to the slow rate at which the water level rises. However, groundwater flooding can cause significant damage to property, especially in urban areas, and can pose further risks to the environment and ground stability.

There are several mechanisms that increase the risk of groundwater flooding including prolonged rainfall, high in-bank river levels, artificial structures, groundwater rebound and mine water rebound. Properties with basements or cellars or properties that are located within areas deemed to be susceptible to groundwater flooding are at particular risk. Development within areas that are susceptible to groundwater flooding will generally not be suited to SuDS; however, this is dependent on detailed site investigation and risk assessment at the FCA stage.

Groundwater Flood Map 5m Resolution v2.3

JBA Consulting has developed a high resolution groundwater flood map which accounts for groundwater flood hazard. Groundwater levels were modelled for a range of return periods and were then compared to ground surface levels to determine the head difference in metres. Zero difference would suggest artesian discharge of groundwater at the ground surface.

The map is split into five different classes based on the difference head, as shown in Table 4-1. The Groundwater Flood Map is also showed on the SFCA Maps.

Table 4-1: Groundwater Flood Map Hazard Classifications

Groundwater head difference (m)	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood

Groundwater head difference (m)	Class label
	event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event. There is a risk of flooding to subsurface assets but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.

4.6 Canal and reservoir flood risk

4.6.1 Canals

The risk of flooding along a canal is considered residual and is dependent on a number of factors. As canals are manmade systems that are heavily controlled, it is unlikely they will respond in the same way as a natural watercourse during a storm event. Flooding is more likely to be associated with residual risks, similar to those associated with river defences, such as overtopping of canal banks, breaching of embanked reaches or asset (gate) failure as highlighted in Table 4-2. Canals can also have a significant interaction with other sources, such as watercourses that feed them and minor watercourses or drains that cross underneath.

Table 4-2: Canal flooding mechanisms

Potential Mechanism	Significant Factors
Leakage causing erosion and rupture of canal lining leading to breach	Embankments Sidelong ground Culverts Aqueduct approaches
Collapse of structures carrying the canal above natural ground level	Aqueducts Large diameter culverts Structural deterioration or accidental damage
Overtopping of canal banks	Low freeboard Waste weirs
Blockage or collapse of conduits	Culverts

The risks associated with these events are also dependent on their potential failure location with the consequence of flooding higher where floodwater could cause the greatest harm due to the presence of local highways and adjacent property. The focus should be on areas adjacent to raised embankments. The pound length of the canal also increases the consequence of failure, as flows will only cease due to the natural

exhaustion of supply. Stop plank[17] (log) arrangements, stop gates and the continued inspection and maintenance of such assets by the Canal & River Trust help to manage the overall risk of a flood event.

There are no major canalised watercourses in Flintshire.

4.6.2 Reservoirs

A reservoir can usually be described as an artificial lake where water is stored for use. Some reservoirs supply water for household and industrial use, others serve other purposes, for example, as fishing lakes or leisure facilities. Like canals, the risk of flooding associated with reservoirs is residual and is associated with failure of reservoir outfalls or breaching. This risk is reduced through regular maintenance by the operating authority. Reservoirs in the UK have an extremely good safety record with no incidents resulting in the loss of life since 1925.

NRW is the enforcement authority for the Reservoirs Act 1975 in Wales. All large reservoirs must be regularly inspected and supervised by reservoir panel engineers. Reservoir undertakers in Flintshire include NRW, DCWW and private undertakers. FCC is the undertaker for one reservoir; namely Flour Mill near Holywell.

The reservoir undertaker manages and controls the use of the reservoir, and is responsible for maintaining compliance with the law. The undertaker is the person, people or company that uses a reservoir for a particular purpose. If there is no use, the owners or lessees are the undertakers. The operator may be different from the owner.

Reservoir Flood Maps

NRW has produced reservoir flood maps (RFM) for all large reservoirs that they regulated under the Reservoirs Act 1975 (reservoirs that hold over 10,000 cubic meters of water). The FWMA updated the Reservoirs Act and targeted a reduction in the capacity at which reservoirs should be regulated from 25,000m³ to 10,000m³. This reduction is, at the time of writing, yet to be confirmed meaning the requirements of the Reservoirs Act 1975 should still be adhered to. The maps were originally produced for Local Resilience Forums to use for emergency planning, however, The Pitt Review, 2007, recommended that the maps be made available to the public online as part of wider flood risk information.

The maps show the largest area that might be flooded if a reservoir were to fail and release the water it holds, including information about the depth and speed of the flood waters. In September 2016, the EA produced a RFM guide ' Explanatory Note on Reservoir Flood Maps for Local Resilience Forums – Version 5[18]' which provides information on how the maps were produced and what they contain.

The RFM outlines are not included on the SFCA Maps due to issues with data sensitivity, however they can be viewed online at:

https://maps.cyfoethnaturiolcymru.gov.uk/Html5Viewer/Index.html?configBase=https://maps.cyfoethnaturiolcymru.gov.uk/Geocortex/Essentials/REST/sites/Flood_Risk/viewers/Flood_Risk/virtualdirectory/Resources/Config/Default

There are five large reservoirs in Flintshire. The RFM shows the areas that would be affected in the unlikely event of a breach.

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17 Wooden boards for dropping into grooves at a narrows; to permit drainage for maintenance work on a canal section or to isolate a leaking section

18 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/558441/LIT_6882.pdf

4.7 Flood risk data sources in Flintshire

Table 4-3 provides a strategic overview of the key flood risk datasets used in this SFCA according to the source of flooding within Flintshire. The information contained is the best available at the time of publication and is intended to provide the Council with a strategic overview of risk. **Error! Reference source not found.**

Table 4-3: Flood risk data

Flood Source	Datasets
Fluvial / tidal	WG Development Advice Maps (DAM)
	Flood Zones 2 and 3
	Flintshire LFRMS
	Dee FRMP
	Tidal Dee flood defence breach modelling in six locations Saltney (Mold Junction Drain), Bumper's Lane (Waters Meet), Hawarden Business Park, Pentre, Queensferry and Broken Bank.
	North West England and North Wales Shoreline Management Plan SMP2 (refer to section 4.7.1 for further information)
Pluvial (surface water runoff)	NRW Surface Water Flood Risk Maps
	Flintshire PFRA
Sewer	Welsh Water Historical Flood Records (DG5 Register) and Infrastructure Capacity Data
	FCC LLFA historic sewer flooding database
Groundwater	5 metre Groundwater Flood Map (JBA)
Reservoir	NRW Reservoir Flood Maps (available online only)
All sources	Conwy and Clwyd, River Dee CFMPs
	Dee FRMP
	NRW Historic Flood Map and Recorded Flood Outlines
Flood risk management infrastructure	NRW flood defence dataset and Areas Benefitting from Defences
	NRW Flood Storage Areas
	NRW detailed coastal defence data

4.7.1 Shoreline Management Plan: Managed retreat and managed re-alignment in Flintshire[19]

The Shoreline Management Plan (SMP2) is a non-statutory, high level, policy document for coastal flood and erosion risk management planning. It takes account of other existing planning initiatives and legislative requirements, and is intended to inform wider strategic planning. Local planning authorities should consider SMP2 policies when formulating their statutory land use development plans. There are three shoreline management policies in place along Copeland's coastline, namely 'hold the line',

19 https://onedrive.live.com/?cid=E5153484C5971E2D&id=E5153484C5971E2D%21111&parId=E5153484C5971E2D%21108&o=OneUp

'managed realignment' and 'no active intervention'. **Error! Reference source not found.** is an extract from the North West England and North Wales SMP2 report showing the policy options for managing flood risk along the coast.

Table 4-4: SMP2 policies for managing the shoreline

Policy Option	Description
Hold the line	By maintaining or changing the current standard of protection. This policy includes those situations where work is carried out in front of the existing defences (such as beach recharge, rebuilding the toe of a structure, building offshore breakwaters and so on) to improve or maintain the standard of protection provided by the existing defence line. It also includes work behind existing defences (such as building secondary flood defences) where this work would form an essential part of maintaining the current coastal defence system.
Advance the line	By building new defences on the seaward side of the original defences. Use of this policy is limited to those policy units where significant land reclamation is considered.
Managed realignment	By allowing the shoreline to move backwards or forwards, with management to control or limit movement (such as reducing erosion or building new defences on the landward side of the original defences).
No active intervention	Where there is no investment in coastal defences or operations.

Table 2: Descriptions of the four shoreline management policies used in SMP2

The North West England and North Wales Shoreline Management Plan SMP2 covers the coastline from the Great Orme in Llandudno, Conwy to the Scottish Border on the Solway Firth. It also covers the major estuaries within this area including the River Dee. Sub-Cell 11a – Great Orme's Head to Southport contains all of the Flintshire Shoreline that is covered within this SMP.

The dune frontages west of the Point of Ayr are to be maintained through a Managed Realignment policy, this allows natural processes to continue while monitoring whether beach recharge or secondary defences are required in the future. Along the Dee frontages a Hold the Line policy is adopted where there is significant development, infrastructure or other assets. Managed Realignment will be explored in the medium to long term where there may be opportunities for habitat creation elsewhere.

Hold the line

Where hold the line has been proposed, the intent is to manage the risk from coastal flooding or erosion to important assets and interests in an appropriate way. This could be achieved by maintaining current defences or by constructing new defences in the future. When upgrading defences or significant changes in management practice is required, this is progressed through a Strategy or Scheme and will be subject to more detailed appraisal, consultation and consenting.

Managed realignment

Managed realignment provides the opportunity to create a more natural coastline by allowing sediment movement which helps maintain beaches or provides space for natural landward roll-back of saltmarsh, beaches or dunes in response to ongoing coastal change and sea level rise.

The SMP2 recognises that there are a number of opportunities to move defences landward, or to remove defences so the shoreline realigns back to higher ground, in order to create more space for salt marshes and hence improve the natural defence

and provide environmental benefits. However, in locations where managed realignment is proposed, the SMP2 does not generally define or predict the new shoreline or defence position. In theory, the shoreline could be moved inland up to where the area at risk of coastal flooding ends, however in reality defences are often not moved back that far, due to the presence of built or natural assets or infrastructure, where for example, Network Rail are able to intervene to protect the railway.

No active intervention

This policy option lets nature take its course on the shoreline without any management and is usually in place where risk management is not required, or where sediment erosion from cliffs is required to feed beaches or to allow beaches, dunes or saltmarsh to adjust or rollback naturally as sea levels rise. This policy can also apply where there is insufficient national economic justification to maintain defences in the long term and therefore no funding available from public sources.

5 Historic flooding in Flintshire

There are a number of datasets and sources of information that record incidents of historic flooding across Flintshire. Records of historic flood events help to build a picture of where flooding occurs most frequently. This can then help to direct flood risk management actions to those places that need them the most. A record of the flood source is also crucial to determining the kind of flood risk management actions that are appropriate.

As stated in Table 3-1, under the FWMA, the LLFA is required to investigate and record details of "locally significant" flood events within its area. This duty includes owning and maintaining a flood incident register which records such information as flood location, receptors, date and time, flood duration and flood source. FCC has not, at the time of producing this SFCA, developed such a register. The LLFA has many paper records which are to be digitised into a GIS file in the future.

DCWW, as a UK Water and Sewerage Company, are obliged to record and report incidents of sewer flooding by the industry regulator, OFWAT. DCWW has provided its flooding register for both internal (property) and external flooding incidents.

5.1 NRW Historic Flood Map

The Historic Flood Map (HFM) is a spatial dataset showing the maximum extent of all recorded historic flood outlines from river, sea and groundwater, and shows areas of land that have previously been flooded across Wales. Records began in 1946 when predecessor bodies to NRW started collecting information about flooding incidents.

The HFM accounts for the presence of defences, structures, and other infrastructure where such things existed at the time of flooding. It includes flood extents that may have been affected by overtopping, breaches or blockages. It is also possible that historic flood extents may have changed and that some areas would not flood at present i.e. if a flood defence has since been built.

The absence of the HFM in an area does not mean that the area has never flooded, only that records of historic flooding do not exist. The HFM is shown on the SFCA maps in Appendix A.

5.2 Historic tidal and fluvial flooding

There isn't much information available on previous tidal and fluvial flood events in Flintshire. As discussed, the LLFA is yet to fully establish its historic flood incident database. The PFRA and the Dee FRMP don't include specific references though the LFRMS discusses widespread flooding that occurred in 2000 to the communities of Mold, Flint, Rhydymwyn, Hendre, Pontblyddyn, and Bagillt.

The Dee FRMP does mention a tidal surge (a very high tide combined with stormy weather) that combined with a spring tide caused some localised flooding along the Dee estuary in December 2013.

