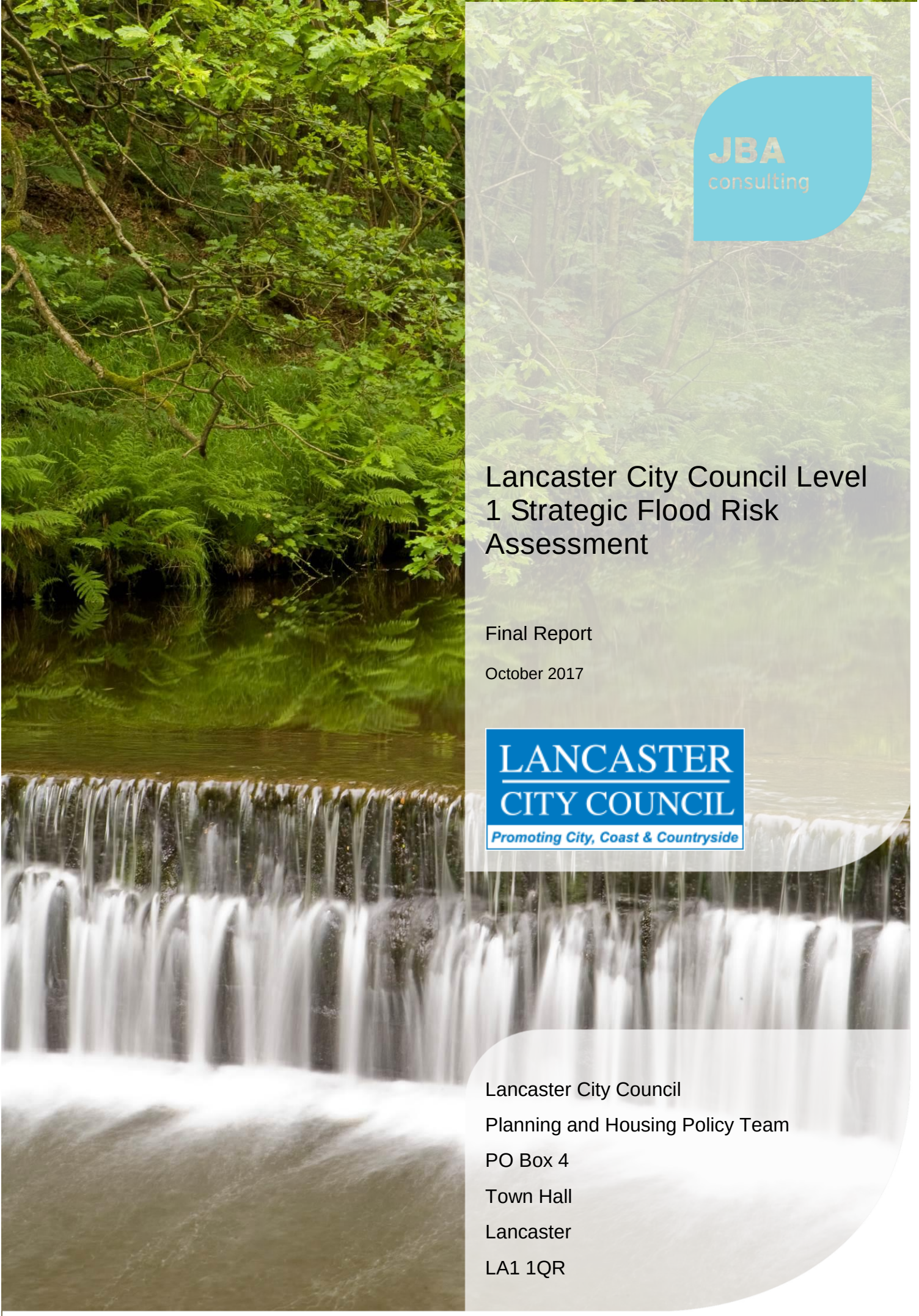

Lancaster City Council Level 1 Strategic Flood Risk Assessment

Final Report

October 2017

Lancaster City Council

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Contract

This report describes work commissioned by Maurice Brophy, on behalf of Lancaster City Council, by a letter dated 21 December 2016. Lancaster City Council's representative for the contract was Maurice Brophy. Mike Williamson, Tasmin Fletcher, Howard Keeble and Charlotte Lloyd-Randall of JBA Consulting carried out this work.

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Purpose

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Executive Summary

This Level 1 Strategic Flood Risk Assessment (SFRA) updates the previous Level 1 assessment published in 2007 using up-to-date flood risk information together with the most current flood risk and planning policy available from the National Planning Policy Framework[1] (NPPF) and Flood Risk and Coastal Change Planning Practice Guidance[2] (FRCC-PPG). Lancaster City Council (LCiC) requires this update to initiate the sequential risk-based approach to the allocation of land for development and to identify whether application of the Exception Test is likely to be necessary. This will help to inform and to provide the evidence base for the Lancaster City Local Plan.

Lancaster City Council provided their latest potential sites data and information. An assessment of flood risk to all sites is provided to assist LCiC in their decision making process for sites to take forward as part of their Local Plan.

The aims and objectives of this SFRA update are:

- To form part of the evidence base and inform the Sustainability Appraisal (Incorporating the Strategic Environmental Assessment) for the council's Local Plan.
- To reflect current national policy documentation including the NPPF and its accompanying Flood Risk and Coastal Change Planning Practice Guidance to enable LCiC to meet its obligations as defined by the NPPF.
- To supplement current policy guidelines and to provide a straightforward risk based approach to development management in the area.
- To make recommendations on the suitability of potential development sites based on flood risk for LCiC's Local Plan.
- To understand current flood risk from all sources and any historic and future flood risk information to enable investigation and identification of the extent and severity of flood risk throughout the city. This assessment will enable LCiC to steer development away from those areas where flood risk is considered greatest, ensuring that areas allocated for development can be developed in a safe, cost effective and sustainable manner.
- To consider a precautionary approach to climate change.
- To provide guidance for developers and planning officers on planning requirements.
- To pay particular attention to surface water flood risk, using the Environment Agency's (EA's) third generation Risk of Flooding from Surface Water (RoFSW).
- To provide a reference document (this report) to which all parties involved in development planning and flood risk can reliably turn to for initial advice and guidance.
- To develop a report that forms the basis of an informed development management process that also provides guidance on the potential risk of flooding associated with future planning applications and the basis for site-specific Flood Risk Assessments (FRAs) where necessary.
- To provide a suite of interactive GeoPDF flood risk maps illustrating the interaction between flood risk and potential development sites.
- To identify land required for current and future flood management that should be safeguarded as set out in the NPPF.

1 http://planningguidance.planningportal.gov.uk/blog/policy/

2 http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

A number of potential development sites are shown to be at varying risk from fluvial, tidal, surface water flooding and residual risk. Table 1-1 summarises the number of sites at risk from each flood zone as per the Environment Agency's Flood Map for Planning.

Table 1-1: Number of Potential Development Sites at Risk from Flood Map for Planning Flood Zones

Potential Development Site	Number of sites within…			
	Flood Zone 1*	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Residential	283	28	61	29
LP Strategic Housing Allocation	3	1	2	1
Mixed Use	0	0	0	1
Employment	16	2	16	4
Total	**302**	**31**	**79**	**35**
*Sites with 100% area within Flood Zone 1				

Out of the 447 sites provided for assessment by LCiC, 35 are within or partially within the functional floodplain (Flood Zone 3b), delineated from this SFRA. Out of these 35 sites, 7 are recommended for withdrawal where the level of risk is considered too great for development to proceed. There are a further 5 sites that are recommended for withdrawal based on significant surface water flood risk and that are at a high level of risk for development within flood zone 3A.

Recommendations, in Section 0 of this report, are made for each site at risk, broadly entailing the following:

- Consider withdrawing the site based on level of flood risk (strategic recommendation A);
- Exception Test required if site passes Sequential Test (strategic recommendation B);
- Consider site layout and design if site passes Sequential Test (strategic recommendation C);
- Site-specific FRA required (strategic recommendation D); and
- Site permitted on flood risk grounds due to no perceived risk, subject to consultation with the LPA / LLFA (strategic recommendation E).

Table 1-2 lists the number of sites each strategic recommendation is applied to.

Table 1-2: Number of potential development sites per strategic recommendation

Site/Proposed use	Strategic Recommendation				
	A	B	C	D	E
Residential	40	0	52	233	73
LP Strategic Housing Allocation	0	0	3	4	0
Employment	7	0	14	17	1
Mixed use	1	0	2	0	0
Total	**48**	**0**	**71**	**254**	**74**

In summary, there are 48 sites that are recommended for withdrawal (strategic recommendation A) and there are no sites that are needed to carry out and pass the Exception Test for development to proceed (strategic recommendation B). 74 sites are likely to be permitted for development on flood risk grounds (strategic recommendation E).

Included along with this report as part of the SFRA are:

- Detailed interactive GeoPDF maps showing all available flood risk information together with the potential development sites - Appendix A;

- Development Site Assessment spreadsheet detailing the risk to each site with recommendations on development - Appendix B;
- A note on the delineation of the functional floodplain following discussion and agreement between LCiC and the EA - Appendix C; and

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Abbreviations

ABD..... Areas Benefitting from Defences
ACD ..... Area of Critical Drainage
AEP..... Annual Exceedance Probability
AIMS ..... Asset Information Management System
AStGWF..... Areas Susceptible to Groundwater Flooding
CC..... Climate change
CCA ..... Civil Contingencies Act
CDA ..... Critical Drainage Area
CFMP..... Catchment Flood Management Plan
CIL ..... Community Infrastructure Levy
CSO ..... Combined Sewer Overflow
DCLG ..... Department for Communities and Local Government
DPD ..... Development Plan Documents
DTM ..... Digital Terrain Model
EA ..... Environment Agency
FAA ..... Flood Alert Area
FCA..... Flood Consequence Assessment
FCDPAG ..... Flood and Coastal Defence Project Appraisal Guidance
FCERM ..... Flood and Coastal Erosion Risk Management Network
FDGiA ..... Flood Defence Grant in Aid
FEH..... Flood Estimation Handbook
FRA..... Flood Risk Assessment
FRCC-PPG ..... Flood Risk and Coastal Change Planning Practice Guidance
FRM ..... Flood Risk Management
FRMP..... Flood Risk Management Plan
FRMS..... Flood Risk Management Strategy
FRR..... Flood Risk Regulations
FSA ..... Flood Storage Area
FWA ..... Flood Warning Area
FWMA..... Flood and Water Management Act
GI ..... Green Infrastructure
GIS..... Geographical Information Systems
HFM ..... Historic Flood Map
IDB ..... Internal Drainage Board
LA..... Local Authority
LCiC ..... Lancaster City Council
LCoC……..Lancaster County Council
LDF ..... Local Development Framework
LFRMS..... Local Flood Risk Management Strategy

LLFA ..... Lead Local Flood Authority
LPA ..... Local Planning Authority
LRF ..... Lancashire Resilience Forum
MAFP ..... Multi-Agency Flooding Plan
NGO ..... Non-Governmental Organisation
NPPF ..... National Planning Policy Framework
PCPA ..... Planning and Compulsory Purchase Act
PFRA ..... Preliminary Flood Risk Assessment
PPG17 ..... Planning Policy Guidance Note 17
RBD ..... River Basin District
RBMP..... River Basin Management Plan
RMA ..... Risk Management Authority
RoFRS ..... Risk of Flooding from Rivers and the Sea Map
RoFSW……Risk of Flooding from Surface Water
RSS..... Regional Spatial Strategy
SA ..... Sustainability Appraisal
SEA..... Strategic Environmental Assessment
SFRA ..... Strategic Flood Risk Assessment
SHLAA ..... Strategic Housing Land Availability Assessment
SMP ..... Shoreline Management Plan
SoP ..... Standard of Protection
SPD..... Supplementary Planning Documents
SuDS..... Sustainable Drainage Systems
SWMP..... Surface Water Management Plan
UDP ..... Unitary Development Plan
uFMfSW ..... updated Flood Map for Surface Water
UKCIP02 ..... UK Climate Projections 2002
UKCP09 ..... UK Climate Projections 2009
UU ..... United Utilities
WFD..... Water Framework Directive

1 Introduction

Lancaster City Council (LCiC, 'the Council') is part of a two-tiered local government system with LCoC acting as the Local Planning Authority (LPA) and Lancashire County Council the Lead Local Flood Authority (LLFA). As LPA, the Council requires a Strategic Flood Risk Assessment (SFRA) to develop the evidence base for the emerging Lancaster Local Plan and accompanying Sustainability Appraisal. The County Council, as LLFA, is responsible for managing flood risk from ordinary watercourses, surface water and groundwater whilst also being a statutory consultee on all major planning applications submitted to the LPA.

1.1 Commission

LCiC commissioned JBA Consulting by letter dated 21 December 2016 to undertake an update of the existing Level 1 Strategic Flood Risk Assessment completed in September 2007. At the time of writing, LCiC is in the process of preparing its new Local Plan which will take forward a new spatial strategy for the District and will include the allocation of sites and detailed policies to guide development. As such, the Local Plan will play a direct role in delivering the City's regeneration and growth objectives which will be informed by this Level 1 SFRA update. The new Local Plan will consist of five Development Plan Documents (DPDs), supported by a series of Supplementary Planning Documents (SPDs).

This update has been carried out in accordance with the Government's latest development planning guidance including the National Planning Policy Framework[3] (NPPF) and flood risk and planning guidance called the Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG). The latest guidance is available online via:

http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change

This updated SFRA makes use of the most up-to-date flood risk datasets to assess the extent of risk, at a strategic level, to potential development allocation sites identified by LCiC. Included within the SFRA are this report together with appendices containing SFRA maps showing the potential sites overlaid with the latest, readily available, gathered flood risk information and a Development Site Assessment spreadsheet indicating the level of flood risk to each site following a strategic assessment of risk. This information will allow LCiC to identify the strategic development options that may be applicable to each site and to inform on the need for the application of the Sequential Test.

1.2 Scope and Objectives:

The objectives of this Level 1 SFRA update are:

- To understand flood risk from all sources and to investigate and identify the extent and severity of flood risk throughout the City. This assessment will enable LCiC to steer development away from those areas where flood risk is considered greatest, ensuring that areas allocated for development can be developed in a safe, cost effective and sustainable manner.
- To form part of the evidence base and inform the Sustainability Appraisal (Incorporating the Strategic Environmental Assessment) for the council's new Local Plan.
- To make recommendations on the suitability of potential development sites based on flood risk for LCiC's Local Plan.
- To provide guidance for developers and planning officers dealing with applications as well as for the LLFA to fulfil its role including consultation on planning applications for the approval of Sustainable Drainage Systems (SuDS) schemes.
- To pay particular attention to surface water flood risk, using the EA's third generation Risk of Flooding from Surface Water (RoFSW).
- To enable LCiC to meet its obligations under the NPPF.

3 http://planningguidance.communities.gov.uk/blog/policy/

- To supplement current policy guidelines and to provide a straightforward risk based approach to development management in the City.
- To provide a reference document (this report) to which all parties involved in development planning and flood risk can reliably turn to for initial advice and guidance.
- To develop a report that forms the basis of an informed development management process that also provides guidance on the potential risk of flooding associated with future planning applications and the basis for site-specific Flood Risk Assessments (FRAs) where necessary.
- To identify land required for current and future flood management that should be safeguarded as set out in the NPPF.
- To advise on the site-specific applicability of SuDS for managing surface water runoff.
- To assist LCiC in identifying specific locations where further and more detailed flood risk data and assessment work may be required as part of a Level 2 SFRA or sequential test, prior to the allocation of specific developments.

This report begins by outlining the connections between the planning framework and flood risk policy thus discussing legislation, planning policy, flood risk management policy and the roles and responsibilities of key stakeholders. All available sources of flood risk within the local authority area are then examined before an assessment of flood risk to the potential development sites. Conclusions and recommendations are cited at the end of the report.

1.3 SFRA Future Proofing

As discussed, this SFRA has been developed using the most up-to-date data and information available at the time of submission. The SFRA has been future proofed as far as possible though the reader should always confirm with the source organisation (LCiC) that the latest information is being used when decisions concerning development and flood risk are being made. The Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG), alongside the NPPF, is referred to throughout this SFRA, being the current primary development and flood risk guidance information available at the time of the finalisation of this SFRA.

The EA would usually recommend updating an SFRA every three to four years, unless there is a significant flood affecting the area, in which case an immediate review should be undertaken.

This SFRA uses the EA's Flood Map for Planning version issued in November 2016 to assess fluvial and tidal risk to potential development sites. The Flood Map for Planning is updated at quarterly intervals by the EA, as and when new modelling data becomes available. The reader should therefore refer to the online version of the Flood Map for Planning to check whether the flood zones may have been updated since November 2016.

http://apps.environment-agency.gov.uk/wiyby/37837.aspx

1.4 Flood Risk Vulnerability Classification

In order to determine the suitability of land for development in flood risk areas, the development vulnerability must first be established. The Flood Risk Vulnerability Classifications are illustrated in table 1-3.

Table 1-3: Flood Risk Vulnerability Classification[4]

Classification	Explanation
Essential infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water

4 https://www.gov.uk/guidance/flood-risk-and-coastal-change

	treatment works that need to remain operational in times of flood. • Wind turbines.
Highly vulnerable	• Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More vulnerable	• Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill* and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less vulnerable	• Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill* and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.
Water-compatible development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities.

	• Ministry of Defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Table 1-4: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classifications		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test required	✓	✓
	3A	Exception Test required	✓	×	Exception Test required	✓
	3B	Exception Test required	✓	×	Exception Test required	×

✓ Development is appropriate × Development should not be permitted

1.5 Flood Zone Definitions

These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. They are shown on the Environment Agency's Flood Map for Planning (Rivers and Sea), available on the Environment Agency's web site.

Table 1-5: Flood Zone 1 Definition

Flood Zone 1: Low Probability	
Definition	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river and sea flooding in any year (<0.1%).
Appropriate uses	All uses of land are appropriate in this zone.
FRA requirements	For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in an FRA [Flood Risk Assessment]. This need only be brief unless the factors above or other local considerations require particular attention.
Policy aims	In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development and the appropriate application of sustainable drainage techniques.

Table 1-6: Flood Zone 2 Definition

Flood Zone 2: Medium Probability	
Definition	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) and between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.
Appropriate uses	The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure listed in… [The Flood Risk Vulnerability Classification] are appropriate in this zone. Subject to the Sequential Test being applied, the highly vulnerable uses are only appropriate in this zone if the Exception Test is passed.
FRA requirements	All development proposals in this zone should be accompanied by a FRA.
Policy aims	In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques.

Table 1-7: Flood Zone 3A Definition

Flood Zone 3A: High Probability	
Definition	This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) and a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Appropriate uses	The water-compatible and less vulnerable uses of land are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential Infrastructure permitted in this zone should be designed and constructed to remain operational and safe for user in times of flood.
FRA requirements	All development proposals in this zone should be accompanied by a FRA,
Policy aims	In this zone, developers and local authorities should seek opportunities to: reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques; relocate existing development to land in lower Flood Zones; and Create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocation and safeguarding open space for flood storage.

Table 1-8: Flood Zone 3B Definition

Flood Zone 3B: Functional Floodplain	
Definition	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).
Appropriate uses	Only the water-compatible uses and the essential infrastructure that has to be there should be permitted in this zone. It should be designate and constructed to: • Remain operational and safe for users in times of flood; • Result in no net loss of floodplain storage; • Not impede water flows; and • Not increase flood risk elsewhere. Essential infrastructure in this zone should pass the Exception test.
FRA requirements	All development proposed in this zone should be accompanied by a FRA.
Policy aims	In this zone, developers and local authorities should seek opportunities to: Reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques; and Relocate existing development to land with a lower probability of flooding.

2 Study Area

According to the 2011 census population estimates[5], 138,375 people live in the Lancaster District. The District covers approximately 57,620 hectares of land and its main settlements are Lancaster, Morecambe, Heysham and Carnforth, as well as many outlying villages and rural hinterland. A section of the Yorkshire Dales National Park lies within the District, as well as parts of the Arnside and Silverdale Area of Outstanding Natural Beauty (AONB) and Forest of Bowland AONB.

Historically, the manufacturing and textiles industry has been important in the District, however employment in this sector fell throughout the 20th century and is now below the national average, with a greater proportion of people now employed in the service sector. Tourism is a significant source of employment, for example in the resort towns of Morecambe and Heysham and historic Lancaster, and the expanding universities in Lancaster are a significant economic asset. The proportion of people employed in agriculture is higher than the national average due to the rural nature of much of the District.