The HFM shows there are 61 areas of historic flooding in Flintshire. The most significant areas are in the east of the County around Hawarden Airport, Sandycroft and Queensferry with the source coming from Main River. There is also a large swathe running through Mold due to flooding from the River Alyn and several ordinary watercourses. The River Alyn also caused widespread flooding to the village of Rhydymwyn in 2000. Only two of the 61 HFM incidents are attributable to flooding from the sea; these are of the railway line at Ffynnongroyw, due to operational failure and / or breach of the sea defence; and at Walwen where the sea defence was overtopped.

5.3 Historic surface water flooding

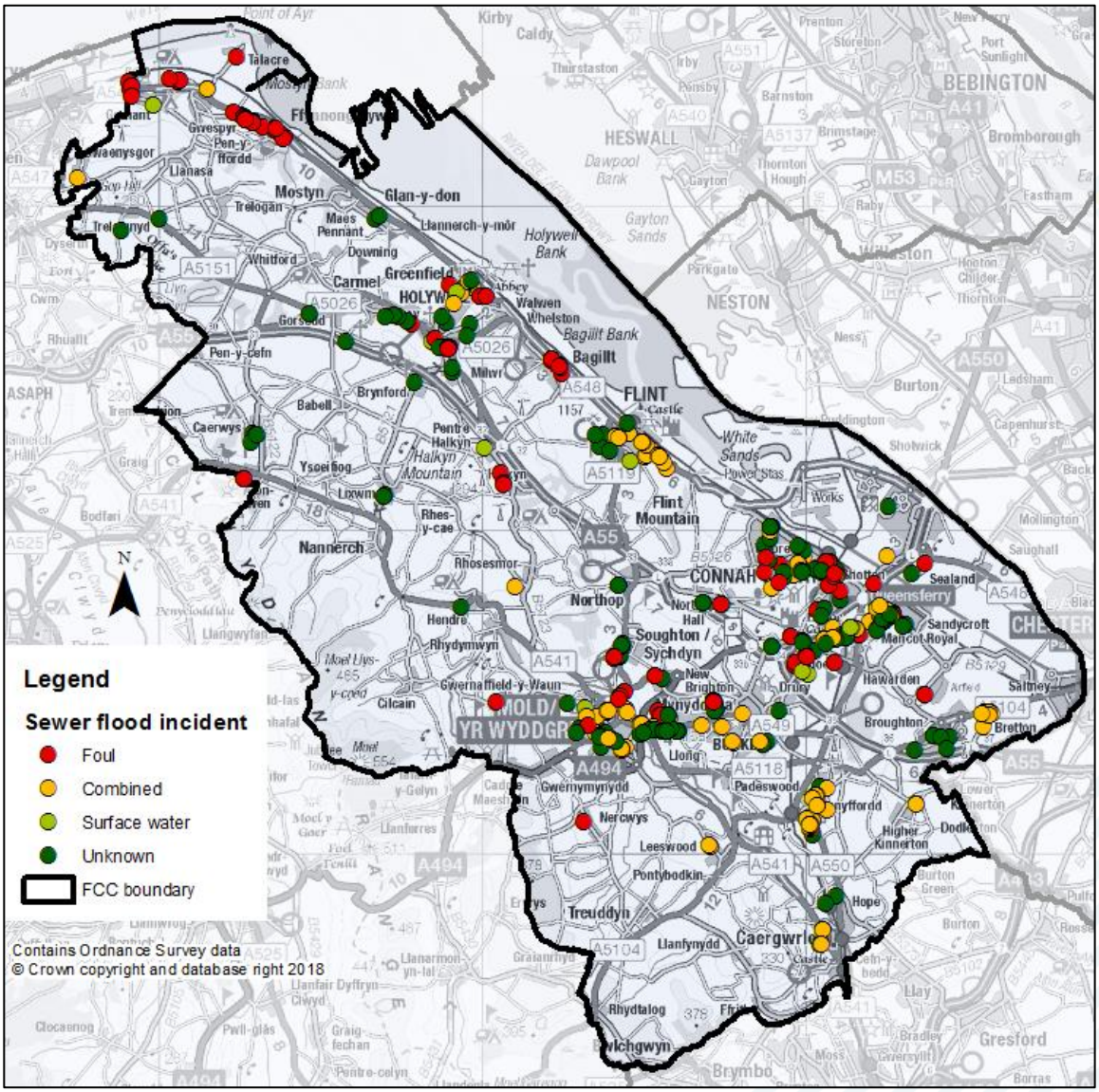
As discussed, DCWW provided a copy of its flood incident register. The majority of locations on the register relate to properties, although some external locations may include large areas such as sections of highway, fields, car parks, etc. Given the property level detail in this dataset, it is not appropriate to show this data on the large scale SFCA Maps in Appendix A, rather it is shown in this report in

Figure 5-1 on a smaller scale.

Figure 5-1 shows all recorded incidents of sewer flooding from DCWW's wastewater and sewerage network from 1990 to November 2016, accounting for 891 incidents. Of these incidents; 345 could be attributed to hydraulic overload of foul sewers; 256 to combined foul and surface water; 62 to surface water only; and 228 are from an unknown or unrecorded source.

It is noticeable that most incidents occur in the more built up areas around Queensferry and Connah's Quay (approximately 236 incidents); Mold (185); Holywell (120); Penyffordd (58); Flint (48); and 61 all foul incidents along the A548 road around the less populated area of Ffynnongroyw in the north of the County.

Figure 5-1: DCWW flood incident register



6 Flood Risk Management and Alleviation

6.1 Catchment Based Approach (CaBA)

The Catchment Based Approach embeds collaborative working at a river catchment scale to deliver cross cutting improvements to our water environments. The CaBA partnerships drive cost-effective practical delivery on the ground, resulting in multiple benefits including reduced flood risk and resilience to climate change.

Catchment partnerships are groups of organisations with an interest in improving the environment in the local area and are led by a catchment host organisation. The partnerships work on a wide range of issues, including the water environment but also address other concerns that are not directly related to river basin management planning. UK Government is also working to strengthen or establish partnerships in the areas most affected by the December 2015 floods to encourage a more integrated approach to managing risk across all catchments.

The National Resilience Review will align closely with Defra's work on integrated catchment-level management of the water cycle in the UK Government's 25 year Environment Plan (see Section 0). UK Government's aspirations for the next cycle of

planning (now to 2021) is for more integrated catchment planning for water, where Flood and Coastal Risk Management, River Basin Management, nature conservation and land management are considered together.

Catchment partnerships relevant to Flintshire include:

- Tidal Dee Catchment Partnership, hosted by the Welsh Dee Trust and Cheshire Wildlife Trust
- The Middle Dee Partnership, hosted by the Welsh Dee Trust and Cheshire Wildlife Trust

6.2 Natural Flood Management and Working with Natural Processes - what is it?

Natural Flood Management (NFM) or Working with Natural Processes (WwNP) is a type of flood risk management used to protect, restore and renaturalise the function of catchments and rivers to reduce flood and coastal erosion risk. WwNP has the potential to provide environmentally sensitive approaches to minimising flood risk, to reduce flood risk in areas where hard flood defences are not feasible and to increase the lifespan of existing flood defences. NFM and WwNP are used interchangeably in the UK though the term WwNP used throughout this report.

A wide range of techniques can be used that aim to reduce flooding by working with natural features and processes in order to store or slow down flood waters before they can damage flood risk receptors (e.g. people, property, infrastructure, etc.). WwNP involves taking action to manage flood and coastal erosion risk by protecting, restoring and emulating the natural regulating functions of catchments, rivers, floodplains and coasts. Techniques and measures, that may be applicable to Flintshire, include:

- Peatland and moorland restoration in upland catchments
- Re-meandering streams
- Targeted woodland planting
- Reconnection and restoration of functional floodplains
- Restoration of rivers and removal of redundant structures
- Installation or retainment of large woody material in river channels
- Improvements in management of soil and land use
- Creation of rural and urban SuDS
- Restoration and management of sand dunes, saltmarshes and mudflats on the coast
- Managed realignment of the coastline
- Beach nourishment

Both the European Commission and UK Government are actively encouraging the implementation of WwNP measures within catchments and coastal areas in order to assist in the delivery of the requirements of various EC Directives relating to broader environmental protection and national policies. It is fully expected that the sustained interest in WwNP implementation across the UK will continue in the post-Brexit era as a fundamental component of the flood risk management tool kit.

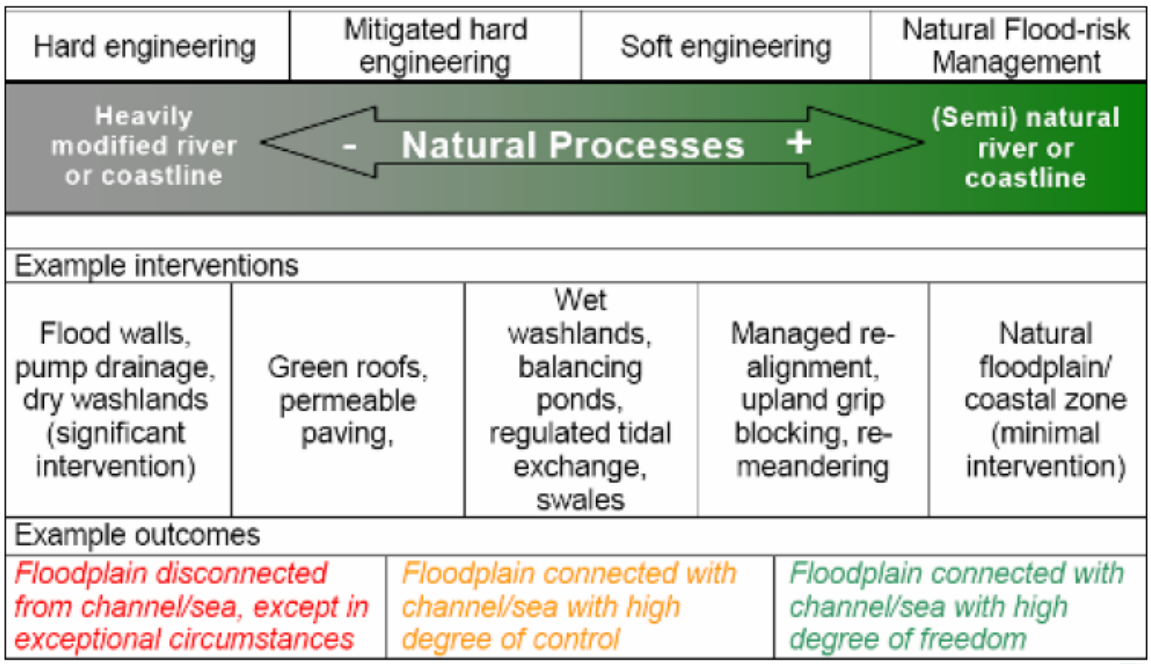
Unlike in England, the potential for WwNP has not, at the time of writing, been mapped nationally for Wales.

6.2.1 WwNP in Flintshire

The Flintshire LFRMS discusses WwNP in the context of Flood and Coastal Erosion Risk Management whereby WwNP means slowing down the flow of water (e.g. by re-establishing floodplains that hold floodwaters) or speeding up the flow of water (e.g.

by removing unnatural obstructions), to prevent floodwaters from causing harm. Such techniques protect, restore or emulate natural processes which regulate flooding and erosion. Natural processes operate across a continuum from mitigated engineering to full naturalisation.

Figure 6-1: NRW's conceptual model of WwNP[20]



The LFRMS includes an example, from 2003, at Talacre on the northern coastline whereby certain low spots in the natural coastal dune system were raised using sand dredged locally from the River Dee. The raised areas were then reinforced by planting locally sourced Marram Grass. The raising of the dunes provides protection to the village of Talacre from possible tidal surge events.

6.2.2 Maps of Natural Flood Management[21]

Natural flood management is a means of working with natural processes by implementing nature-based interventions to help reduce the risk of flooding. The maps to help identify potential areas for working with natural processes to reduce fluvial flood risk have been developed as part of the research project 'Working with Natural Processes – the evidence base'. This joint project was delivered under the Flood and Coastal Erosion Risk Management Research and Development programme managed by the Environment Agency.

The maps identify potential areas for the following measures:

- floodplain reconnection
- run-off attenuation features and gully blocking
- woodland planting covering floodplain planting, riparian planting and wider catchment woodland

20 Flintshire Local Flood Risk Management Strategy, Strategy Document 2013 - 2017, December 2013, Flintshire County Council

21 http://naturalresources.wales/flooding/managing-flood-risk/maps-for-natural-flood-management/?lang=en

It is recommended that the maps are used alongside the Working with Natural Processes Evidence Directory to help users think about the types of measures that could be used and where they may be most effective within a catchment.