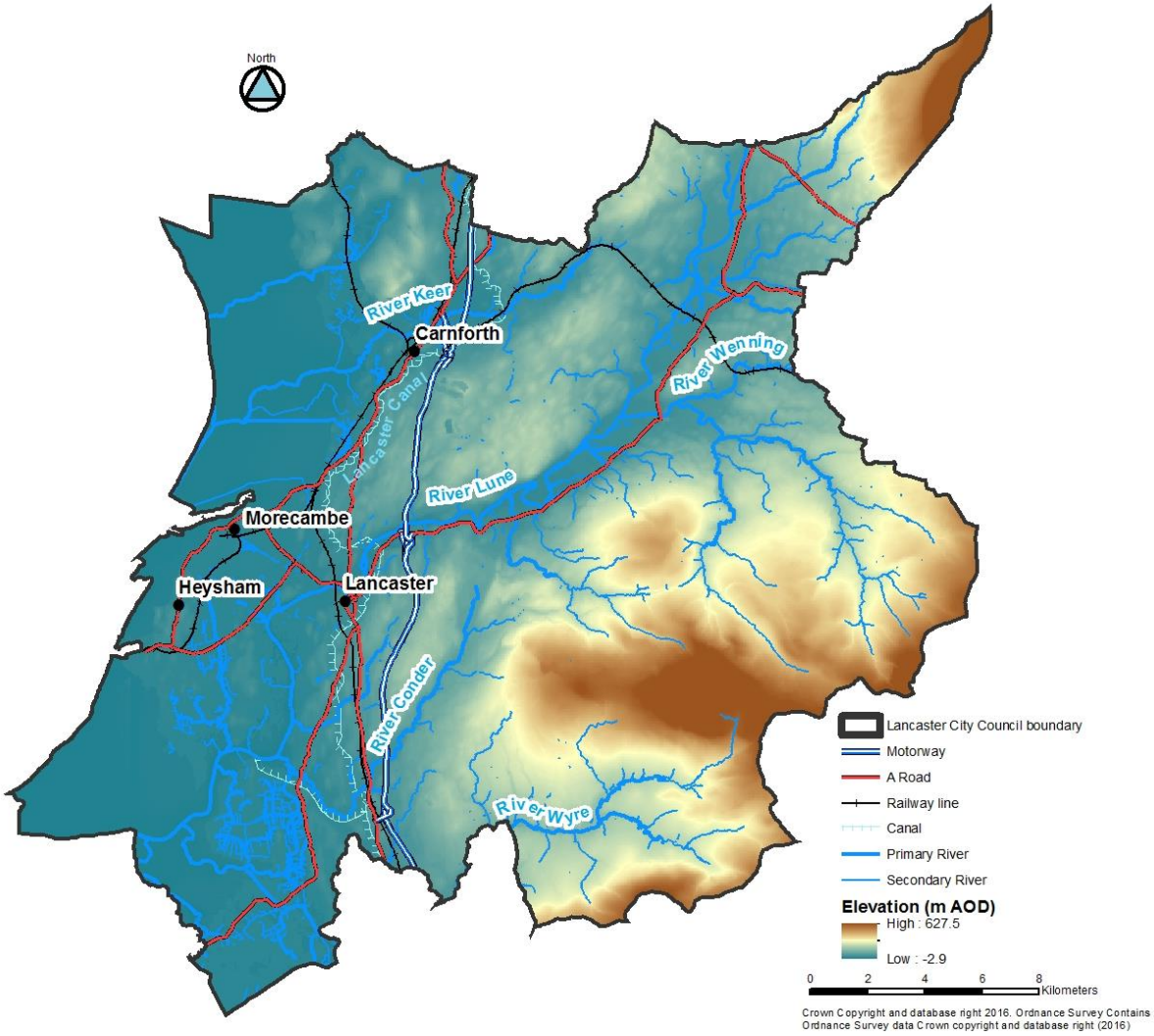
As illustrated by Figure 2-1 the most significant Main Rivers in the District are the River Lune, the River Conder and the River Keer, which all drain south-westwards into the Irish Sea at Morecambe Bay, and the River Wenning, a tributary of the Lune. The Lune is tidally influenced as far as Skerton Weir in Lancaster. Canals in the District include the Lancaster Canal, which runs roughly north-south through the District from Tewitfield to Bay Horse, and the Glasson Branch which extends westwards from Galgate to Glasson Dock. There are numerous ordinary watercourses in the District; ordinary watercourses are any watercourses that are not a designated 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.

The topography of the area is characterised by higher ground of the Forest of Bowland and Yorskhire Dales to the east, and lower-lying floodplain to the west. The coastal boundary of the District to the west means that there is also a risk of tidal flooding in several communities.

The bedrock of the District is predominantly Millstone Grit (siltstone, sandstone and mudstone), with areas of limestone to the north. This is overlain by superficial deposits of glacial till and alluvium, with areas of peat in upland parts of the Forest of Bowland.

5 http://www.ons.gov.uk/ons/guide-method/census/2011/index.html

Figure 2-1: SFRA study area



2.1.1 River Lune Catchment

In the Lune catchment, the main source of flooding is tidal, approximately 2,200 properties are potentially at tidal flood risk from a 0.5% annual probability event (APE), although most of these properties benefit from flood defences. There are approximately 500 properties at risk of flooding from rivers (fluvial flooding). By 2100, we estimate there will be 700 properties at risk of fluvial flooding due to the effects of climate change6.

2.1.2 River Wyre Catchment

The Wyre is steep and rural in its upper catchment with rapid runoff. The Lower Wyre is at a low elevation, urbanised and sometimes at or below sea level. Approximately 7,600 residential and commercial properties are at a 1% annual risk of fluvial flooding (from rivers) within the catchment; 90% of which are concentrated in the towns of Fleetwood, Cleveleys, Poulton-le

6 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293698/Lune_Catchment_Flood_Management_Plan.pdf

Fylde and Thornton. In the future, it is estimated that over 9000 properties will be at risk from a 1% fluvial event after taking into account climate change7.

2.1.3 River Wenning sub-catchment

The River Wenning is a rural tributary of the Lune draining from the western slopes of the Yorkshire Dales. There are a few small villages in the catchment where properties are at flood risk: Hornby, High Bentham, Clapham and Wennington. The nature of flood risk is particularly hazardous due to the fast responding and flowing rivers. There is a total of 140 properties at risk in the sub-area from a 1% APE. Of these, 80 are protected by raised defences in Hornby. Critical infrastructure at risk includes three sewage works near High Bentham, Low Bentham and Hornby. The average depth of flooding to properties is typically less than a metre but is expected to increase by 0.5m by 2100 and the total number of properties at risk increase to 2208.

7 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293706/Wyre_Catchment_Flood_Management_Plan.pdf

8 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293698/Lune_Catchment_Flood_Management_Plan.pdf

3 Understanding Flood Risk

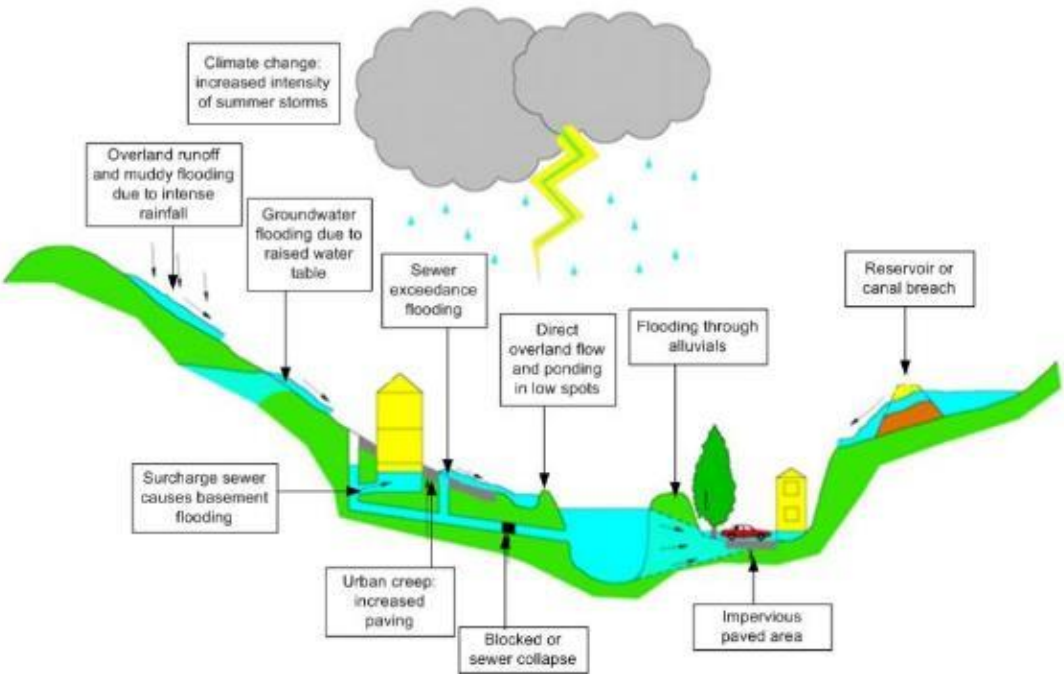
3.1 Sources of Flooding

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 3-1) include:

- **Fluvial** (rivers) - 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.

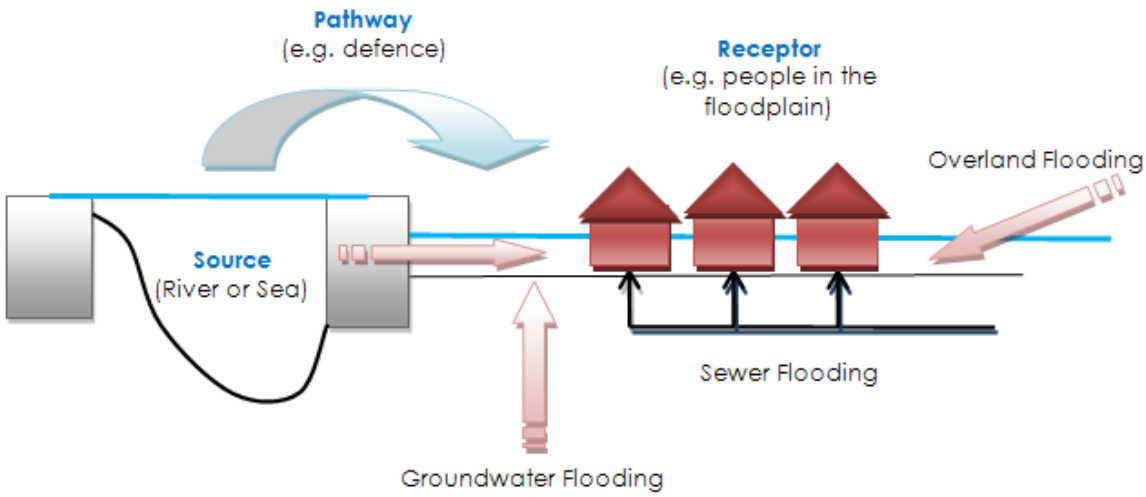
Figure 3-1: Flooding from all sources



3.2 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 3-2 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 3-2: 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.

3.2.1 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. Table 3-1 provides an example of the flood probabilities used to describe Flood Zones as defined in the FRCC-PPG and as used by the EA in their Flood Map for Planning (Rivers and Sea)[9].

Note that the Flood Zones shown on the Flood Map for Planning (Rivers and Sea) do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding.

9 http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=floodmap

Table 3-1: NPPF Flood Zones10

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	**This zone comprises land where water has to flow or be stored in times of flood.** Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

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

3.2.2 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

3.3 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.

3.3.1 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

10 Table 1, Paragraph 065 of the Flood Risk and Coastal Change Planning Practice Guidance

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

3.3.2 Residual Risk

Defended sites, located behind EA flood defences 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 taken into account.

Paragraph 041 of the FRCC-PPG defines residual risk as:

"…those remaining after applying the sequential approach to the location of development and taking mitigating actions. 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".

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".

Developers must be able to demonstrate that development will be safe to satisfy the second part of the Exception Test (see Section 6.7.1). To that end, Paragraph 042 of the FRCC-PPG states:

"Where residual risk is relatively uniform, such as within a large area protected by embanked flood defences, the Strategic Flood Risk Assessment should indicate the nature and severity of the risk remaining, and provide guidance for residual risk issues to be covered in site-specific flood risk assessments. Where necessary, local planning authorities should use information on identified residual risk to state in Local Plan policies their preferred mitigation strategy in relation to urban form, risk management and where flood mitigation measures are likely to have wider sustainable design implications".