The maps do not cover all measures for working with natural processes and users may wish to refer to other sources of relevant information when identifying areas of opportunity.

6.3 Green Infrastructure assessments

Open space, or Green Infrastructure (GI), should be designed and managed as a multifunctional resource capable of delivering a wide range of environmental and quality of life benefits for local communities and should be provided as an integral part of all new development, alongside other infrastructure such as utilities and transport networks.

Open space can provide many social, economic and environmental benefits close to where people live and work including:

- Places for outdoor relaxation and play;
- Space and habitat for wildlife with access to nature for people;
- Environmental education;
- Local food production - in allotments, gardens and through agriculture;
- Improved health and well-being – lowering stress levels and providing opportunities for exercise;
- Climate change adaptation - for example flood alleviation and cooling urban heat islands.

Open space can perform many functions, including flood risk mitigation. LDPs should account for increased flood risk, resulting from climate change, through the planning of GI. GI can have an important role to play in reducing the likelihood of flooding by providing space for flood storage, reducing runoff and increasing infiltration, whilst also providing other benefits as stated above.

Alongside GI should be the implementation of SuDS (Section 7.6.5), specifically within potential development sites, where possible. The suitability of GI and SuDS can be informed by this SFCA through utilisation of open space for water in the areas of greatest flood risk, which would be key to helping deliver sustainable development. Examples include:

- Restoration of the natural character of floodplains;
- Keeping and preserving of areas of existing natural floodplain;
- Introduction of new areas and enhancing existing areas of greenspace whilst incorporating sustainable drainage within new development; and
- Reduction of downstream flood risk.

FCC produced a strategy for green space[22] in 2013, however, it does not include any reference to flood risk mitigation. FCC may consider reviewing the Strategy to factor in options for flood risk management based on the outputs of this SFCA. This could also be linked in to certain WwNP measures discussed in Section 6.2.

6.4 NRW flood risk management assets

NRW maintains a spatial dataset called the Spatial Flood Defences dataset. This national dataset contains such information as:

22 A Green Space Framework Strategy for Flintshire, Flintshire County Council, February 2013

- Asset type (flood wall, embankment, high ground, dunes, demountable defence);
- Flood source (fluvial, tidal, fluvial and tidal);
- Design standard (SoP);
- Asset length;
- Asset age;
- Asset location; and
- Asset condition. See for condition assessment grades using the Environment Agency's (EA) Condition Assessment Manual[23] (CAM).

Figure 6-2: EA flood defence condition assessment grades

Grade	Rating	Description
1	Very Good	Cosmetic defects that will have no impact on performance
2	Good	Minor defects that will not reduce the overall performance of the asset
3	Fair	Defects that could reduce the performance of the asset
4	Poor	Defects that would significantly reduce the performance of the asset. Further investigation needed.
5	Very Poor	Severe defects resulting in complete performance failure.

In total, there are 77 manmade raised flood defences in Flintshire, 56 of which are embankments and 21 which are walls. Of the 77 assets, 16 are coastal i.e. offering protection from tidal flooding; 32 for fluvial flooding; and 29 from combined fluvial and tidal flooding. The combined fluvial and tidal defences are all located along the Dee estuary from Rockcliffe to Chester and the coastal defences are all located from Talacre to Flint. The majority of fluvial defences are located along the River Alyn protecting the golf course east of Mold and areas to the north of Mold. There is also a wall in Rhydymwyn on the bend of the Nant Gain watercourse. The Catchwater Drain, to the east of Higher Kinnerton is embanked on both banks, protecting what appears to be agricultural land.

One of the coastal defences at Walwen and Whelston; a number of defences along the Dee estuary; and several of the River Alyn defences are recorded to be in poor condition and should therefore be further investigated with a few to carrying out remedial works or asset replacement. The NRW assets are shown on the SFCA Maps in, Appendix A, colour coded by their condition assessments as per the EA gradings shown in Figure 6-2.

6.5 LLFA flood risk management assets

The LLFA own and maintain a number of assets throughout Flintshire which will include culverts, bridge structures, gullies, weirs and trash screens. The majority of these assets will lie along ordinary watercourses within smaller built-up areas where

23 Environment Agency. (2012). Visual Inspection Condition Grades. In: EA Condition Assessment Manual. Bristol: Environment Agency. p9.

watercourses may have been culverted or diverted, or within rural areas. All these assets can have flood risk management functions as well as an effect on flood risk if they become blocked or fail. In most cases responsibility lies with the riparian / land owner.

As part of its FWMA duties, the LLFA has a duty to maintain a register of structures or features, which are considered to have a significant effect on flood risk, including details on ownership and condition as a minimum. The Asset Register should include those features relevant to flood risk management function including feature type, description of principal materials, location, measurements (height, length, width, diameter) and condition grade. The Act places no duty on the LLFA to maintain any third-party features, only those for which the authority has responsibility as land/asset owner.

The Flintshire LFRMS, published in December 2013, states that the Council has begun to populate a register of all existing information on structures that are likely to have a significant effect on flood risk. However, FCC believes it will take many years before the register is sufficiently comprehensive to be of real value in flood risk management.

Based on that information, the LLFA has not provided information on its asset register for this SFCA.

The LLFA should carry out a strategic assessment of structures and features on the FRM Asset Register to inform capital programme and prioritise maintenance programme. Critical assets (i.e. culverts in poor condition) should be prioritised for designated works.

6.6 Water company assets

The sewerage infrastructure across Flintshire is likely to be based on Victorian sewers from which there is a risk of localised flooding associated with the existing drainage capacity and sewer system. The drainage system may be under capacity and / or subject to blockages resulting in localised flooding of roads and / or property. DCWW is responsible for the management of the adopted sewerage system. This includes surface water and foul sewerage.

There may however be some private surface water sewers in the county as only those connected to the public sewer network that were transferred to the water companies under the Private Sewer Transfer in 2011 are likely to have been constructed since this transfer date. Surface water sewers discharging to watercourses were not part of this transfer and would therefore not be under the ownership of DCWW, unless adopted under a Section 104 adoption agreement.

Water company assets include Wastewater Treatment Works, Combined Sewer Overflows, pumping stations, detention tanks, sewer networks and manholes. Dee Valley Water will also own various water mains and piped infrastructure in its area.

6.7 NRW Flood Risk Management Activities and Flood and Coastal Erosion Risk Management Research and Development

As well as the ownership and maintenance of a network of formal defence structures, NRW carries out a number of other flood risk management activities that help to reduce the probability of flooding, whilst also addressing the consequences of flooding. These include:

- Maintaining and improving existing flood defences, structures and Main River channels.
- Enforcement and maintenance where riparian owners unknowingly carry out work that may be detrimental to flood risk.
- Identifying and promoting new flood alleviation schemes (FAS) where appropriate.

- Working with local authorities to influence the location, layout and design of new and redeveloped property and ensuring that only appropriate development is permitted relative to the scale of flood risk, i.e. through this SFCA.
- Operation of flood warnings and flood alerts for areas within designated Flood Warning Areas (FWA) or Flood Alert Areas (FAA). FWAs are shown on the SFCA Maps in Appendix A.
- Promoting awareness of flooding so that organisations, communities and individuals are aware of the risk and are therefore sufficiently prepared in the event of flooding.
- Promoting resilience and resistance measures for existing properties that are currently at flood risk, or may be in the future as a result of climate change.
- The Flood and Coastal Erosion Risk Management (FCERM) Research and Development programme is run by NRW in collaboration with the Welsh Government, the EA and Defra and aims to serve the needs of all flood and coastal operating authorities in England and Wales. The programme provides the key evidence, information, tools and techniques to:
  - Inform the development of FCERM policy and strategy,
  - Understand and assess coastal and flood risks and the processes by which these risks arise,
  - Manage flood and coastal erosion assets in a sustainable way,
  - Prepare for and manage flood events effectively.
- Based on information publicly available from NRW, there are a number of completed, ongoing and proposed national flood risk management work programmes. Follow the link below for the latest news where there may be programmes relevant to Flintshire:

https://naturalresources.wales/evidence-and-data/research-and-reports/reports-evidence-and-data-on-flooding/flood-and-coastal-erosion-risk-management-research/?lang=en

7 Development and Flood Risk

7.1 Introduction

This section of the SFCA provides a strategic assessment of the suitability, relative to flood risk, of sites in Flintshire to help inform the development of the new LDP.

The information and guidance provided in this chapter (supported by the SFCA mapping in Appendix A and Development Site Assessment Spreadsheet in Appendix B) can be used by FCC to inform their new LDP, and provide the basis from which to apply the Justification and Acceptability Tests in sections 6 and 7 of TAN 15 (see Section 3.3 of this report. Surface water risk is also reviewed and recommendations are made as per Section 8 and Appendix 4 of TAN 15 concerning surface water management and SuDS.

Detailed modelled climate change outputs are not available for this study, and therefore a cautious approach to assessing future risk to existing settlements and sites at risk has been adopted. It can be often the case that modelled 1 in 1000 year AEP event outlines are similar to modelled climate change scenarios for the 1 in 100 year AEP event. The breach modelling outputs provided in 7.3 provides further details in terms of key sites. Flintshire LDP sites assessment

The LPA provided a GIS layer of possible development sites with potential to be included as site allocations in the new LDP. 83 potential sites have been provided, entailing the proposed uses listed in Table 7-1. Table 7-1 also shows the associated vulnerability of each proposed use that is used to help assign the strategic recommendations discussed in section 7.2.

Table 7-1: Proposed site uses and flood risk vulnerability

Proposed site use	Flood risk vulnerability (Figure 2 of TAN15)
Housing	Highly vulnerable
Employment	Less vulnerable
Mixed Use	Highly vulnerable
Community Facility	Highly vulnerable
School	Highly vulnerable

7.2 Screening of potential development sites

This assessment provides key information required for TAN 15 regarding the suitability of land for development and application of local evidence. This SFCA also includes a breach analysis of four breach models within Flintshire these are Saltney (Mold Junction Drain), Bumper's Lane (Waters Meet), Hawarden Business Park, Pentre, Queensferry and Broken Bank. These breach locations illustrate the risk of flooding which can be found in Appendix B the site assessment spreadsheet and can be compared to the tolerable depths found Table A1.15 of TAN15.

The tolerance condition assessment uses thresholds from Table A1.15 of TAN 15 which is described as not being prescriptive and is only indicative guidance. Therefore, the numbers provided in the tolerance condition assessment tables are estimated from a representative area of the site under assessment.

The Development Site Assessment spreadsheet, in Appendix B, provides a detailed breakdown of each potential development site showing the area, in hectares, and percentage coverage of each of the TAN 15 DAM zones, Flood Zones 2 and 3 and the surface water flood zones taken from the RoFSW dataset.

Furthermore, Appendix C displays the risk of flooding from each breach location and the tolerable depths. This also details whether key sites fall within the 0.1% flood outline (Zone C) though also assesses the tolerable criteria for risks to developments associated with flood depth, rate of rise of flood waters, speed of flood water inundation and flow velocity.

FCC should use the Development Site Assessment spreadsheets in Appendix B and C to identify if FCA's are required for the Justification and Acceptability Test. FCC can use the sites assessment to assess wider strategic objectives, against regeneration in areas already at risk of flooding, and the compatibility of vulnerability classifications and Flood Zones (refer to TAN15) for the new LDP.

Table 7-2 shows the number of sites within each fluvial and / or tidal flood zone and Table 7-3 shows the number of sites within each surface water flood zone.

Table 7-2: Number of potential development sites at risk from fluvial / tidal flooding

Potential Development Site	Number of sites within...					
	*DAM A	DAM B	DAM C1	DAM C2	Flood Zone 2	Flood Zone 3
Housing	73	5	6	3	7	9
Employment	2	2	1	2	2	2
Mixed Use	2	1	1	1	1	1
School	0	1	1	0	1	1
Community Facilities	1	0	0	0	0	0
TOTAL	**78**	**9**	**9**	**6**	**11**	**13**
*Sites with 100% area within DAM Zone A						

Table 7-3: Number of potential development sites at risk from surface water flooding

Potential Development Site	Number of sites within...		
	Low Risk (1 in 1000)	Medium Risk (1 in 100)	High Risk (1 in 30)
Housing	64	50	35
Employment	2	2	2
Mixed use	3	3	3
School	1	1	0
Community facilities	1	1	1
TOTAL	**71**	**57**	**41**

The spreadsheet also includes high level broad-brush strategic recommendations on the viability of development for each site. The strategic recommendations are intended to assist the LPA in carrying out the Justification and Acceptability Test. Table 7-4 shows the number of sites each strategic recommendation applies to.

Strategic recommendations:

- Strategic Recommendation A – withdrawal. Consider withdrawing the site based on significant level of fluvial, tidal or surface water flood risk and site vulnerability;
- Strategic Recommendation B – avoidance. Consider site layout and design around the identified flood risk;
- Strategic Recommendation C – minimum requirements. Site-specific FCA required; and
- Strategic Recommendation D - site permitted on flood risk grounds due to little perceived risk, subject to consultation with the LPA / LLFA.

Table 7-4: Number of sites per strategic recommendation

Proposed use of site	Strategic Recommendation			
	A	B	C	D
Housing	10	2	60	3
Employment	1	1	0	0
Mixed Use	1	0	2	0
School	1	0	0	0
Community Facilities	1	0	0	0
Total	**14**	**3**	**62**	**3**

It is important to note that this SFCA does not assess each individual site in detail. Each individual site will require further investigation, as local circumstances may dictate the outcome of the strategic recommendation. The strategic recommendation may therefore change upon further investigation.

Such local circumstances may include the following:

- Flood depths and hazards will differ locally to each at risk site therefore modelled depth, hazard and velocity data should be assessed for the relevant flood events, including climate change (using the Welsh Government Climate Change guidance), through a detailed site-specific FCA.
- Current surface water drainage infrastructure and applicability of SuDS techniques are likely to differ at each site considered to be at risk from surface water flooding. Further investigation would therefore be required for any site at surface water flood risk.
- If there are sites which have planning permission but construction has not started, the SFCA will only be able to influence the design of the development e.g. finished floor levels. New, more robust flood extents (from new models) cannot be used to reject development where planning permission has already been granted.
- It may be possible at some sites to develop around the flood risk. Planners are best placed to make this judgement i.e. will the site still be deliverable if part of it needs to be retained to make space for flood water.
- Surrounding infrastructure and land use may influence scope for layout redesign / removal of site footprints from risk.

- Current land use: A number of sites included in the assessment are likely to be brownfield, thus the existing development structure could be taken into account as further development may not lead to increased flood risk.
- Existing planning permissions may exist on some sites where the NRW may already have passed comment and/or agreed to appropriate remedial works concerning flood risk. Previous flood risk investigations/FCAs may already have been carried out at some sites.
- Cumulative effects. New development may result in increased risk to other potential or existing sites which could be assessed through a more detailed FCA.

The strategic recommendations are provided as a guide, based on the fluvial, tidal and surface water flood risk information made available for this SFCA at the time of the assessment.

Information regarding local, site-specific information is beyond the scope of this SFCA. It is FCC's responsibility to carry out justification testing of each site using the information provided in this SFCA and more specifically using their local, site-specific knowledge and advice from NRW.

The strategic recommendations and Development Site Assessment spreadsheets in Appendix B and C, should together assist the LPA in carrying out the Justification and Acceptability Tests, where applicable, for each site as part of the LDP Review.

The following sections summarise the strategic recommendations from the Development Site Assessment spreadsheet.

7.2.1 Strategic Recommendation A - Consider removal of site

This strategic recommendation DOES NOT take account of local circumstances, only that part of a site area falls within a flood zone.

Strategic Recommendation A applies to any site where the following criteria is true:

- 10% or greater of the site area of a highly vulnerable site type is within the high risk Zone C2
- 10% or greater of the site area of any site type is within the high risk NRW Flood Zone 3 flood outline
- 10% or greater of the site area of any site type is within the high risk surface water flood outline
- 10% or greater of the site area of a more vulnerable site are within the medium risk surface water flood outline

The 10% threshold is not included within any policy, it is merely considered that it may prove difficult for developers to deliver a site where 10% or more of the site area is considered as undevelopable. This 10% threshold does not account for local circumstances therefore it may be possible to deliver some of the sites, particularly in larger sites, included with Strategic Recommendation A upon more detailed investigation. Strategic Recommendation A applies to 14 sites, shown in Table 7-5 due to significant fluvial / tidal flood risk and Table 7-7 due to significant surface water flooding.

Table 7-5: Sites to consider withdrawing based on fluvial / tidal flood risk

Site ID	Site name	Proposed use	Site area (ha)	DAM C2 (%)	Flood zone 3 (%)
MAN001	Land between Mancot Lane and Mancot Way, Mancot	Housing	1.55	0.00	37.95
MOL044	Land opposite Pool House, Denbigh Road, Mold	Housing	3.94	28.45	28.45
2	Northern Gateway	Mixed Use	166.57	0.00	99.98
1	Land at Saltney	School	40.19	0.00	99.24

Table 7-6: Sites to consider withdrawing based on surface water risk

Site ID	Site name	Proposed use	Site area (ha)	% Area at medium risk	% Area at high risk
BAG014	former Canton Depot, Pen y Maes Rd, Bagillt	Housing	1.11	20.13	11.71
COE005	Former Clwyd Alloys Works, Corwen Road, Coed Talon	Housing	2.28	3.64	19.63
EWL013	Wood Lane, Hawarden	Housing	0.89	9.99	15.81
EWL018	Wood Lane, Ewloe	Community Facility	0.24	9.24	29.03
FFY004	Land between A548, Main Road and Fairfield Avenue, Ffynnongroyw	Housing	0.52	42.24	0.00
FFY006	Land adjacent Elsinore, Fairfield Avenue, Ffynnongroyw	Housing	0.93	94.46	2.30
FFY007	Land to the west of Fairfield Avenue, Ffynnongroyw	Housing	1.26	66.49	2.37
MAN006	Land adj Mancot Way / Foxes Close, Mancot	Housing	0.92	15.13	0.00

Site ID	Site name	Proposed use	Site area (ha)	% Area at medium risk	% Area at high risk
MOL019	Penybont Farm, Chester Road, Mold	Employment	13.50	1.67	13.71
NOR033	Land north and east of Northop Cricket Club, Northop.	Housing	6.57	13.26	8.52

Of the 14 sites recommended for withdrawal there are four sites based on significant fluvial / tidal flood risk. Two of these sites are proposed for housing, one mixed use and one school. Each of these four sites fall into the highly vulnerable category (see Table 7-1). Site MOL044 has over a quarter of its area within Zone C2 where TAN 15 states that allocations should not be made and planning applications not proposed. This site could only be allocated if this 28% area of the site could be removed from the site footprint or be left as open space within the site to receive floodwaters.

Site MAN001 has just under 38% of its area within NRW Flood Zone 3. This area should either be removed from the site footprint or should be designed to incorporate open space to accommodate floodwaters. Sites 1 and 2 should not be developed and should be left as open space given that virtually the whole of these sites are within Flood Zone 3.

Several of the ten sites recommended for withdrawal based on surface water flood risk (Table 7-3) are likely to be too small to be able to accommodate surface water risk on site. This most certainly applies to those sites with areas under 1 hectare. It may be that the larger sites can store surface water on site, though this would require detailed investigation and planning into the suitability of appropriate SuDS techniques.

For each site, a more detailed assessment of site conditions would be required to ascertain whether there are actual surface water flow paths through the sites or whether risk is confined to certain parts of the site in natural depressions. Flood depths and hazards; ground condition assessments for SuDS; and provision for safe access and egress points during a flood would also need to be gauged. A detailed site design and drainage strategy together with a detailed FCA would need to demonstrate that each site would be safe for its lifetime, which is usually 100 years for residential and 70 years for other uses.

7.2.2 Strategic Recommendation B - Avoidance of high risk zones

This strategic recommendation DOES NOT take account of local circumstances, only that part of a site area falls within a Flood Zone.

This recommends that, due to only a small proportion of a site being at risk, it may be possible that a detailed review of site layout and / or design around the flood risk, as part of a detailed FCA at the development planning stage, may enable development to proceed. Or a less vulnerable site, i.e. employment site, may be able to incorporate suitable SuDS into the site layout to mitigate surface water originating on-site, following a detailed FCA or wider drainage strategy.

Strategic Recommendation B applies to sites where the following criteria is true:

- <10% of the area of any site type is within NRW Flood Zone 3
- <10% of the area of a highly vulnerable site is within DAM C2
- <10% of any highly vulnerable site within the high or medium risk surface water flood zone
- 10% or greater of a less vulnerable site within the medium risk surface water flood zone

The 10% threshold is not included within any policy, it is merely considered that it may be possible for developers to avoid NRW Flood Zone 3 and DAM C2 and also the high and medium risk surface water flood zones when less than 10% of the site area is at risk. This 10% threshold does not account for local circumstances.

There are three potential sites to which Strategic Recommendation B applies, listed in Table 7-7. Each site should be large enough to avoid the risk or incorporate the risk areas into the site design and layout. The locations of the risk at each site should be investigated as to whether it is confined to specific areas or scattered around the site. Also, the presence of natural flow paths should be checked.

Table 7-7: Sites to consider layout and design to avoid risk areas

Site ID	Site Name	Proposed use	Site Area (ha)	Viability
FLI007	Land at Northop Road, Flint	Housing	9.38	Avoid C2 and FZ3. Consider surface water requirements
NH020	Land south of Wellfield Farm, Village Road, Northop Hall	Housing	5.96	Avoid C2 and FZ3. Consider surface water requirements
3	Hawarden Industrial Park	Employment	32.47	Avoid C2, C1 and FZ3. If unavoidable then justification test must be passed and consequences accepted. Consider surface water requirements

7.2.3 Strategic Recommendation C - FCA required

This strategic recommendation DOES NOT take account of local circumstances, only that part of a site area falls within a flood zone.

This recommends that development could be allocated due to low flood risk perceived from the NRW flood maps and DAM, assuming a site-specific FCA shows the site can be safe and it is demonstrated that the site is sequentially preferable. A site within DAM B could still be rejected if the conclusions of the FCA decide development is unsafe or inappropriate.

Strategic Recommendation C applies to sites where the following criteria is true:

- Any site within DAM A or B that does not have any part of its footprint within DAM C1 or C2 or Flood Zone 3.
- Any site 100% within DAM B requires an FCA to identify the consequences that cannot be overcome or managed to an acceptable level.
- Any site 100% within DAM A where surface water flood risk is apparent but not considered significant.
- Any site 100% within DAM A that is greater than or equal to 1 hectare in area.

Strategic Recommendation C applies to 62 of the 82 sites. 54 of the 62 sites require an FCA due to some level of risk from surface water with the remaining eight at very low flood risk though greater than 1 hectare in size.

7.2.4 Strategic Recommendation D - No requirements on flood risk grounds

This strategic recommendation DOES NOT take account of local circumstances, only that part of a site area falls within a flood zone.

This recommends that development should be allocated on flood risk grounds, based on the evidence provided within this SFCA. Further investigation may be required by the developer and an FCA would be required to assess further or new information that may not have been included within this SFCA.

Strategic Recommendation D applies to any site with its area 100% within DAM A, not within any surface water flood zone and less than 1 hectare in size.

This strategic recommendation only applies to three sites.

7.3 Tidal breach locations within Flintshire

Six targeted breach locations have been modelled based on a review of existing coastal defences and to provide FCC with indicative extents of flooding at these locations to highlight residual risk. The breach locations, together with their outputs are shown on the SFCA Maps in Appendix A. It should be noted that a defence breach could occur anywhere; and during extreme tidal events there is greater potential for multiple defence failures, particularly where reliance is placed on sand dunes.

The breach modelling assessed the 1 in 200 AEP and the 1 in 1000 AEP events. Both events were also modelled taking account of climate change. In accordance with the Welsh Government letter to Chief Planning Officers of 9 January 2014, consideration of climate change for a 0.1% AEP tidal flood event has also been appraised (see Section 7.6.2). It is clear from the resultant mapping that large extents of coastal towns could be inundated in the future. FCC in consultation with NRW will need to ensure that a pragmatic approach to regeneration within coastal towns is applied to ensure the ongoing viability of such communities.

summarises the possible consequences to existing communities of each

Breach location	Summary of risk	
	1 in 200 AEP event	1 in 1000 AEP event
Saltney (Mold Junction Drain)	Flooding to buildings and land immediately south of the breach up to depths of approx. 0.7 m	There is a small increase in flooding to the same area though with an increase in max depths to approx. 0.8 m
Bumper's Lane (Waters Meet)	Flooding to several farms and agricultural land to the north of the Dee. Buildings and infrastructure around Bumper's Lane and Sealand Road. Depths reaching up to 0.9 m	Flooding does not increase by much from the 1 in 200 AEP event though depths do increase over 2 m in some places
Hawarden Business Park	Widespread flooding as far south from the Dee as Chester Road (B5129). Agricultural land between the Dee and the railway line, to parts of Sandycroft and east to Saltney Ferry Road. Max depths exceeding 2 m	The extent of flooding does not increase by much however the range of depths do increase. Max depths can reach up to 2.3 m
Pentre	Flooding to Pentre and Sandycroft north of the railway line. Some shallow flooding to eastern parts of Sandycroft south of the railway line. Max depths up to 2 m	Increased flooding to Sandycroft and to Pentre south of the railway line. Depths generally deeper with max depth reaching over 3 m
Queensferry	Flooding confined mainly to the north of the railway line though some shallower flooding to Queensferry and Shotton south of the railway line but north Chester Road (east). Some deep flooding (up to 2 m) at the River Wepre south of the railway line. Max depths up to 2 m	Flood extent does not increase much beyond further shallow flooding of more buildings in Queensferry and Shotton south of the railway line. Depths do increase however with max depths reaching approx. 2.7 m
Broken Bank	Deep flooding to surrounding rural land over 2 m in some places. No flooding of infrastructure south of Weighbridge Road	Similar flood extent with no great increase in depths. Max depth approx. 2.3 m

targeted breach occurring.