4 The Planning Framework and Flood Risk Policy

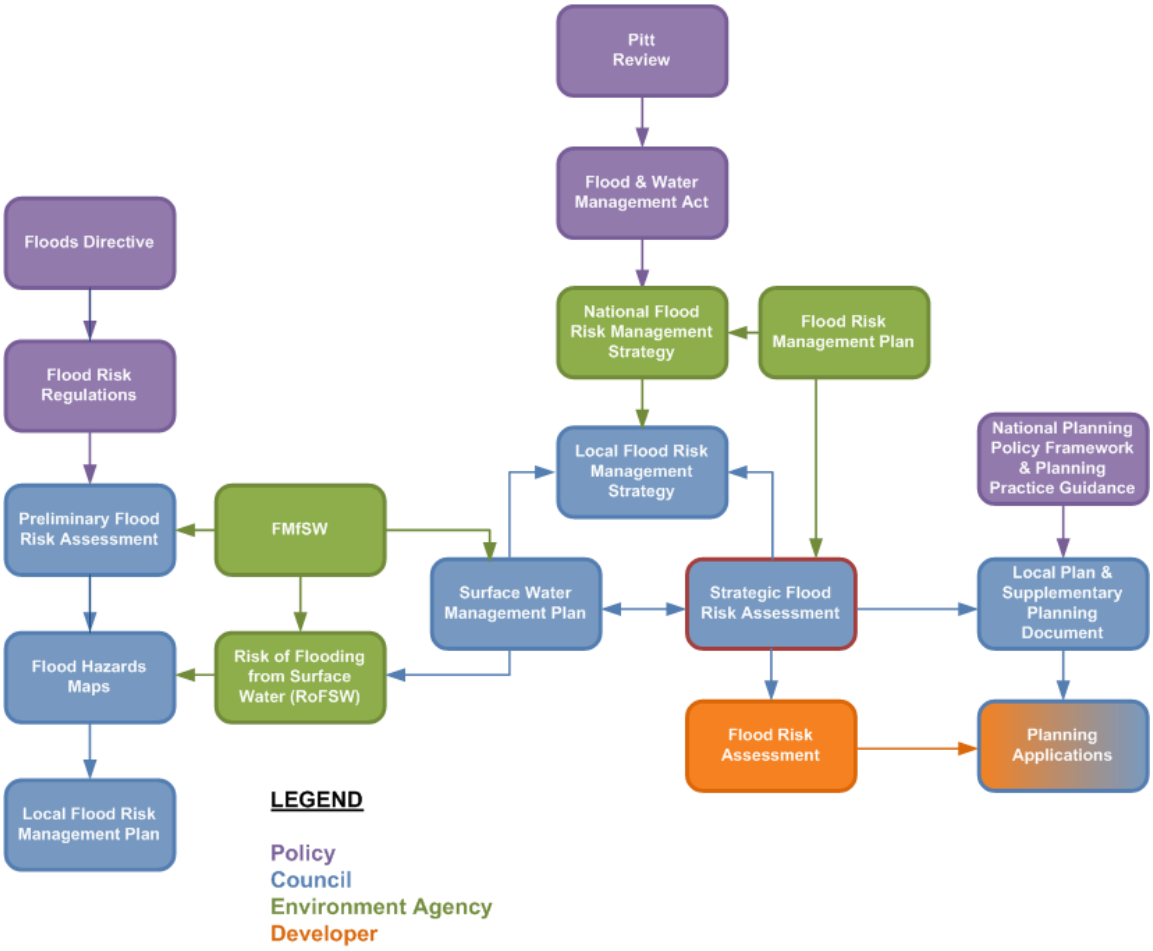
4.1 Introduction

The main purpose of this section of the SFRA 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 LCiC's responsibilities and duty 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 4-1 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 SFRAs can provide much of the base data required to support the delivery of the council'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 Local Plans, which in turn help deliver flood risk management infrastructure and sustainable new development at a local level. This SFRA should be used to support LCiC's Local Plan and to help inform planning decisions.

Figure 4-1: Key documents and strategic planning links with flood risk



4.2 Legislation

4.2.1 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 law by the Flood Risk Regulations (FRR) 2009 which require Lead Local Flood Authorities (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, prepare flood hazard and risk maps and prepare 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 4-2: EU Floods Directive

PFRAs should cover the entire area for local flood risk (focusing on ordinary watercourses, surface water and groundwater flooding). Where significant Flood Risk Areas are identified using a 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 4-2.

The FRMP would need to consider objectives for flood risk management (reducing the likelihood and consequences of flooding) and measures to achieve those objectives.

The EA 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.

4.2.1.1 Lancashire Area Preliminary Flood Risk Assessment 2011

The first cycle PFRA for the Lancashire Area was submitted to the EA in June 2011 and helped to determine whether there was a significant risk across the three LLFAs of Lancashire County Council, Blackpool Council and Blackburn with Darwen Borough Council, based on local flooding (surface water, groundwater and ordinary watercourses) and, if so, to identify the parts of the Area affected by these risks. As explained previously, the PFRA process is cyclical and will need to be carried out again by 2017.

For the purposes of the PFRA, areas of significant flood risk as identified as affecting at least 30,000 people or 150 critical services. The PFRA investigated 25 past flood events, but found that there was insufficient evidence to identify any that could be considered to have had 'significant harmful consequences'. The analysis of surface water, using the EA's Areas Susceptible to Surface Water Flooding (AStSWF), revealed that up to 9300 properties could be at risk. However, this did not exceed the threshold of 30,000 required for it to be identified as Flood Risk Areas. The City Council was therefore not required to produce flood hazard maps, flood risk maps and flood risk management plans for that area. The PFRA still recognised the need to produce a Local Flood Risk Management Strategy (LFRMS) for the area however, as part of the councils' obligations as LLFAs under the Flood and Water Management Act (2010).

4.2.2 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 the EA.

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

4.2.3 Water Framework Directive & Water Environment Regulations

The purpose of the Water Framework Directive (WFD), which was transposed into English Law by the Water Environment Regulations (2003), is to deliver improvements across Europe in the management of water quality and water resources through a series of plans called River Basin Management Plans (RBMP). The LCiC area is covered by the North West River Basin Management Plan, managed by the EA and published in 2015. Water quality and flood risk can go hand in hand in that flood risk management activities can help to deliver habitat restoration techniques. The North West RBMP, 2015, includes examples such as the Living Waterways project, whereby failing urban waterbodies have been targeted to reduce flood risk whilst also improving water quality, restoring habitats and reducing diffuse pollution.

The EA is responsible for monitoring and reporting on the objectives of the WFD on behalf of Government. They work with Government, 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[11].

The second management cycle of the WFD[12] has already begun and the second river basin management plans were completed in 2015, building upon the first set of RBMPs completed in 2009.

The main responsibility for LCoC is to work with the EA to develop links between river basin management planning and the development of Local Authority plans, policies and assessments. In particular, the programme of actions (measures) within the RBMP highlights the need for:

- Water Cycle Studies to promote water efficiency in new development through regional strategies and local development frameworks,
- Surface Water Management Plan implementation,
- Considering the WFD objectives (achieving good status or potential as appropriate) in the spatial planning process, including LDDs and Sustainable Community Strategies, and
- Promoting the wide scale use of SuDS in new development.

4.3 Planning Policy

4.3.1 National Planning Policy Framework

The NPPF was published in March 2012, and is based on core principles of sustainability. It forms the national policy framework in England and is accompanied by a number of Planning Practice Guidance notes. It must be taken into account in the preparation of Local Plans and is a material consideration in planning decisions. Section 10 Paragraph 100 of the NPPF states that Local Plans…

"...should be supported by a Strategic Flood Risk Assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as Lead Local Flood Authorities and Internal Drainage Boards. Local Plans should apply a sequential, risk-based approach to the location of development to avoid, where possible, flood risk to people and property and manage any residual risk, taking account of the impacts of climate change, by applying the Sequential Test, if necessary applying the Exception Test, safeguarding land from development that is required for

11 https://www.gov.uk/government/policies/improving-water-quality/supporting-pages/planning-for-better-water

12 http://ec.europa.eu/environment/water/water-framework/info/timetable_en.htm

current and future flood management, using opportunities offered by new development to reduce the causes and impacts of flooding and where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long term, seeking opportunities to facilitate the relocation of development including housing to more sustainable locations".

The Sequential Test must be performed when considering the placement of future development and for planning application proposals. The Sequential Test is used to direct all new development to locations at the lowest probability of flooding. It states that development should not be permitted or allocated if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding.

The Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG) sits alongside the NPPF and sets out detailed guidance on how this policy should be implemented.

4.3.2 Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG)

On 6 March 2014 the Department for Communities and Local Government (DCLG) launched their planning practice guidance, including guidance for flood risk and coastal change, which replaces the previous Technical Guidance. This new guidance is available as a web-based resource[13], which is accessible to all and is regularly updated. Whilst the NPPF concentrates on high level national policy, the FRCC-PPG is more detailed. The practice guidance advises on how planning can take account of the risks associated with flooding and coastal change in plan making and the development management process. This is in respect of Local Plans, SFRAs, the sequential and exception tests, permitted development, site-specific flood risk, Neighbourhood Planning, flood resilience and resistance techniques and the vulnerability of development to make development safe from flooding.

4.3.3 Localism Act

The Localism Act was given Royal Assent in November 2011 with the purpose of shifting power from Central Government back to local councils, communities and individuals. The Government abolished Regional Spatial Strategies, providing the opportunity for councils to re-examine the local evidence base and establish their own local development requirements for employment, housing and other land uses through the plan making process.

Additionally, this act places a duty to cooperate on local authorities, including statutory bodies and other groups, in relation to the planning of sustainable development. This duty to cooperate requires local authorities to:

"...engage constructively, actively and on an ongoing basis in any process by means of which development plan documents are prepared so far as relating to a strategic matter." (Provision 110).

This act, together with the Neighbourhood Planning (General) Regulations 2012, also provides new rights to allow Parish or Town Councils to deliver additional development through neighbourhood planning (Neighbourhood Plans). This means local people can help decide where new homes and businesses should go and what they should look like.

4.3.4 Local Plan

A Local Plan[14] is a statutory document prepared in consultation with the local community. It is designed to promote and deliver sustainable development. Local Plans have to set out a clear vision, be kept up to date and to set out a framework for future development of the local area, addressing needs and opportunities in relation to housing, the economy, community facilities and infrastructure as well as safeguarding the environment and adapting to climate change and securing good design.

Local plans set the context for guiding decisions and development proposals and along with the NPPF, set out a strategic framework for the long-term use of land and buildings, thus providing a

13 http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

14 Town and Country Planning, England. The Town and Country Planning (Local Planning) (England) Regulations 2012

framework for local decision making and the reconciliation of competing development and conservation interests.

The NPPF states that Local Plans should be supported by a SFRA and should take account of advice provided by the EA and other flood risk management bodies. The SFRA should be used to ensure that when allocating land or determining planning applications, development is located in areas at lowest risk of flooding. Policies to manage, mitigate and design appropriately for flood risk should be written into the Local Plan, informed by both the SFRA and Sustainability Appraisal.

4.3.4.1 Lancaster District Local Plan

The Lancaster District Local Plan is currently being updated and is due for adoption by September 2018. It will cover the period 2011-2031 and will be comprised of five key Development Plan Documents (DPDs);

- Strategic Policies and Land Allocations
- Development Management
- Morecambe Area Action Plan
- Arnside and Silverdale AONB Plan
- Gypsy and Traveller Accommodation

These will be supported by a series of Supplementary Planning Documents (SPDs) which will provide further guidance on specific sites or complex issues.