Table 7-9 lists the potential LDP sites that could be at risk from these breach scenarios.

This analysis of breach modelling outputs does not include the overtopping modelling work completed separately to this SFCA.

Breach location	Summary of risk	
	1 in 200 AEP event	1 in 1000 AEP event
Saltney (Mold Junction Drain)	Flooding to buildings and land immediately south of the breach up to depths of approx. 0.7 m	There is a small increase in flooding to the same area though with an increase in max depths to approx. 0.8 m
Bumper's Lane (Waters Meet)	Flooding to several farms and agricultural land to the north of the Dee. Buildings and infrastructure around Bumper's Lane and Sealand Road. Depths reaching up to 0.9 m	Flooding does not increase by much from the 1 in 200 AEP event though depths do increase over 2 m in some places
Hawarden Business Park	Widespread flooding as far south from the Dee as Chester Road (B5129). Agricultural land between the Dee and the railway line, to parts of Sandycroft and east to Saltney Ferry Road. Max depths exceeding 2 m	The extent of flooding does not increase by much however the range of depths do increase. Max depths can reach up to 2.3 m
Pentre	Flooding to Pentre and Sandycroft north of the railway line. Some shallow flooding to eastern parts of Sandycroft south of the railway line. Max depths up to 2 m	Increased flooding to Sandycroft and to Pentre south of the railway line. Depths generally deeper with max depth reaching over 3 m
Queensferry	Flooding confined mainly to the north of the railway line though some shallower flooding to Queensferry and Shotton south of the railway line but north Chester Road (east). Some deep flooding (up to 2 m) at the River Wepre south of the railway line. Max depths up to 2 m	Flood extent does not increase much beyond further shallow flooding of more buildings in Queensferry and Shotton south of the railway line. Depths do increase however with max depths reaching approx. 2.7 m
Broken Bank	Deep flooding to surrounding rural land over 2 m in some places. No flooding of infrastructure south of Weighbridge Road	Similar flood extent with no great increase in depths. Max depth approx. 2.3 m

Table 7-8: Summary of the six breach locations (see SFCA Maps)

Table 7-9: Illustrates the key sites at risk from flooding if 2117 climate change scenario defences breached.

Site ID	Site Name	Site Area (ha)	Proposed use
MAN001	Land between Mancot Lane and Mancot Way, Mancot	1.55	Housing
MAN006	Land adj Mancot Way/ Foxes Close, Mancot	0.93	Housing
2	Northern Gateway	166.58	Mixed Use
1	Land at Saltney	40.20	School

7.4 Summary of Justification and Acceptability Testing Outcomes

There are several outcomes which could come out of the Justification and Acceptability Testing process. Each outcome is discussed below. The LPA should refer to Section 3.3.3 of this report, and Appendix B, for details on the sites assessments carried out for this SFCA.

7.4.1 Rejection of site

A site which fails to pass the Justification and Acceptability Testing would be rejected. Rejection would also apply to any highly (residential, mixed use inclusive of residential) or less vulnerable (employment) sites within Flood Zone 3 where development should not be permitted. Or where highly vulnerable sites are located within DAM C2.

In terms of surface water flood risk, if risk is considered significant or where the size of the site does not allow for on-site storage or application of appropriate SuDS then such sites could be considered for rejection.

7.4.2 Consideration of site layout and design

Site layout and site design is important at the site planning stage where flood risk exists. The site area would have to be large enough to enable any alteration of the developable area of the site to remove development from the functional floodplain, or to leave space for on site storage of flood water. Careful layout and design at the site planning stage may apply to such sites where it is considered viable based on the level of risk. Surface water risk and opportunities for SuDS should also be assessed during the planning stage.

Depending on local circumstances, if it is not possible to adjust the site boundary to remove the site footprint from Flood Zone 3 or DAM C2 to a lower risk zone then development should not be permitted. If it is not possible to adjust the developable area of a site to remove the proposed development to a lower risk zone or to incorporate the on site storage of water within site design, then the Justification and Acceptability Test would have to be passed as part of a site-specific Flood Consequence Assessment.

7.4.3 Surface water risk to potential sites

For sites at surface water flood risk the following should be considered:

- Possible withdrawal, redesign or relocation of the site for those sites at identified to be at significant risk;
- A detailed site-specific FCA incorporating surface water flood risk management or drainage strategy for larger strategic sites;
- An FCA may want to consider detailed surface water modelling, particularly for the larger sites which may influence sites elsewhere;
- The size of development and the possibility of increased surface water flood risk caused by development on current Greenfield land (where applicable), and cumulative impacts of this within specific areas;
- Management and re-use of surface water on-site, assuming the site is large enough to facilitate this and achieve effective mitigation. Effective surface water management should ensure risks on and off site are controlled;
- Larger sites could leave surface water flood prone areas as open greenspace, incorporating social and environmental benefits;
- SuDS should be used where possible. Appropriate SuDS may offer opportunities to control runoff to Greenfield rates or better. Restrictions on surface water runoff from new development should be incorporated into the development planning stage. For brownfield sites, where current infrastructure may be staying in place, then runoff should attempt to mimic that of Greenfield rates, unless it can be demonstrated that this is unachievable or hydraulically impractical. Developers should refer to the national 'non-statutory technical standards for sustainable drainage systems' and other guidance documents cited in Section 7.6.5 of this report;
- Runoff up to and including the 1% AEP event should be managed on site where possible;
- Measures of source control should be required for development sites;
- Developers should be required to set part of their site aside for surface water management, to contribute to flood risk management in the wider area and supplement green infrastructure networks;
- Developers should be required to maximise permeable surfaces;
- Flow routes on new development where the sewerage system surcharges as a consequence of exceedance of the 1 in 30 AEP design event should be retained.

7.5 Safeguarded land for flood storage

Where possible, the LPA may look to allocate land designed for flood storage functions. Such land can be explored through the site allocation process whereby an assessment is made, using this SFCA, of the flood risk at potential sites and what benefit could be gained by leaving the site undeveloped. In some instances, the storage of flood water can help to alleviate flooding elsewhere, such as downstream developments. Where there is a large area of a site at risk that is considered large enough to hinder development, it may be appropriate to safeguard this land for the storage of floodwater.

Applicable sites may include any current greenfield sites:

- That are considered to be large enough to store flood water to achieve effective mitigation,
- With large areas of their footprint at high or medium surface water flood risk (based on the surface water risk),

- That is within the floodplain (Flood Zone 3/ DAM C2),
- With large areas of their footprint at risk from DAM C1 and Flood Zone 2, and
- That are large enough and within a suitable distance to receive flood water from a nearby development site, where storage is not feasible, using appropriate SuDS techniques which may involve pumping, piping or swales / drains.

Brownfield sites could also be considered though this would entail site clearance of existing buildings and conversion to greenspace.

By using the sequential approach to site layout, the LPA and developers should be able to avoid the areas at risk and leave clear for potential flood storage. See the SFCA Maps in Appendix A to spatially assess the areas of the sites at risk.

7.6 Accounting for Climate Change

Climate change will increase flood risk over the lifetime of a development. The effects are well documented and include rising sea levels and more frequent periods of heavy rainfall increasing the risk of flooding.

When considering new development proposals, Technical Advice Note 15: Development and Flood Risk (TAN15) states that it is necessary to take account of the potential impact of climate change over the lifetime of development. Residential development is assumed to have a lifetime of 100 years while a lifetime of 75 years is assumed for non-residential developments. To ensure future development can provide a safe and secure living and /or working environment throughout its lifetime, national planning policy requires proposals in areas of high flood risk to be accompanied by an assessment of flooding consequences to and from the development, taking into account the impacts of climate change. This SFCA does not focus on detailed mitigation measures for climate change but rather focuses on the 0.1% extreme event, as per TAN 15 requirements. However, several climate change scenarios have been appraised as part of this SFCA and the 0.1% event plus climate change for the tidal breach modelling has been taken account of in relation to the key development sites (see section 7.6.2).

7.6.1 Welsh Government: Climate Change Allowances

The Welsh Government Chief Planning Officer letter and guide on FCA Climate Change Allowances (2016) sets out requirements. The purpose of this guide is to set out the climate change allowances that should be used in flooding consequence assessments submitted in support of relevant planning applications, and to inform development plan allocations.

Providing an allowance for the potential impacts of climate change when assessing future flood risk, allows for development proposals to incorporate design measures that help to manage that risk and improve resilience

In line with TAN15, the climate change allowances have been informed by latest available information on climate change projections and different scenarios of carbon dioxide (CO2) emissions to the atmosphere. Allowances are provided for different epochs (periods) of time over the next century.

Table 7-10 indicates the anticipated increase in peak river flows for the river basin districts that cover Flintshire. The allowances are consistent with the A1B (medium) emissions scenario derived from latest research projects and converted into regionalised data of climate change on flood flows for the 2020s, 2050s and 2080s time-horizon, and for the B1 (low) and A1F1 (high) emissions scenarios for the 2080s time-horizon.

Estimates of peak flow increases are provided, which represent future flood risk. The allowances are based on percentage increases of change from a 1961-1990 baseline and are provided for the:

- 10th percentile (lower end estimate)
- 50th percentile (change factor/central estimate)
- 90th percentile (upper end estimate).

Table 7-10: Recommended Peak River Flow Allowances for the River Dee river basin district (use 1961 to 1990)[24]

RBD	Allowance Category	Total Potential Change Anticipated for…		
		2020s (2015-2039)	2050s (2040-2069)	2080s (2070-2115)
Dee	Upper end	+20%	+30%	+45%
	Higher central	+15%	+20%	+25%
	Central	+10%	+15%	+20%

Sea Level Rise Allowances

Projections of relative mean sea level rise for each epoch (period of time) is provided for the Welsh coastline in Table 7-11. These projections are consistent with the latest global predictions for sea level rise. The rate of change is projected to increase in each epoch.

Table 7-11: sea level allowance for each epoch in millimetres (mm) per year and cumulative sea level rise for each epoch.

Period	2009-2025	2026-2055	2056-2085	2086-2116	Cumulative rise to 2116
Annual Change (mm/yr)	3.5	8.0	11.5	14.5	N/A
Total Increase (mm)	59.5	240	345	449.5	1094

Period	mm increase	Cumulative rise (mm)
2009-2025	17 (years inclusive) x 3.5	59.5
2026-2055	30 x 8.0	240.0
2056-2085	30 x 14.5	345.0
2086-2091	6 x 14.5	87.0
75 year lifetime	**add**	**731.5**

To calculate sea level, add the annual allowances for each year post for the agreed lifetime of development. Table 7-12 and

24 https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Table 7-13 demonstrate how to apply the calculation for 75 year and 100 year developments commencing in 2016.

Table 7-12: Calculating sea level rise for a 75yr lifetime of development

Table 7-13: Calculating sea level rise for a 100yr lifetime of development

Period	mm increase	Cumulative rise (mm)
2009-2025	17 x 3.5	59.5
2026-2055	30 x 8.0	240.0
2056-2085	30 x 11.5	345.0
2086-2091	31 x 14.5	449.5
100 year lifetime	**add**	**1094.00**

Developments built in 2016 with a 100 year lifetime must demonstrate resilience to sea level rises until 2116. This table shows that an allowance for an increase of 1094mm should be made.

When considering proposals with a lifetime of development beyond 2116, an additional allowance of 14.5mm should be added for each subsequent year[25].

7.6.2 Climate Change scenarios

The modelled climate change scenarios used the new Welsh Climate Change guidance for planning, as detailed in Section 7.6.1. For this SFCA fluvial climate change scenarios were not modelled due to there being no change in the allowances. However,

Period	mm increase	Cumulative rise (mm)
2009-2025	17 (years inclusive) x 3.5	59.5
2026-2055	30 x 8.0	240.0
2056-2085	30 x 14.5	345.0
2086-2091	6 x 14.5	87.0
75 year lifetime	**add**	**731.5**

the Welsh Climate Change guidance has been used to establish the cumulative sea level rise due to climate change for the year 2117.

25 http://bailey.persona-pi.com/Public-Inquiries/M4-Newport/C%20-%20Core%20Documents/17.%20Road%20Drainage%20and%20the%20Water%20Environment/17.2.22.pdf

These updated climate change events were then modelled for the six targeted breach locations (shown in Appendix A):

- Saltney (Mold Junction Drain)
- Bumper's Lane (Waters Meet)
- Hawarden Business Park
- Pentre
- Queensferry
- Broken Bank

Table 7-14 summarises the possible consequences to existing communities of each targeted breach plus the impacts of climate change occurring.

Table 7-14: Summary climate change scenarios for the six breach locations (see SFCA Maps)

Breach location	Summary of risk	
	1 in 200+CC AEP event	1 in 1000+CC AEP event
Saltney (Mold Junction Drain)	Flooding to buildings and land immediately south of the breach up to depths of approx. 2 m	There is a small increase in flooding to the same area with wider extents near Mancot. The flood depths increase with max depths to approx. 3 m
Bumper's Lane (Waters Meet)	Flooding to several farms and agricultural land to the north of the Dee. Buildings and infrastructure around Bumper's Lane and Sealand Road. Depths of approx. to 0.9 m	Flooding extents does increase slightly from the 1 in 200 AEP event though depths do increase over 3 m in some places
Hawarden Business Park	Widespread flooding as far south from the Dee as Chester Road (B5129). Agricultural land between the Dee and the railway line, to parts of Sandycroft and east to Saltney Ferry Road. Depths close to reaching 3 m	The extent of flooding does not increase by much however the range of depths do increase. Max depths can reach over 3 m in some places
Pentre	Flooding to Pentre and Sandycroft north of the railway line. Some shallow flooding to eastern parts of Sandycroft south of the railway line. Max depths over 2 m nearly reaching 3 m in some locations	Increased flooding to Sandycroft and to Pentre south of the railway line. Depths generally deeper with max depth reaching over 3 m
Queensferry	Flooding is widespread however to the south of the railway line it is shallower flooding from Aston Road past Sandycroft. Some deep flooding (up to 2 m) at the River Wepre. Max depths reaching up to approx. 2.5 m	Flood extent does not increase much beyond further shallow flooding of more buildings in Queensferry and Shotton south of the railway line. Depths do increase however with max depths reaching 3 m
Broken Bank	Deep flooding to surrounding rural land and along Chester Road West reaching 2 m in some places. No flooding of infrastructure south of Weighbridge Road	Similar flood extent with no great increase in depths. Max depth approx. 3 m

7.6.3 Future Impacts of Climate Change

This section will look into the future impacts of climate change on small coastal settlements and the impacts on coastal process and increasing pressures on coastal defences.

How climate change could affect sea level rise in coastal communities

Sea level rise is projected to increase as a result of climate change. It is expected that the UK coastlines will be subjected to more frequent and severe storms and wave action which will increase coastal erosion, damage to coastal defences and the likelihood and consequences of coastal flooding. Increased erosion rates can lead to a loss of land, damage to railway lines and roads that are located in close proximity to the coast. Additionally, this may threaten beaches and therefore tourism in Wales, which contributes over £2.5 billion each year to the Welsh economy[26]. In relation to local community impacts, climate change may also lead to longer-term effects on neighbourhoods. For instance, areas that suffer the impacts of climate change or are considered to be at high risk may be affected by increased flooding and a reduction in housing values, development and investment, and also increased insurance costs for home owners and business owners alike.

What are the impacts of climate change on coastal processes, wave action and sediment supply?

According to many researchers, climate change will cause a rise in sea levels and wave heights and accelerate coastal erosion making coastal areas more vulnerable, especially communities relying on the immediate coastal area for their residence, communications and economic and social activities[27].

The coast is subject to both erosion and accretion. It is estimated that about 23% of the Welsh coastline is eroding (346km of a total of 1,498km). The combination of sea level rise and erosion is likely to reduce the area of beaches and affect other coastal features. It is assumed that urban areas will continue to be protected against sea level rise and coastal erosion. However, this is likely to require significant future investment and, in some cases, may not be sustainable[28].

Coastal erosion and sea-level rise may increase or reduce sediment supply, depending on local context. However, change in the character or extent of these habitats is certain, requiring proactive management responses. Where fixed landward assets prevent natural migration of the coastline, habitat loss will occur due to coastal squeeze; in other locations rollback or managed realignment should be considered as management options. Coastal water tables may rise due to sea level rise, or fall due to changing rainfall, depending on local context. Both may have serious impacts on coastal biodiversity, and on other coastal land uses.

What are the increased pressures on sea defences and tidal flood embankments due to climate change?

Coastal defences currently protect nearly 28% of the Welsh coastline and £8 billion of assets from coastal erosion and flooding[29]. However, these defences do not sufficiently manage the existing risk of coastal erosion and sea level rise as a result of climate change will further reduce their efficiency. Building coastal defences can be technically difficult and may not be affordable in all locations in the future.

The previous Welsh Government invested £39 million during 2010-11 in flood and coastal erosion risk management in Wales. If investment in flood risk management is

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26 http://www.cynulliad.cymru/NAfW%20Documents/ki-025.pdf%20-%2003112011/ki-025-English.pdf
27 https://www.jrf.org.uk/report/impacts-climate-change-disadvantaged-uk-coastal-communities
28 A climate change risk assessment for Wales (Defra)
29 http://www.assembly.wales/NAfW%20Documents/ki-025.pdf%20-%2003112011/ki-025-English.pdf

maintained at current levels then by 2035 the number of properties in Wales at significant likelihood of flooding would increase from 65,000 to 115,000, with a consequent increase in expected annual damages. To maintain the number of properties at flood risk in 2035 at levels comparable to now may require trebling investment levels, while reducing the number of properties at risk would require further investment again. A wider range of actions may be necessary to manage the impacts of current and future flooding[22].

The coastal management strategy for a section of coast (e.g., hard coastal defences, beach nourishment, managed realignment) is a key aspect for determining the long-term response of the coast to climate change effects, including sea-level rise. There is now increased realisation that current coastal management practices, which are very much focussed on hold-the-line adaption strategies, are not sustainable in the long-term. The second generation Shoreline Management Plans increasingly advocate managed realignment as an alternative adaptation strategy, especially for less developed stretches of coast. Managed realignment is likely to increase in the future as a key management strategy and although this will result in increased local erosion rates, the enhanced erosion may benefit other sections of coast by reducing erosion or even causing accretion. Adaptation is emerging as the key coastal management paradigm to cope with coastal erosion.

North West England and North Wales Shoreline Management Plan 2: Sub-cell 11a – Great Orme's Head to Southport

This section of coast includes the area stretching between Great Orme's Head, North Wales, and Southport and incorporates the two major estuaries of the Dee and Mersey as well as the smaller Clwyd and Alt estuaries. As such, there are significant interactions between the open coast and the estuaries in this section.

This coastline is important for tourism (North Wales), industry and commercial activities (Dee and Mersey estuaries) as well as its environmental significance (Formby Dunes, Dee estuary).

For much of the coastline, the preferred SMP2 policies will maintain existing defences where economically viable in the long-term, thus having a beneficial impact on people, their health and property by reducing risk to areas of significant urban development and developed parts of the coastline from flooding or erosion. In some circumstances funding streams for future maintenance of these defences may by via public/private co-funding or through private contributions.

It should also be recognised however, that a policy to hold the line for a frontage does not mean guaranteed funding and issues of affordability and prioritisation of defence schemes may become more pronounced in the future and the probability and consequences of coastal flooding may increase significantly due to projected climate change. Consequently, in the future there will be a need to complement defences with a wider range of actions to manage the consequences of flooding and coastal erosion, through adaptation and resilience measures (see section 7.6.4).

It important to note that due to the significant uncertainties associated with climate change and the magnitude of change, there is potential for SMP2 policies to need to be reviewed in the future.

Managed realignment:

There are numerous environmental conservation designations along the frontage, with the Dee estuary internationally designated as a Special Protection Area, Ramsar site and Marine Protection Area to protect the extensive inter-tidal flats and the numerous waterfowl that use the habitat. The long term plan is to continue to manage risks to commercial and industrial assets from flooding and erosion, but to also allow more natural evolution where appropriate. In order to mitigate the impacts of the defences on the evolution of the estuary in combination with expected long term future sea level

rise the plan allows for creation of areas of new habitat by moving defences inland where opportunities exist.

Managed realignment was therefore assessed as an alternative policy at a number of locations within the Dee. As a result of this assessment a number of areas with potential opportunities for managed realignment have been identified. It was not deemed appropriate to propose managed realignment as the headline policy in these locations in the short term until a suitable plan for delivering this realignment has been developed and all the potential options have been reviewed with stakeholders.

7.6.4 Property Flood Resilience (PFR)

Flood resilience and resistance measures are designed to mitigate flood risk and reduce damage and adverse consequences to existing property. Resistance and resilience measures may aim to help residents and businesses recover more quickly following a flood event.

It should be noted that it is not possible to completely prevent flooding to all communities and business.

It should be noted that PFR measures would not be expected to cause an increase in flood risk to other properties or other parts of the local community. They will help mitigate against flood risk but, as with any flood alleviation scheme, flood risk cannot be removed completely. Emergency plans should, therefore, be in place that describe the installation of measures and residual risks.

As the flood risk posed to a property cannot be removed completely, it is recommended that PFR products are deployed in conjunction with pumps of a sufficient capacity. Pumps will help manage residual flood risks not addressed by resistance measures alone such as rising groundwater.

Definitions

Flood resilience measures aim to reduce the damage caused by floodwater entering a property. Flood resilience measures are based on an understanding that internal flooding may occur again and when considering this eventuality, homes and businesses are encouraged to plan for flooding with an aim of rapid recovery and the return of the property to a habitable state.

For example, tiled floors are easier to clean than carpets, raised electricity sockets and high-level wall fixings for TVs / computers may mean that that power supply remains unaffected. Raising kitchen or storage units may also prevent damage that may not require replacement after a flood. There is a lot of information available about what items get damaged by floodwater and features that are considered to provide effective resilience measures that can be installed at a property.

Flood resistance measures aim to reduce the amount of floodwater entering the property. Obvious inflow routes, such as through doors and airbricks may be managed, for example, by installing bespoke flood doors, door flood barriers and automatic closing airbricks. However, the property's condition and construction are also key to understanding how floodwater may enter and move between buildings. For example, flood water can also flow between properties through connecting cavity walls, cellars, beneath suspended floors and through internal walls. Flood resistance measure alone may not keep floodwater out. Building condition is a critical component of any flood mitigation study.

Property Mitigation Surveys

To define the scale and type of resistance or resilience measures required, a survey will need to be undertaken to pick up property threshold levels, air brick levels, doorways, historic flood levels and a number of ground spot levels required to better understand the flood mechanisms for flood water arriving at the property (e.g. along

road, pavements, etc.). The depth of flooding at each property will help guide the selection of resistance measures proposed. Surveys will need to include consideration of issues such as:

- Detailed property information
- An assessment of flood risk, including property (cross) threshold levels
- Routes of water ingress (fluvial, ground and surface water flooding)
- An assessment of impact of flood waters
- A schedule of measures to reduce risk (resistance and resilience)
- Details of recommendations (including indicative costs)
- Advice on future maintenance of measures
- Advice on flood preparedness

All sources of flooding will need to be considered, including a comprehensive survey of openings (doors, windows and air bricks), as well as potential seepage routes through walls and floors, ingress through service cables, pipes, drains and identify possible weaknesses in any deteriorating brickwork or mortar.

7.6.5 Sustainable Drainage Systems (SuDS)

Development has the potential to cause an increase in impermeable area, an associated increase in surface water runoff rates and volumes, and consequently a potential increase in downstream flood risk due to overloading of sewers, watercourses, culverts and other drainage infrastructure. Managing surface water discharges from new development is therefore crucial in managing and reducing flood risk to new and existing development downstream. Carefully planned development can also play a role in reducing the amount of properties that are directly at risk from surface water flooding.

The Flood and Water Management Act 2010 (Schedule 3), which has not been commenced, requires new developments to include Sustainable Drainage Systems (SuDS) features that comply with national standards. The Welsh Government proposes to publish interim national standards on an advisory basis until such time as it determines the most effective way of embedding SuDS principles in new developments in the longer term. This will enable designers; property developers; local authorities and other interested parties to both demonstrate that they have taken account of the Welsh Government's planning advice on Development and Flood Risk[30], Nature Conservation and Planning[31] and to test the standards, so that if necessary they can be revised before being placed on a statutory footing.