A Draft Development Management DPD and Draft Strategic Polices and Land Allocations DPD were consulted on between January and March 2017. The Council intends to formally publish a Local Plan in early 2018.

4.3.4.2 Sustainability Appraisal

The Sustainability Appraisal (SA) is a key component of the Local Plan evidence base, ensuring that sustainability issues are addressed during the preparation of local plans. The SA is a technical document which has to meet the requirements of the Strategic Environmental Assessment Directive 2001/42/EC which assesses and reports on a plan's potential impact on the environment, economy, and society. The SA carries out an assessment of the draft policies at various stages throughout the preparation of the Local Plan, and does this by testing the potential impacts, and consideration of alternatives are tested against the plan's objectives and policies. This ensures that the potential impacts from the plan on the aim of achieving sustainable development are considered, in terms of the impacts, and that adequate mitigation and monitoring mechanisms are implemented.

Ongoing Sustainability Appraisals have been undertaken on the draft Land Allocations DPD and the Development Management DPD since 2012. The latest SAs on the Land Allocations and Development Manangement DPDs, published in January 2017, state the following objectives in relation to flood risk under SA objective EN1:

'To reduce or manage flooding'

'To encourage the inclusion of flood mitigation measures such as SuDS'

It also recognises that areas at risk of flooding should be protected from development that would increase that risk and that new developments should be encouraged to use SuDS to manage runoff and further reduce flood risk. This SFRA will assist LCiC in achieving these objectives.

4.4 Flood Risk Management Policy

4.4.1 Development Management Policies

The Development Management DPD, referred to in Section 4.3.4.1, sets out a number of policies which include consideration of flood risk. Policy DM38: Development and Flood Risk are Policy DM39: Surface Water Run-Off and Sustainable Drainage are the specific policies for addressing flood risk and surface water related issues. Policy DM38 states that:

"Inappropriate development in areas at risk of flooding should be avoided by direction development away from areas of highest risk. But where development is necessary, it should be designed to make it safe without increasing flooding elsewhere."

4.4.2 Lancaster City Council Level 1 SFRA (September 2007)

The 2007 Level 1 SFRA was commissioned by LCiC to provide an assessment and overview of flood risk considerations by collating and appraising available information sources on flood risk. The study analysed current and future flooding issues in specific 'Character Areas' (areas delineated for flood risk evaluation within the SFRA of similar flooding characteristics), in order to helpfully inform preparation of the Local Plan and to indicate further considerations which may be needed in the context of development proposals.

The SFRA delineates the Lancaster District into zones of low, medium and high probability based on EA flood zone data, with detailed flood risk mapping used for the River Wenning, Back Lane watercourse and River Keer. The report highlights the fact that there has been substantial investment in flood defence infrastructure, although a residual risk remains associated with extreme events which may exceed the design capacity of defences, and/or structural failure.

The report make several recommendations, including:

- That a SPD is developed in light of the suggested development control conditions presented by the SFRA
- That the Council review their adopted flood risk response plan
- That the SFRA is reviewed once every 12 months with any updates, for example to local or national policy/guidance and/or significant flood events

4.4.3 Flood Risk Management Plans

Flood risk management plans (FRMPs) explain the risk of flooding from rivers, the sea, surface water, groundwater and reservoirs with each FRMP covering a specific river basin district. FRMPs set out how risk management authorities, including the EA and LLFAs, will work with communities to manage flood risk over the current period 2015 - 2021. Each EU member country must produce FRMPs as set out in the EU Floods Directive 2007.

The North West FRMP[15] is within the North West River Basin District which covers approximately 13,200 square kilometres from Cumbria to the north to Cheshire in the south. As LLFA, Lancashire City Council was not required to produce a FRMP for its own area following the PFRA process whereby significant flood risk areas were not identified.

The area covered by LCiC lies primarily within the River Lune catchment, however a small section of the District lies within the catchment of the River Wyre. Therefore, both the Lune Catchment Flood Management Plan (CFMP)[16] and the Wyre CFMP[17] policies are relevant in this study.

The CFMPs contain useful information about how the catchments work, previous flooding and the sensitivity of the river systems to increased rainfall. The EA may draw on the evidence and previous proposals set out in the CFMPs to help develop the FRMP.

15 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507120/LIT_10208_NORTH_WEST_FRMP_SUMMARY_DOCUMENT.pdf

16 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293698/Lune_Catchment_Flood_Management_Plan.pdf

13 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293706/Wyre_Catchment_Flood_Management_Plan.pdf

4.4.4 National and Local Flood Risk Management Strategies

As presented in Figure 4-1 in Section 4.1, the FWMA establishes how flood risk will be managed within the framework of National Strategies for England and Local Strategies for each LLFA area.

The National Strategy for England has been developed by the EA with the support and guidance of Defra. 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 Act requires risk management authorities (local authorities, sewerage companies and highways authorities) to work together and act consistently with the National Strategy in carrying out their flood and coastal erosion risk management functions effectively, efficiently and in collaboration with communities, business and infrastructure operators to deliver more effective flood risk management.

LLFAs have responsibility for developing a Local Flood Risk Management Strategy (LFRMS) for their area covering local sources of flooding (see Table 4-1). 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.

4.4.4.1 Lancashire and Blackpool Local Flood Risk Management Strategy

The Lancashire and Blackpool LFRMS was produced in October 2013 and the strategy has been adopted for the period of 2014-2017 and is now currently under review. The Strategy sets out how the Blackpool Council and Lancashire City Council will manage risk from all types of flooding such as surface water runoff, groundwater and ordinary watercourses for which they have a responsibility as LLFAs, and other types of flooding where local agents can play a supporting role to lead agencies.

The LFRMS has nineteen objectives which have been grouped according to five key themes. The objectives will be delivered through a range of measures detailed in the report. The key themes are:

Roles and Responsibilities:

- RR1 Identify RMAs and define each RMA's roles and responsibilities in relation to managing risk from all sources of flooding
- RR2 Allow RMAs to make efficient decisions on flood risk management and exploit opportunities effectively
- RR3 Give risk management authorities powers to undertake flood related works
- RR4 Ensure alignment of local Flood Risk Management and Emergency Planning functions

Understanding Risk:

- UR1 Understand key local flood risks
- UR2 Work together with other RMAs to investigate and manage interactions between Main River, coastal flooding and local flood risks
- UR3 Record, investigate and report flooding incidents
- UR4 Take account of climate change when fulfilling duties and responsibilities in flood risk management

Funding:

- F1 Define the approach to, and opportunities for, resourcing and funding local flood risk management activities
- F2 Encourage beneficiaries to invest in local flood risk management

Communication and Involvement:

- C&I1 Deliver flood risk management through effective partnership and working
- C&I2 Establish effective data sharing agreements
- C&I3 Encourage stakeholder and community involvement in flood risk management

Sustainable Flood Risk Management:

- SFRM1 Integrate economic, social and environmental improvements with local flood risk management in line with sustainability principles
- SFRM2 Manage development so that it reduces flood risk
- SFRM3 Promote the use of SuDS
- SFRM4 Encourage innovation in local flood risk management
- SFRM5 Set out an asset management plan
- SFRM6 Work with the owners of assets with a flood risk management function

The Strategy will be implemented through an Action Plan, which will involve working with other RMAs across Lancashire. The Plan includes measures proposed to achieve the Strategy's objectives, which are identified as short, medium or long term. The final strategy of the LFRMS has now been adopted by Lancashire City Council.

4.4.5 Local Flood Studies

Lancashire County Council, as a Lead Local Flood Authority (LLFA), has a duty to investigate flooding in accordance with Section 19 of the Flood and Water Management Act 2010. Flood Investigation Reports are publicly available for the Summer 2012 floods and the December 2015 floods.

4.4.5.1 Flood Investigation Report Lancashire Summer 2012

The period between June and September 2012 was one of the wettest on record, with principal flood events occurring on 22/23 June and 24 September. During the events, the Councils, EA, UU and the Emergency Services worked collaboratively the help prevent and alleviate flooding. The most severe flooding in the June event occurred in East Lancashire, at Croston, Whalley, Leyland, Rossendale and Darwen. In the September event, the most severe flooding occurred in West Lancashire, Croston and parts of Wyre. No properties were reported as flooded in Lancaster District during either event.

The 2012 floods were the first widespread test of flood response and risk management in Lancashire since the introduction of the Flood and Water Management Act 2010. The report concluded that all Lancashire's RMAs exercised their flood risk management functions effectively and proactively in the vast majority of recorded flood incidents. It was noted that in particular the Making Space for Water meetings in each district provided an effective method for RMAs to discuss issues prior to the flood incidents. The report highlights key objectives to be pursued by RMAs, including providing simpler and more accessible public information on flood risk and the roles of RMAs, empowering communities to be more flood risk aware and finding ways for agencies to work effectively across boundaries (organisational, geographic, political, catchment etc.).

4.4.5.2 Flood Investigation Report Lancashire December 2015

The Flood Investigation Report for the December 2015 flooding was delivered in two parts; a county level report on the causes, response and impacts of the incident, and a district level report which provides affected communities with information on what is being done by RMAs to help manage flood risk at specific locations.

The extreme and unprecedented storms and rainfall experienced in November and December 2015 lead to extensive flooding across not only Lancashire, but many other regions in the North West. 229 communities in Lancashire were affected, with approximately 2500 homes flooded, as well as other private property, items of critical public infrastructure and essential community buildings. It was concluded that following the flood events, improvements were required to the

way in which flood investigations and risk management were communicated to affected communities, which prompted the development of the district level reports.

The Lancaster District Flood Report, published in November 2016 by the County Council, identifies opportunities for further investigation and investment in flood risk management. It sets out the responsibilities and functions of each RMA, and provides a series of recommended actions, at a city, district and community level. District-wide actions include reviewing the Lancaster Level 2 SWMP and reviewing the Ordinary Watercourse Study for Lancaster District. For the forty locations in Lancaster District where internal property flooding was reported, the required actions from RMAs are set out, along with a status of completion. The report will be updated on a quarterly basis to allow affected communities to see progress and resolution of as many issues as possible, as quickly as possible.

4.4.6 Surface Water Management Plans

In June 2007, widespread extreme flooding was experienced in the UK. The 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 Government's guidance document[18] 2011 for SWMPs 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 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. *No high risk locations were identified in the Lancaster District as part of this process*.

4.4.7 Flood Risk Partnerships and Partnership Plans

LiCC 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 District (see Section 7 on Emergency Planning for more information) include:

- The North West Regional Flood and Coastal Committee (FRCC) - established by the EA under the FWMA to bring together members appointed by the LLFAs and independent members. Responsible for reviewing flood defences in the region and determining how they will be managed in the future.
- The Lancashire Strategic Partnership Group – this group is made up from the twelve Lancashire RMAs (District and Borough Councils). The Group meets to discuss the strategic direction of flood risk management and any widespread flooding which affects more than one Local Authority area.
- The Partnership Management Group - this group is attended by technical and operational lead officers from the EA, UU and all of the LAs. The group addresses priority flooding incidents, coordinates delivery and establishes priority for joint working.
- Making Space for Water - operational meetings are held in each district and is attended by all of the Lancashire RMAs including Lancashire County Council, Lancaster City Council, the EA and UU. They address issues at the district and borough level.
- Key businesses and organisations – LCiC has ongoing relations with major land owners, employers and organisations such as the Canal and Waterways Trust, Lune River Trust, National Trust, Natural England, Highways England and Network Rail.