The Department for Communities and Local Government (DCLG) announced, in December 2014, that local planners should be responsible for delivering SuDS32. Changes to planning legislation gave provisions for major applications of ten or more residential units or equivalent commercial development to require sustainable drainage within the development proposals in accordance with the 'non-statutory technical standards for sustainable drainage systems'33, published in March 2015. A Practice

30 http://gov.wales/topics/planning/policy/tans/tan15/?lang=en
31 http://gov.wales/topics/planning/policy/tans/tan5/?lang=en
32 http://www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2014-12-18/HCWS161/
33 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

Guidance34 document has also been developed by the Local Authority SuDS Officer Organisation (LASOO) to assist in the application of the non-statutory technical standards.

Maintenance options must clearly identify who will be responsible for SuDS maintenance and funding for maintenance should be fair for householders and premises occupiers; and, set out a minimum standard to which the sustainable drainage systems must be maintained.

The runoff destination should always be the first consideration when considering design criteria for SuDS including the following possible destinations in order of preference:

1. To ground;
2. To surface water body;
3. To surface water sewer;
4. To combined sewer.

Effects on water quality should also be investigated when considering runoff destination in terms of the potential hazards arising from development and the sensitivity of the runoff destination. Developers should also establish that proposed outfalls are hydraulically capable of accepting the runoff from SuDS through consultation with the LLFA, NRW and DC/WW.

The non-statutory technical standards for sustainable drainage systems (March 2015) sets out appropriate design criteria based on the following:

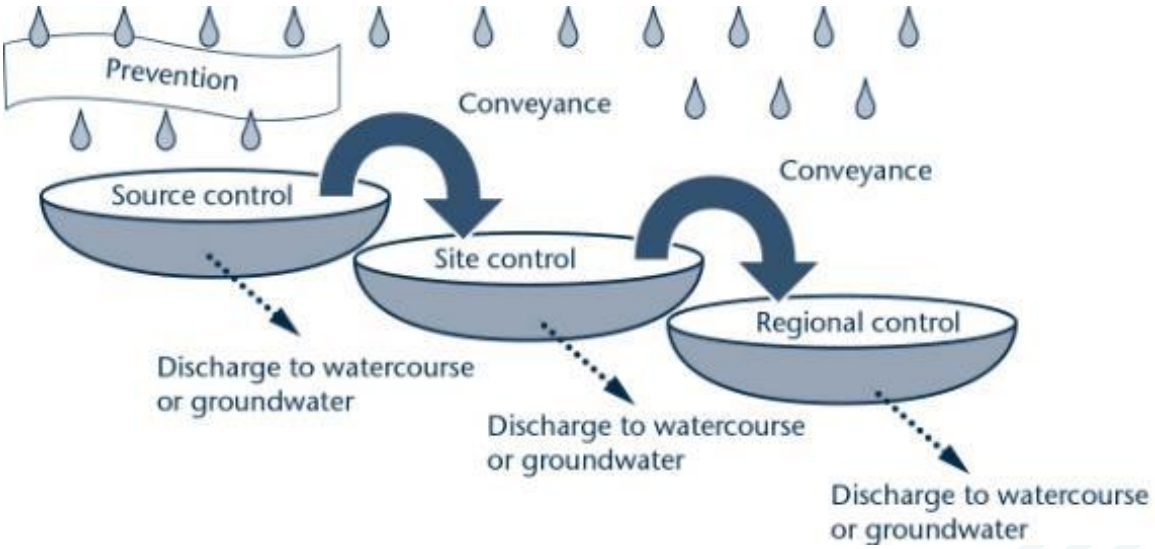
1. Flood risk outside the development;
2. Peak flow control;
3. Volume control;
4. Flood risk within the development;
5. Structural integrity;
6. Designing for maintenance considerations;
7. Construction.

Many different SuDS techniques can be implemented. As a result, there is no standard correct drainage solution for a site. In most cases, a combination of techniques, using the Management Train principle (see

Figure 7-1), will be required, where source control is the primary aim.

34 http://www.susdrain.org/files/resources/other-guidance/lasoo_non_statutory_suds_technical_standards_guidance_2016_.pdf

Figure 7-1: SuDS Management Train Principle[35]



The effectiveness of a flow management scheme within a single site is heavily limited by land use and site characteristics including (but not limited to) topography; geology and soil (permeability); and available area. Potential ground contamination associated with urban and former industrial sites should be investigated with concern being placed on the depth of the local water table and potential contamination risks that will affect water quality. The design, construction and ongoing maintenance regime of any SuDS scheme must be carefully defined as part of a site-specific FCA Including a SuDS Design Statement.

A clear and comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential for successful SuDS implementation.

Implementing SuDS within Wales

On 19 May 2017, the Welsh Government published a Consultation on the Implementation of Sustainable Drainage Systems on New Developments.

This consultation sought views on the Welsh Government's proposed approach for delivering effective sustainable drainage systems (SuDS) on new developments. Specifically, this was an opportunity to discuss the content of Schedule 3 to the Flood and Water Management Act 2010 (the Act) which has not been enacted. It was also an opportunity to discuss the Regulations and Orders, including the National Standards

35 CIRIA (2008) Sustainable Drainage Systems: promoting good practice – a CIRIA initiative

for the Implementation of Sustainable Drainage (the SuDS Standards), needed to implement Schedule 3 of the Act.

In order to implement the requirements of Schedule 3, further consultation on the draft statutory instruments and statutory SuDS standards which provide the framework for its introduction was open from 16 November 2017 until the 15 February 2018. Subject to the outcome of this further consultation, the legislation will be introduced into the Assembly in May 2018, with a view to it coming into force early 2019[36].

7.6.6 Local Standards

In addition to the national standards, the LPA and LLFA may set local requirements for planning permission that include more rigorous obligations than these non-statutory technical standards. More stringent requirements should be considered where current Greenfield sites lie upstream of high risk areas. This could include improvements on Greenfield runoff rates. FCC does not currently have its own guidance for SuDS therefore the national standards should apply.

The CIRIA SuDS Manual[37] 2007 should also be consulted by the LPA and developers. The SuDS manual (C697) is highly regarded and was updated in 2016 to incorporate the latest research, industry practice, technical advice and adaptable processes to assist in the planning, design, construction, management and maintenance of good SuDS. The SuDS Manual complements the non-statutory technical standards and goes further to support the cost-effective delivery of multiple benefits.

Drainage for New Developments

Development has the potential to cause an increase in impermeable area, an associated increase in surface water runoff rates and volumes, and a consequent potential increase in downstream flood risk due to overloading of sewers, watercourses, culverts and other drainage infrastructure.

Managing surface water discharges from new development is crucial in managing and reducing flood risk to new and existing development.

Carefully planned development can also play a role in reducing the amount of properties that are directly at risk from surface water flooding. The Planning System has a key role to play in setting standards for sustainable drainage from new developments and ensuring that developments are designed to take account of the risk from surface water flooding. Sustainable drainage plays an important part in reducing flows in the sewer network and in meeting environmental targets, alongside investment in maintenance by the water companies on their assets. Water companies plan their investment on a five year rolling cycle, in consultation with key partners, including the NRW.

FCC LPA and LLFA expect the content for a SuDS Design Statement for a typical housing development should include:

- Description and plan showing the characteristics of the site including – topography, ground conditions, natural directions and paths for water movement
- Options analysis of discharge routes offsite (infiltration, watercourse, surface water sewer) with information on any agreements / confirmed information.
- Options analysis of drainage solutions demonstrating considerations of SuDS principles in development layout. Particularly - keeping water on or near the surface from collection to conveyance to storage, the use of sub-catchments and SuDS in sequence from management at source to larger features in open

36 http://gov.wales/about/cabinet/cabinetstatements/2017/sustainabledrainage/?lang=en
37 https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx

space, integration with landscape. NOTE If no agreement on discharge route has been established alternatives must be explored.

- Outline figures to support drainage options
- Principles of management of return periods both within and external to the drainage system up to 1 in 100 plus climate change
- Proposed management arrangements for all drainage infrastructure including who is responsible, what maintenance activities and how resourced.
- Concept plan and critical sections to demonstrate feasibility of solutions

The most successful SuDS schemes are delivered through a collaboration between the Drainage Engineer and the design team for example, the architect, landscape architect and Highway Engineer.

Overland Flow Paths

Underground drainage systems have a finite capacity and regard should always be given to larger events when the capacity of the network will be exceeded. Hence there is a need to design new developments with exceedance in mind. This should be considered alongside any surface water flows likely to enter a development site from the surrounding area.

Master planning should ensure that existing overland flow paths are retained within the development. As a minimum, the developer should investigate, as part of a FCA, the likely extents, depths and associated hazards of surface water flooding on a development site, as shown by the RoFSW dataset. This is considered to be an appropriate approach to reduce the risk of flooding to new developments. Green infrastructure should be used wherever possible to accommodate such flow paths. Floor levels should always be set a minimum of 300 mm above adjacent roads to reduce the consequences of any localised flooding.

The effectiveness of a flow management scheme within a single site is heavily limited by site constraints including (but not limited to) topography; geology and soil (permeability); development density; existing drainage networks both on-site and in the surrounding area; adoption issues; and available area. The design, construction and ongoing maintenance regime of such a scheme must be carefully defined at an early stage and a clear and comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential.

8 Emergency Planning

The provisions for emergency planning for local authorities as Category 1 responders are set out by the Civil Contingencies Act, 2004. This framework is a resource for all involved in emergency planning and response to flooding from the sea, rivers, surface water, groundwater and reservoirs. The Framework sets out Government's strategic approach to:

- Ensuring all delivery bodies understand their respective roles and responsibilities when planning for and responding to flood related emergencies;
- Giving all players in an emergency flooding situation a common point of reference which includes key information, guidance and key policies;
- Establishing clear thresholds for emergency response arrangements;
- Placing proper emphasis on the multi-agency approach to managing flooding events;
- Providing clarity on the means of improving resilience and minimising the impact of flooding events;
- Providing a basis for individual responders to develop and review their own plans; and
- Being a long-term asset that will provide the basis for continuous improvement in flood emergency management.

Along with the NRW flood warning systems, there are a range of flood plans at a sub-regional and local level, outlining the major risk of flooding and the strategic and tactical response framework for key responders.

This SFCA contains useful data to allow emergency planning processes to be tailored to the needs of the area and be specific to the flood risks faced. The SFCA Maps in Appendix A and accompanying GIS layers should be made available for consultation by emergency planners during an event and throughout the planning process.

8.1 Civil Contingencies Act

Under the Civil Contingencies Act (CCA, 2004)[38], the LLFA and LPAs are classified as Category 1 responders and thus have duties to assess the risk of emergencies occurring, and use this to:

- Inform contingency planning;
- Put in place emergency plans;
- Put in place business continuity management arrangements;

38 https://www.gov.uk/preparation-and-planning-for-emergencies-responsibilities-of-responder-agencies-and-others#the-civil-contingencies-act

- Put in place arrangements to make information available to the public about civil protection matters;
- Maintain arrangements to warn, inform and advise the public in the event of an emergency;
- Share information with other local responders to enhance coordination; and
- Cooperate with other local responders to enhance coordination and efficiency and to provide advice and assistance to businesses and voluntary organisations about business continuity management.

During an emergency, such as a flood event, the local authority must also co-operate with other Category 1 responders (such as the emergency services and the NRW) to provide the core response.

8.1.1 North Wales Local Resilience Forum

The North Wales Local Resilience Forum (LRF) has identified flood risk as a very high risk in the North Wales Community Risk Register. The LRF produce Multi Agency Plans for responding to emergencies within North Wales including flooding.

Within Flintshire the Joint Emergency Planning Unit also produce their own Multi Agency Plans in consultation with the LRF and the Category 1 Responders (Police, Fire, Ambulance, Health, Natural Resources Wales, Coastguard, Local Authorities etc) for specific flood risks in the county. The plans currently in place include the Multi Agency Response Plan for flooding in Flintshire.

The plan covers the River Alyn Catchment and its communities including Rhydymwyn, Mold, Pontblyddyn and Llong, and the Triton Tidal Sites of point of Ayr, Ffynnongroyw, Greenfield to Baglit, and the Hawarden Embankment and North Embankment of the canalised section of the River Dee. The plan also includes the Reservoir Inundation impact for the 5 main reservoirs in Flintshire namely Cilcain 3 and 4, Oakenholt (Flint), Ysceifiog (Caerwys) and Flour Mill (Holywell).

The Joint Emergency Planning Unit (JEPU) for Flintshire and Denbighshire Councils works closely with the North Wales Resilience Forum (NWRF), which was established in March 2005. The membership of the NWRF is made up of the strategic level managers of each of the Category 1 responders (Local Authorities including FCC, Police, Ambulance, Local Health Boards, Fire & Rescue Services and other relevant bodies). Its overall purpose is to ensure that there is an appropriate level of preparedness to enable an effective multi-agency response to emergencies including floods which may have a significant impact on the communities of North Wales.

8.1.2 North Wales Community Risk Register

As a strategic decision-making organisation, the NWLRF prepared a Community Risk Register (CRR), which considers the likelihood and consequences of the most significant risks and hazards the area faces, including fluvial and urban flooding. This SFCA can help to inform this. The CRR is considered as the first step in the emergency planning process and is designed to reassure the local community that measures and plans are in place to respond to the potential hazards listed within the CRR.

http://www.flintshire.gov.uk/en/PDFFiles/Emergency-Planning/68076-NWCRR-A5-Booklet-English.pdf

8.1.3 Community Emergency Plan

Communities may need to rely on their own resources to minimise the impact of an emergency, including a flood, before the emergency services arrive. Many communities already help each other in times of need, but experience shows that those who are prepared cope better during an emergency. Communities with local

knowledge, enthusiasm and information are a great asset and a Community Emergency Plan can help. Details on how to produce a community emergency plan, including a toolkit and template, are available from Government's website[39].

The FLRF has also provided information on how to create a community emergency plan, which is available from:

http://www.flintshire.gov.uk/en/Resident/Emergency-Planning/Emergency-Planning.aspx

FCC provides information on emergency planning for flooding at:

http://www.flintshire.gov.uk/en/Resident/Emergency-Planning/Floods.aspx

This SFCA provides a number of flood risk data sources that should be used when producing or updating flood plans. The LPAs will be unable to write their own specific flood plans for new developments at flood risk. Developers should write their own. Generally, owners with individual properties at risk should write their own individual flood plans, however larger developments or regeneration areas, such as retail parks, hotels and leisure complexes, should consider writing one collective plan for the assets within an area.

This SFCA can help to:

- Update these flood plans if appropriate;
- Inform emergency planners in understanding the possibility, likelihood and spatial distribution of all sources of flooding (emergency planners may however have access to more detailed information, such as for Reservoir Inundation Maps, which have not been made available for this SFCA);
- Identify safe evacuation routes and access routes for emergency services;
- Identify key strategic locations to be protected in flooding emergencies, and the locations of refuge areas which are capable of remaining operational during flood events;
- Provide information on risks in relation to key infrastructure, and any risk management activities, plans or business continuity arrangements;
- Raise awareness and engage local communities;
- Support emergency responders in planning for and delivering a proportionate, scalable and flexible response to the level of risk; and
- Provide flood risk evidence for further studies.

8.2 Flood warning and evacuation plans

Developments that include areas that are designed to flood (e.g. ground floor car parking and amenity areas) or have a residual risk associated with them, will need to provide appropriate flood warning and instructions so users and residents are safe in a flood. This will include both physical warning signs and written flood warning and evacuation plans. Those using the new development should be made aware of any evacuation plans.

Whilst there is no statutory requirement on the NRW or the emergency services to approve evacuation plans, LPAs are accountable under their Civil Contingencies duties, via planning condition or agreement, to ensure that plans are suitable. This should be done in consultation with development management officers. Given the cross cutting

39 https://www.gov.uk/guidance/resilience-in-society-infrastructure-communities-and-businesses#community-resilience

nature of flooding, it is recommended that further discussions are held internally to the LPAs between emergency planners and policy planners / development management officers, the LLFA, drainage engineers and also to external stakeholders such as the emergency services, the NRW, DCWW/Dee Valley Water, Internal Drainage Boards and Canal & River Trust (if applicable).

It may be useful for both the LLFA and spatial planners to consider whether, as a condition of planning approval, flood evacuation plans should be provided by the developer which aim to safely evacuate people out of flood risk areas, using as few emergency service resources as possible. The application of such a condition is likely to require policy support in the LPA's Local Plans, and discussions within the North Wales Local Resilience Forum are essential to establish the feasibility / effectiveness of such an approach, prior to it being progressed. It may also be useful to consider how key parts of agreed flood evacuation plans could be incorporated within local development documents, including in terms of protecting evacuation routes and assembly areas from inappropriate development.

Once the development goes ahead, it will be the requirement of the plan owner (developer) to make sure the plan is put in place, and to liaise with the LPA and LLFA regarding maintenance and updating of the plan.

8.2.1 What should the Plan Include?

Flood warning and evacuation plans should include the information stated in Table 8-1. Advice and guidance on plans is accessible from the NRW website.

Table 8-1: Flood warning and evacuation plans

Consideration	Purpose
Availability of existing flood warning system	The NRW offers a flood warning service that currently covers designated Flood Warning Areas in Wales. In these areas, they are able to provide a full Flood Warning Service.
Rate of onset of flooding	The rate of onset is how quickly the water arrives and the speed at which it rises which, in turn, will govern the opportunity for people to effectively prepare for and respond to a flood. This is an important factor within Emergency Planning in assessing the response time available to the emergency services.
How flood warning is given and occupants awareness of the likely frequency and duration of flood events	Everyone eligible to receive flood warnings should be signed up to the NRW flood warning service. Where applicable, the display of flood warning signs should be considered. In particular sites that will be visited by members of the public on a daily basis such as sports complexes, car parks, retail stores. It is envisaged that the responsibility should fall upon the developers and should be a condition of the planning permission. Information should be provided to new occupants of houses concerning the level of risk and subsequent procedures if a flood occurs.
The availability of staff / occupants / users to respond to a flood warning and the time taken to respond to a flood warning	The plan should identify roles and responsibilities of all responders. The use of community flood wardens should also be considered.
Designing and locating safe	Dry routes will be critical for people to evacuate as well as emergency services entering the site. The extent, depth and

Consideration	Purpose
access routes, preparing evacuation routes and the identification of safe locations for evacuees	flood hazard rating, including allowance for climate change, should be considered when identifying these routes.
Vulnerability of occupants	Vulnerability classifications associated with development as outlined in the TAN15. This is closely linked to its occupiers.
How easily damaged items will be relocated and the expected time taken to re-establish normal use following an event	The impact of flooding can be long lasting well after the event has taken place affecting both the property which has been flooded and the lives that have been disrupted. The resilience of the community to get back to normal will be important including time taken to repair / replace damages.

8.2.2 NRW Flood Warning Areas

NRW monitor river levels within the main rivers affecting the County and based upon weather predictions provided by The Met Office, making an assessment of the anticipated maximum water level that is likely to be reached within the proceeding hours (and/or days). Where these predicted water levels are expected to result in inundation of a populated area, the NRW will issue a series of flood warnings within defined Flood Warning Areas (FWA), encouraging residents to take action to avoid damage to property in the first instance.

More information on flood warning is provided by the NRW via:

https://naturalresources.wales/flooding/flood-codes/?lang=en

There are 15 NRW FWAs in operation across the County. These are located along the River Dee and River Alyn and can be seen on the SFCA Maps in Appendix A.

Live information on flood warnings and flood alerts is available via:

https://naturalresources.wales/flooding/check-flood-warnings/?lang=en

8.3 Flood awareness

Emergency planners may also use the outputs from this SFCA to raise awareness within local communities. This should include raising awareness of flood risks, roles and responsibilities and measures that people can take to make their homes and businesses more resilient to flooding from all sources whilst also encouraging all those at fluvial flood risk to sign up to the NRW's Floodline[40] service.

It is also recommended that Category 1 responders are provided with appropriate flood response training to help prepare them for the possibility of a major flood with an increased number of people living within flood risk areas, to ensure that adequate pre-planning, response and recovery arrangements are in place.

40 https://naturalresources.wales/flooding/sign-up-to-receive-flood-warnings/?lang=en

9 Conclusions and Recommendations

9.1 Conclusions

This SFCA provides a single repository planning tool relating to flood risk and development in Flintshire. Key flood risk stakeholders, namely NRW, WW and FCC LLFA were consulted to collate all available and relevant flood risk information on all sources into one comprehensive assessment. Together with this report, this SFCA also provides a suite of interactive GeoPDF flood risk maps (Appendix A) and a Development Site Assessment spreadsheet (Appendix B).

The flood risk information, assessment, guidance and recommendations of the SFCA will provide strategic planners with the evidence base required to develop a spatial strategy for the new LDP and apply the justification and acceptability tests of TAN 15 to help assess what type and scale of development should be located, where and demonstrate a risk based approach has been applied.

This SFCA should provide the necessary links between spatial development, wider flood risk management policies, local strategies / plans and on the ground works by combining all available flood risk information together into one single repository for both the LPA and LLFA. This is a strategic study, based on all detailed local information available at the time. Not all flood risks and combinations of risks are accounted for, and there could be a further more detailed assessment of specific areas or sites, where required.

9.2 Recommendations for further work

The SFCA can be developed into a useful planning tool and evidence base to inform decision making for the LDP. Sitting alongside the LFRMS, PFRA, CFMPs and SMP2, it can be used to provide a much broad assessment tool for integrated, strategic and local flood risk management and delivery.

There are a number of plans and assessments listed in

Table 9-1 that would be of benefit to FCC in developing its flood risk evidence base to support the delivery of the Local Plan or to help fill critical gaps in flood risk information.

Table 9-1: Recommended further work for FCC

Type	Study	Reason	Timeframe
Understanding of local flood risk	SWMP / drainage strategy	FCC has not developed a SWMP for Flintshire, nor for any areas or communities within Flintshire. It is recommended that the LLFA uses information from this SFCA to ascertain whether certain locations at high surface water flood risk may benefit from a SWMP such as Mold, Mancot, Flint and Shotton.	Short to Medium term
	Coastal Defences	One of the coastal defences at Walwen and Whelston; a number of defences along the Dee estuary; and several of the River Alyn defences are recorded to be in poor condition and should therefore be further investigated with a few to carrying out remedial works or asset replacement.	Short to Medium term

Type	Study	Reason	Timeframe
Data Collection	Flood Incident Data	FCC has a duty to investigate and record details of significant flood events within their area. General data collected for each incident, should include date, location, weather, flood source (if apparent without an investigation), impacts (properties flooded or number of people affected) and response by any RMA.	Short Term
	Asset Register	FCC should formulate, update and maintain a register of structures and features, which are considered to have an effect on flood risk. The requirement for this is noted in the LFRMS	Short term / ongoing
Risk Assessment	Asset Register Risk Assessment	FCC should carry out a strategic flood risk assessment of structures and features on the Asset Register to inform capital programme and prioritise maintenance programme.	Short term / ongoing
Designating Authorities	Designation of Assets	FCC have permissive powers to designate assets which are considered to affect flood risk and are not owned by the LLFA or NRW	Short term / ongoing
Capacity	SuDS review / guidance	Under the FWMA, FCC as an LLFA is required to establish a SAB. FCC should identify internal capacity required to deal with SuDS applications, set local specification and set policy for adoption and maintenance of SuDS.	Short term-Long term
Partnership	Welsh Water, Dee Valley Water	FCC should continue to work with the water companies on sewer and surface water projects.	Ongoing
	Natural Resources Wales	FCC should continue to work with NRW on fluvial and tidal flood risk management projects. FCC should also identify potential opportunities for joint schemes to tackle flooding from all sources.	Ongoing

Type	Study	Reason	Timeframe
	Joint Emergency Planning Unit	FCC should continue to work with the members of the NWRF to ensure appropriate preparedness to enable multi-agency response to flooding.	Ongoing

Appendices

A Detailed interactive GeoPDF maps

Interactive GeoPDF Maps

Open the Overview Map in Adobe Acrobat (2017s5471_Flintshire_SFCA_Index.pdf). The Index Map contains a set of index squares covering the authority area at a scale of 1:10,000. Clicking on one of these index squares will open up a more detailed map of that area (scale = 1:10,000) by way of a hyperlink.

Within the detailed maps, use the zoom tools and the hand tool to zoom in/out and pan around the open detailed map. In the legend on the right-hand side of the detailed maps, layers can be switched on and off when required by way of a dropdown arrow. The potential development site reference labels can also be switched on and off if, for example, smaller sites are obscured by the labels.

B Development Site Assessment Spreadsheet

Excel spreadsheet containing an assessment of flood risk to the potential development sites based on fluvial Flood Zones 2 and 3 and the DAM B, C1 and C2 and the Risk of Flooding from Surface Water (RoFSW).

C Site Assessment Spreadsheet for breach locations

Excel spreadsheet containing an assessment of Breach and overtopping risk to the potential development at sites. The Breach and overtopping modelling scenarios were targeted at six locations. The breach modelling assessed the 1 in 200 AEP and the 1 in 1000 AEP events. Both events were also modelled taking account of climate change.

D Flintshire Breaches Method Statement

A breach overview document providing a brief explanation about how and where the breach analysis was carried out for each of the six breach locations.

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