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

- Lancashire Resilience Forum (LRF)

4.4.8 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.

The NPPF explains that open space can perform many functions, including flood risk mitigation, and that Local Plans should account for increased flood risk, resulting from climate change, through the planning of Green Infrastructure. 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, specifically within potential development sites, where possible. The suitability of GI and SuDS can be informed by this SFRA through utilisation of open space for water in the areas of greatest flood risk.

4.4.8.1 Lancaster Open Space, Sport and Recreation Facilities Study Refresh 2010

The 2010 study refresh provides an update to the original 2007 Open Space audit and report, which was undertaken in accordance with Planning Policy Guidance Note (PPG) 17: Planning for Open Space, Sport and Recreation & Assessing Needs and Opportunities, and its Companion Guide. The report provides a key evidence base for the Lancaster Local Plan. The study analyses the provision of open space, sport and recreation facilities across the five areas of Lancaster District; South Lancaster, North Lancaster, Heysham and Morecambe, Carnforth, and Rural. The audit does not discuss the availability of greenspace for flood risk management, though several of the greenspace typologies that are listed could potentially be used for the temporary storage of flood water. A site-specific investigation would however be required. The greenspace typologies, identified in PPG17, are as follows:

- Parks and gardens
- Natural and semi-natural greenspaces
- Amenity greenspace
- Provision for children
- Provision for young people
- Outdoor sports facilities
- Allotments
- Cemeteries and churchyards
- Green corridors
- Civic spaces

4.5 Roles and Responsibilities

The responsibilities for the Risk Management Authorities (RMA) under the Flood and Water Management Act and the Flood Risk Regulations are summarised below.

4.5.1 EA 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.

4.5.2 LCoC 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;

4.5.3 Lancashire County Council 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 the 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.
- Is a statutory consultee in the planning process for "major development with surface water drainage" as required by the Town and Country Planning (Development Management Procedure) (England) Order 2015 (Schedule 4).

4.5.4 United Utilities 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 relevant LLFA;
- Has a duty to be subject to scrutiny from LLFAs;
- 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.

4.5.5 Highways Authority (Lancashire City Council) and Highways England as RMAs

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

4.5.6 The Local Community

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

4.5.7 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 can be found in the EA's helpful booklet 'Living on the Edge'[19].

4.5.8 Developers

- Have a vital role in ensuring effective local flood risk management by avoiding development in areas at risk of flooding. Local Strategies should form a key element of local planning guidance.

Table 4-1 provides an overview of the key LLFA responsibilities under the FWMA.

Table 4-1: Key LLFA Duties under the FWMA

FWMA Responsibility	Description of duties and powers	LCiC LLFA Status
Local Strategy for Flood Risk Management	A LLFA has a duty to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategies 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 will not be secondary to the national strategy; rather it will have distinct objectives to manage local flood risks important to local communities.	Final draft produced October 2013 (see Section 4.4.4.1)
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 their area. This duty includes identifying the	Ongoing

19 https://www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities

FWMA Responsibility	Description of duties and powers	LCiC LLFA Status
	relevant risk management authorities and their functions and how they intend to exercise those functions in response to a flood. The responding risk management authority must publish the results of its investigation and notify any other relevant risk management authorities.	
Asset Register	A 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	A 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
Works Powers	The Act provides a LLFA with powers to undertake works to manage flood risk from surface runoff, groundwater and on ordinary watercourses, consistent with the local flood risk management strategy for the area.	Ongoing
Designation Powers	The Act provides a 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	A LLFA is required to play a lead role in emergency planning and recovery after a flood event.	Lancashire Local Resilience Forum (Section 7.1.1)
Community Involvement	A 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 plans.	Various ongoing (Section 7.1.1)
Planning Requirements for SuDS	Sustainable Drainage Systems (SuDS) are to become a planning requirement for major planning applications of 10 or more residential units or equivalent commercial development schemes with sustainable drainage. The LLFA is now a statutory planning consultee and it will be between the LPA and the LLFA to determine the acceptability of these proposed sustainable drainage schemes subject to exemptions and thresholds. Approval must be given before the developer can commence construction. Planning authorities should use planning conditions or obligations to make sure that arrangements are in place for ongoing maintenance of any SuDS over the lifetime of the development.	Follow LASOO Guidance[20]

20 Non-Statutory Technical Standards for Sustainable Drainage, Practice Guidance, Local Authority SuDS Officer Organisation,

FWMA Responsibility	Description of duties and powers	LCiC LLFA Status
Latest changes to FWMA legislation[21]		

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

5 Flood Risk within Lancaster City

5.1 Flood Risk Datasets

This section of the SFRA provides a strategic overview of flood risk from all sources within the City. The information contained is the best available at the time of publication and is intended to provide LCiC with an overview of risk. Where further detail is available, then the source of information is provided. Table 5-1 provides a summary of the key datasets used in this SFRA according to the source of flooding.

Table 5-1: Flood source and key datasets

Flood Source	Datasets / Studies
Fluvial	EA Flood Map for Planning (Rivers and Sea) (February 2017 version)
	EA Risk of Flooding from Rivers and Sea map
	Latest available EA Flood Risk Mapping Studies
	EA Historic Flood Map
	LLFA historic flood incident register
	River Lune & River Wyre Catchment Flood Management Plans
Pluvial (surface water runoff)	EA Risk of Flooding from Surface Water (RoFSW)
	Critical Drainage Areas
	Lancashire Preliminary Flood Risk Assessment
Sewer	United Utilities historic flooding
	United Utilities Drainage Area Zones
Groundwater	EA Areas Susceptible to Groundwater Flooding (AStGWF)
Canal	Canal and River Trust breaches and overtopping incidents data
Reservoir	EA Reservoir Flood Maps (available online)
All sources	Lancashire and Blackpool Local Flood Risk Management Strategy
	Lancashire Fire & Rescue Service historic flood incident data
	North West River Basin Management Plan
	North West Flood Risk Management Plan
	Lancaster Level 1 SFRA 2007
Flood risk management infrastructure	EA flood defence data
	LLFA FRM asset register

5.2 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.

Judging from the EA's Flood Map for Planning, the majority of fluvial flood risk comes from the River Lune and its tributaries, as well as the Rivers Keer and Conder. The areas at risk include urban land in Lancaster, as well as rural locations. The Flood Map for Planning shows there to be extensive tidal flood risk along the coastline, with areas most at risk in Morecambe and the Lune estuary.

The SFRA Maps in Appendix A present the EA's Flood Map for Planning which shows the fluvial and tidal coverage of flood zones 2 and 3 across the City.

5.2.1 EA Flood Map for Planning

The EA's Flood Map for Planning is the main dataset used by planners for predicting the location and extent of fluvial and tidal flooding. This is supported by the CFMPs and FRMPs along with a number of detailed hydraulic river modelling reports which provide further detail on flooding mechanisms.

The Flood Map for Planning provides flood extents for the 1 in 100 AEP fluvial event (Flood Zone 3), the 1 in 200 AEP tidal event (also Flood Zone 3) and the 1 in 1000 AEP fluvial and tidal flood events (Flood Zone 2). Flood zones were originally prepared by the EA using a methodology based on the national digital terrain model (NextMap), derived river flows from the Flood Estimation Handbook (FEH) and two dimensional flood routing. Since their initial release, the EA has regularly updated their flood zones with detailed hydraulic model outputs as part of their national flood risk mapping programme.

The EA Flood Map for Planning is precautionary in that it does not take account of flood defence infrastructure (which can be breached, overtopped or may not be in existence for the lifetime of the development) and, therefore, represents a worst-case scenario of flooding. The flood zones do not consider sources of flooding other than fluvial and tidal, and do not take account of climate change. For this SFRA, Flood Zone 3 is subdivided into Flood Zone 3a and Flood Zone 3b (functional floodplain - see Section 5.2.2).

The EA also provides a 'Risk of Flooding from Rivers and Sea Map'. This map shows the EA's assessment of the likelihood of flooding from rivers and the sea, at any location, and is based on the presence and effect of all flood defences, predicted flood levels and ground levels. This dataset is not used in the assessment of flood risk for planning applications but is a useful source of information to show the presence and effects of flood risk management infrastructure. This dataset is further discussed in Section 5.2.3.

This SFRA uses the EA's Flood Map for Planning version issued in November 2016 to assess fluvial and tidal risk to potential development sites, as per the NPPF and the accompanying FRCC-PPG (see Section 6.5.1 for this assessment). The Flood Map for Planning is updated at quarterly intervals by the EA, as and when new modelling data becomes available. The reader should therefore refer to the online version of the Flood Map for Planning to check whether the flood zones may have been updated since November 2016:

http://apps.environment-agency.gov.uk/wiyby/37837.aspx

5.2.2 Functional Floodplain (Flood Zone 3b)

The functional floodplain forms a very important planning tool in making space for flood waters when flooding occurs. Development should be directed away from these areas.

Table 1, Paragraph 065 of the FRCC-PPG defines Flood Zone 3b as:

"…land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency."

Paragraph 015 of the FRCC-PPG explains that the identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood (such as a flood attenuation scheme) in an extreme (0.1% annual probability) flood, should provide a starting point to help identify the functional floodplain.

The area identified as functional floodplain should take into account the presence and effect of all flood risk management infrastructure including defences. Areas which would naturally flood, but which are prevented from doing so by existing defences and infrastructure or solid buildings, will not normally be identified as functional floodplain. If an area is intended to flood, e.g. an upstream flood storage area designed to protect communities further downstream, then this should be safeguarded from development and identified as functional floodplain, even though it might not flood very often.

A technical note is provided in Appendix C which explains the methodology used in creating the functional floodplain outline. The outline is also displayed on the SFRA Maps in Appendix A.

As part of this SFRA, the EA provided all of its most recent, readily available hydraulic river model 1 in 20 or 1 in 25 year scenario modelled flood outlines for the City. Where a 1 in 20 year, defended scenario outline was available, this was used to help define the functional floodplain. Where a 1 in 20 year defended scenario outline had not been produced, the 1 in 25 year defended scenario outline was used. Where defended outlines are not available or have not been produced, undefended outlines were used. There are no EA Flood Storage Areas within the City though the EA Historic Flood Map was assessed for inclusion within the functional floodplain. The functional floodplain outline was reviewed and agreed upon by the LPA, the LLFA and the EA, based on their local knowledge.

Any site-specific FRAs should further assess the areas of functional floodplain through detailed investigation and assessment of the actual risk and extent of the functional floodplain.

5.2.3 EA Risk of Flooding from Rivers and the Sea Map

This map shows the likelihood of flooding from rivers and the sea based on the presence and effect of all flood defences, predicted flood levels and ground levels. The map splits the likelihood of flooding into four risk categories:

- High – greater than or equal to 1 in 30 (3.3%) chance in any given year
- Medium – less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance in any given year
- Low – less than 1 in 100 (1%) but greater than or equal to 1 in 1,000 (0.1%) chance in any given year
- Very Low – less than 1 in 1,000 (0.1%) chance in any given year

The Risk of Flooding from Rivers and Sea map (RoFRS) is included on the SFRA Maps to act as a supplementary piece of information to assist the LPA in the decision making process for site allocation.

This dataset is not suitable for use with any planning application nor should it be used for the sequential testing of site allocations. The EA's Flood Map for Planning should be used for all planning purposes, as per the FRCC-PPG.

5.3 Surface Water Flooding

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

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

Judging from the Risk of Flooding from Surface Water map (RoFSW), surface water flood risk is prevalent across the District though particularly in the Lune and Keer river valleys and the coast around Morecambe and Lancaster, where the terrain begins to flatten off and surface water can accumulate.

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.

5.3.1 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 flood zones.

Pluvial flooding within urban areas across the country will typically be associated with events greater than the 1 in 30 year 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 year event. There is also a residual risk associated with these networks due to possible network failures, blockages or collapses.

The RoFSW is the third generation national surface water flood map, produced by the EA, 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 SFRA to assess risk from surface water, has proved extremely useful in supplementing the EA Flood Map for Planning, by identifying areas in Flood Zone 1 which may have critical drainage problems.

5.3.2 Risk of Flooding from Surface Water

The EA updated the second generation FMfSW in 2013 to produce a third generation national surface water flood map, the updated Flood Map for Surface Water (uFMfSW), now referred to the Risk of Flooding from Surface Water map. 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. The RoFSW is displayed on the SFRA Maps.

5.3.3 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 EA 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.

United Utilities is the water company responsible for the management of the majority of the District's drainage network.

5.3.4 Locally Agreed Surface Water Information

EA guidance on using surface water flood risk information recommends that the LLFA, should:

"…review, discuss, agree and record, with the Environment Agency, Water Companies, Internal Drainage Boards and other interested parties, what surface water flood data best represents their local conditions. This will then be known as locally agreed surface water information".

For the purposes of the PFRA, LCiC used the Areas Susceptible to Surface Water Flooding (AStSWF) dataset to define surface water flood information in the region. This dataset was used rather than the more recent Flood Map for Surface Water (FMfSW), as it better represents the flood risk in more rural districts with flat topography and a history of poor drainage. The FMfSW was the second generation of surface water map produced by the EA. LCiC should now consider the RoFSW as their locally agreed surface water flood information as this is the latest, most robust surface water flood map available.

5.3.5 Critical Drainage Areas

The Town and Country Planning (Development Management Procedure) (England) Order 2010 defines a Critical Drainage Area (CDA) as:

"…an area within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency".

EA guidance on carrying out Flood Risk Assessments[22] states that a FRA should be carried out for sites in Flood Zone 1 that are…

"…in an area with critical drainage problems as notified by the Environment Agency."

Within the CDAs, it is thought that any increase in surface water runoff rates and/or volume from new development will increase risk to areas downstream or to the surrounding community. A FRA should demonstrate that the development will not adversely affect existing flooding conditions within the CDAs by increasing the rate of surface runoff and should define and address the constraints that will govern the design of the drainage system and layout of the development site. Developers should look to reduce or control runoff to Greenfield rates or better, if feasible.

The use of appropriate mitigation measures should be investigated. Ideally, should work closely with the EA, UU and individual developers to ensure surface water runoff is controlled as near to the source as possible which will include the application of SuDS. See Section 6.8 for more information on SuDS.

5.4 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 FRA stage.

Taken from the 2007 SFRA, according to the Lune CFMP Inception Report, there have been no reported instances of groundwater flooding in the catchment area. Groundwater flood risk should however be considered on a site by site basis in development planning.

5.4.1 Areas Susceptible to Groundwater Flooding (AStGWF)

The EA's national dataset, Areas Susceptible to Groundwater Flooding (AStGWF), is a low resolution map which uses four susceptibility categories to show the proportion of a network of 1 km grid squares where geological and hydrogeological conditions show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring and is not suitable for planning considerations at a site-specific level. It should only be used as a trigger for further investigation as to the possibility of groundwater flooding.

22 https://www.gov.uk/guidance/flood-risk-assessment-in-flood-zone-1-and-critical-drainage-areas

The AStGWF is shown on the SFRA Maps.

5.5 Canal and Reservoir Flood Risk

5.5.1 Canals

The Lancaster Canal runs north to south down the western edge of the Lune catchment. The River Conder feeds the canal through a side weir and the Glasson Branch of the canal extends westwards from Galgate to Glasson Dock. There is the potential flood risk posed by a breach in the canal substructure, particularly at raised locations.

Data received from the Canal and River Trust (CRT) shows incidents of canal breach or overtopping in the Lancaster District. These incidents are shown in Table 5-2.

Table 5-2: CRT Canal breach and overtopping incidents

Date	Type	Location	Comments
04/10/10	Overtopping	Lancaster Canal at Tewitfield	Culvert blockage caused by debris caused overtopping onto towpath and into Whitebeck culvert
08/07/09	Overtopping	Lancaster Canal south of Borwick	Water running into field due to damaged bank protection
02/06/11	Leak	Lancaster Canal near Kellet Lane	Standing water due to leak, repairs required to bank protection
11/11/09	Overtopping	Lancaster Canal at Hall Garth	Embankment erosion allowing overtopping onto the towpath at high water levels
06/09/11	Overtopping	River Conder Feeder	Heavy rainfall caused overtopping of River Conder into feeder channel
26/10/08	Overtopping	River Conder Feeder	High water levels in River Conder coincided with high tide, causing river to overtop into the feeder channel and flood field between river and Conder Feeder
26/10/08	Overtopping	Between Conder Feeder and Glasson Basin	High water levels due to heavy rainfall combined with inflow from feeder channel caused overtopping at several locations
17/06/11	Overtopping	Glasson Branch at Cliffdale	Overtopping onto towpath caused by water levels being drawn down on main line for maintenance work

5.5.2 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.

The EA is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be regularly inspected and supervised by reservoir panel engineers. LAs are responsible for coordinating emergency plans for reservoir flooding and ensuring communities are well prepared.

According to the EA Register of Reservoirs, there are no ‘large raised reservoirs’ directly located within the boundaries of Lancaster or surrounding local authorities. Whilst large reservoirs provide the obvious source of residual risk (breaching/overtopping) from artificial sources, there could potentially be a number of smaller water bodies within the area. Smaller water bodies have potential ownership issues resulting in a lack of regularly inspected and poor embankment conditions. This will increase the residual risk of breaching or overtopping associated with them.

5.5.3 Reservoir Flood Maps

The EA has produced reservoir flood maps (RFM) for all large reservoirs that they regulated under the Reservoirs Act 1975 (reservoirs that hold over 25,000 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 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[23]' which provides information on how the maps were produced and what they contain.

The RFM can be viewed nationally at:

https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=SurfaceWater#Reservoirs_3-ROFR

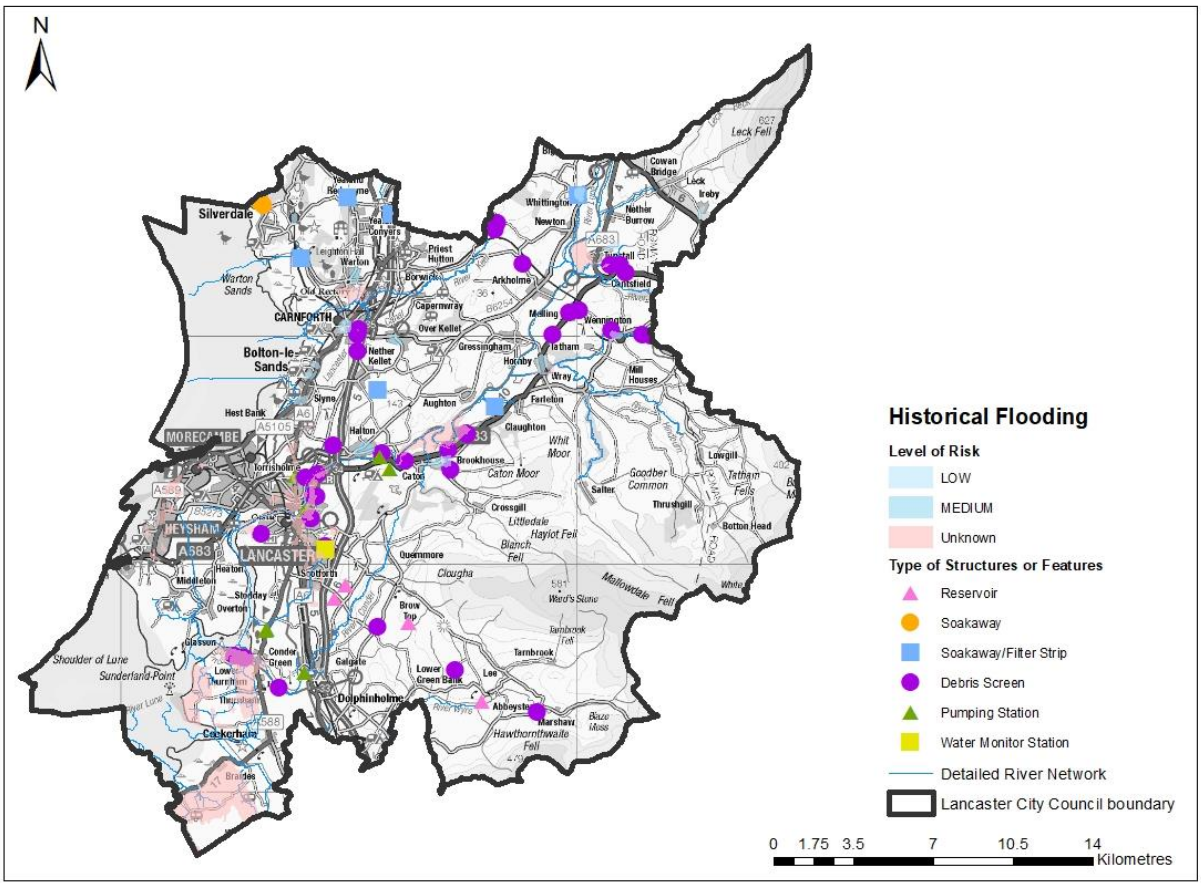
The RFM shows localised flood risk associated with a release of water from Blea Tarn and Langthwaite Reservoirs, which would affect areas of Galgate and other areas downstream on the River Conder.

5.6 Historical Flooding

LCiC provided its historic flood incident register, required under the FWMA, which includes flood incidents of multiple sources having occurred across the City. This includes flooding of property, gardens to property, highways and footpaths. These incidents have been mapped, however as many of these incidents are at the property level and considered as sensitive information, they have not been included on the detailed large scale SFRA maps. They are however shown at the smaller scale of the whole authority in Figure 5- below.

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

Figure 5-1: LCiC historic flood incidents



The LCiC LFRMS and PFRA also summarise historical flood events that have occurred across the City.

Storm Desmond December 2015

In December 2015 Storm Desmond resulted in the highest ever recorded flows on the River Lune, measured at Caton gauging station as exceeding 1,700 cumecs (cubic metres per second). The resulting flooding in and around Lancaster was the most extensive on record. Subsequent analysis, taking these new peak flows into account, has assessed the resulting floods as being between a 1-in-100 year and 1-in-200 year flood. The Environment Agency are using this data in the design for future flood defences. After the flood event, surveyors recorded the extent and height of the floods as far as practically possible, and have incorporated this data into the Historic Flood Map. The data has not been incorporated into the Flood Map for Planning, which is updated as and when new modelled data is produced.

Information on the Storm Desmond December 2015

Coastal, fluvial and flash flooding have all been recognised as significant risks in the Lancaster City Council area as Lancaster is exposed to prevailing south-westerly winds that bring mild, moist air across the Atlantic Ocean. Daily observations from the Lancaster University weather station have been made since 1976. From mid-November through December well over twice the average rainfall fell across northern and western areas from a succession of Atlantic storms

A 2-day rainfall total of 82mm was recorded during Storm Desmond, this is the highest two-day value in the station's history, and the rainfall amount of 60?mm which fell between 0900 GMT on 5 December and 0900 GMT on 6 December is the second highest on record for a 24h period at this station (the highest being 69mm on 8 December 1983). This record-breaking 2-day event followed the wettest November on record at Hazelrigg, which had more than twice the monthly

average rainfall (250mm; 213% of average) and also marked the end of an exceptionally wet 5-week period that contained only 5 dry days.

Recovery and Funding

The Environment Agency's (EA) flood defences protected over 12,500 properties during Storm Desmond, however to reduce to flood risk for the future and prepare for sustainable development, the EA along with communities, government departments and partners have worked to ensure for better protection against future flooding.

Lancaster City council made payments over £66,500 to 133 people in the district using funding from the Government. Properties flooded as a result of Storm Desmond were exempt from council tax for a minimum of three months. Businesses can also apply for an exemption for paying business rates, between 3–12 months depending when the property is re-occupied24. David Cameron also provided £2.3bn investment to protect 300,000 houses across the country and more the £40m was given to fix those defences overwhelmed by the record rainfall in December and to make them more resilient to further bad weather.

Furthermore, in September 2016, the National Flood Resilience Review awarded a further £12.5 million to the Environment Agency and £750,000 to the Fire and Rescue Services to be spent on preparing the country for extreme flooding events. The Environment Agency now has 5 times more temporary flood barriers than winter 201525.

Flood Risk Management for the future

Storm Desmond was an unprecedent event nevertheless, Lancaster County Council along with EA, government and partners have worked to ensure for better protection against future flooding. Lancaster County Council (LCC) as The Lead Local Flood Authority (LLFA) reviewed the Surface Water Management Plan (level 2) for Lancaster District and therefore proposed areas for deeper investigation leading to investment in improvement schemes.

- Following the event, all relevant flood risk management authorities carried out a preliminary review of any flood risk related assets, public infrastructure and/or flood defences which were likely to have been significantly impacts with the flooding. No such assets have been identified within the Lancaster Community.
- All relevant flood risk management authorities have met to discuss the primary flood mechanisms and the impacts this had on the community. The Lead Local Flood Authority encourages any concerned residents to consider installing property level flood resilience measures in order to further reduce the impact of flood water entering their property in the future.
- Since November 2016, all relevant risk management authorities have met to discuss the primary flood mechanisms and the impacts that the flooding has had on this community. It has since been concluded that further action will be required in response to this flood event. This includes a site-specific investigation to gain a better understanding of the local issues. This investigation will be programmed and delivered by the Lead Local Flood Authority – however, the scope of the investigation and target for delivery is yet to be determined26.

Natural Flood Risk Management

In Lancaster, the benefits of introducing more areas of green infrastructure including street trees, green roofs and walls, or parks, can reduce surface run off by increasing infiltration and also by slowing down the rate at which rainfall reaches the group via interception27.

24 Lancaster City Council. (2017). Financial assistance for flood victims. [online] Available at: https://www.lancaster.gov.uk/news/2016/jan/financial-assistance-for-flood-victims [Accessed 28 Jul. 2017].

25 Environment Agency. (2016), How the Environment Agency and partners responded to the flooding of winter 2015, and action plans to protect affected communities. Flood recovery: action plans for flood-hit communities.

26 Lancaster District Flood Report Recommended Actions. February 2017. Lancashire County Council. P30

27 Forest Research. 2010Benefits of green infrastructure. Report by Forest Research. Forest Research: Farnham, UK

Over the past two years, The Woodland Trust has led a project which resulted in the planting of 62,000 new trees on Tebay Common in Cumbria. This project aims to slow down the water that runs off the common and into the Lune at times of high rainfall, ultimately reducing the effect in Lancaster. This project will not only help to reduce flooding, but also will increase biodiversity on land and in the river with more fish and therefore more birds around28. Greater biodiversity is important, especially after many rural areas were impacted as a result of Storm Desmond.

5.6.1 Lancashire Fire and Rescue Service Flood Incident Data

Tyne and Wear Fire and Rescue Service (TWFRS) provided a spatial dataset containing flooding incident locations that TWFRS has attended over the period (from 6 September 2011 – 28 August 2016). TWFRS do not plot the extents of any flooding or each and every property affected by flooding during spate conditions, the incident plot is centred on the flooding location. There are also many different types of flooding incidents included, such as leaks in homes, to rivers breaching and subsequent flooding of properties. It was therefore decided not to include this data on the SFRA Maps. Incidentally, there were 129 flood incidents recorded by TWFRS over this period, across Lancaster district.

5.6.2 Historic Surface Water Flooding

United Utilities provided a copy of its existing DG5 Register which is used to record flood incidents at the individual property level attributable to water company controlled sewer networks, whether that be from foul and / or surface water sewers. Due to the sensitivity of this information, this data could not be mapped as part of this SFRA. The Register does however list a number of properties that have flooded in the past as a result of surface water / sewer system flooding.

5.6.3 EA Historic Flood Map

The Historic Flood Map (HFM) contains outlines of past fluvial, tidal and groundwater flooding though does not contain any information regarding flood source, return period or date of flooding. There are several flood incidents within the HFM in the District, shown on the SFRA Maps in Appendix A. There are incidents of fluvial flooding from the River Lune in Lancaster and River Wenning at Hornby, and tidal flooding in Morecambe and around Cockerham. There are also historic flood incidents recorded at Millhead near the River Keer.

5.7 Flood Risk Management

The aim of this section of the SFRA is to identify existing Flood Risk Management (FRM) assets and previous / proposed FRM schemes in the District. The location, condition and design standard of existing assets will have a significant impact on actual flood risk mechanisms. Whilst future schemes in high flood risk areas carry the possibility of reducing the probability of flood events and reducing the overall level of risk. Both existing assets and future schemes will have a further impact on the type, form and location of new development or regeneration.

5.7.1 EA Assets

The EA provide a spatial defences dataset via the Government's Spatial Data Catalogue from which such spatial data can be downloaded for free. The defences dataset shows that there are several major flood walls and embankments located within the District. Each defence is situated on Main River therefore will be owned and maintained by the EA.

Table 5-3: EA flood walls and embankments

Asset	Flood source	Watercourse	Location	Design standard	Bank	Condition
Embankment	Fluvial	River Lune	Gressingham	70	Left	3
Embankment	Fluvial	River Wenning	Hornby	75	Right	3

28 Lancasterguardian.co.uk. (2017). Flooding solution lies in new £9m river defences. [online] Available at: http://www.lancasterguardian.co.uk/news/environment/flooding-solution-lies-in-new-9m-river-defences-1-7700982 [Accessed 31 Jul. 2017].

Asset	Flood source	Watercourse	Location	Design standard	Bank	Condition
Wall	Fluvial	River Wenning	Hornby	75	Left	3
Embankment	Fluvial	River Keer	Millhead	40	Right	3
Wall	Tidal	-	Millhead	25	Left	3
Embankment	Tidal	-	South of Silverdale	150	-	5 (breached 2005)
Embankment	Fluvial	Farleton Beck	Farleton	80	Both	4
Embankment	Fluvial	Claughton Beck	Claughton	80	Left	3
Wall	Tidal	River Lune	Lancaster	25	Right	3
Walls	Tidal	River Lune	Lancaster	Ranging from 50-500	Left	Ranging from 2-4
Embankment	Tidal	River Lune	Lancaster	500	Left	3
Embankment	Tidal	River Lune	Lancaster	20	Left	3 (past breaches have occurred)
Embankment	Tidal	River Lune	Heaton	25	Right	3
Wall	Fluvial	River Conder	Galgate	100	Both	3
Embankments	Fluvial	River Conder	Conder Feeder	Ranging from 20-100	Both	Ranging from 3-4
Wall	Tidal	-	Glasson	200	-	3
Embankment	Tidal	-	Glasson	200	-	3

As well as the ownership and maintenance of a network of formal defence structures, the EA 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.
- 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.
- Operation of Floodline Warnings Direct and warning services for areas within designated Flood Warning Areas (FWA) or Flood Alert Areas (FAA). EA FWAs are shown on the SFRA 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.

5.7.2 LCoC Assets

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

5.7.3 Water Company Assets

The sewerage infrastructure within the district of Lancaster 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 property. United Utilities is responsible for the management of the urban drainage system. This includes surface water and foul sewerage. There may however be some private surface water sewers in the district as only those connected to the public sewer network transferred to the water companies under the Private Sewer Transfer in 2011. Surface water sewers discharging to watercourses did not transfer and would therefore not be under the ownership of United Utilities, unless adopted under a Section 104 adoption agreement.

Water company assets include Wastewater Treatment Works, Combined Sewer Overflows, pumping stations, detention tanks, sewer networks and manholes.

5.7.4 Future Flood Risk Management Work Programmes

Based on information publicly available from the EA, there are a number of ongoing and proposed flood risk management work programmes in the district. In the Flood and Coastal Erosion Risk Management (FCERM) Development Programme, proposed works include Morecambe Wave Reflection Wall Phases 1-3 (2017-2019), Cote Beck, Halton Flow Control (2019-2021), Glasson Dock Gate Refurbishment (2017-2019) and Slyne Level 3 SWMP (2017-2019). Lancaster Phase 3 Skerton to M6 motorway which is being led by Lancaster City Council and Lancaster Phase 4 Mill Race and Surface Water Study - this is a study to understand the flooding mechanism, rather than on-the-ground works.

6 Development and Flood Risk

6.1 Introduction

This section of the SFRA provides a strategic assessment of the suitability, relative to flood risk, of the potential development sites provided by LCiC to be considered though the Local Plan.

The information and guidance provided in this chapter (supported by the SFRA mapping in Appendix A and the Development Site Assessment Spreadsheet in Appendix B) can be used by LCiC to inform their Local Plan, and provide the basis from which to apply the Sequential Approach in the development allocation and development management process.

Modelled climate change outputs are unavailable for this study therefore a cautious approach to assessing future risk to sites at risk has been adopted. It is 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. Therefore, Flood Zones 2 and 3 of the EA's Flood Map for Planning have been used as a climate change proxy to provide an indication of risk to sites in the future.

For this SFRA therefore, the assumption should be that the current day Flood Zone 2 will become Flood Zone 3a in 100 years' time and the current functional floodplain could become Flood Zone 3a. Predicting future expansion of the functional floodplain is however more difficult as the functional floodplain extent is based on a number of different criteria, as discussed in Section 5.2.2.

This approach to climate change is precautionary though is considered to be the most pragmatic methodology available. This approach is also consistent with other SFRAs and professional modelling experience. As such, for any sites within Flood Zone 2, the possibility of these sites being within Flood Zone 3a within 100 years' time should be considered.

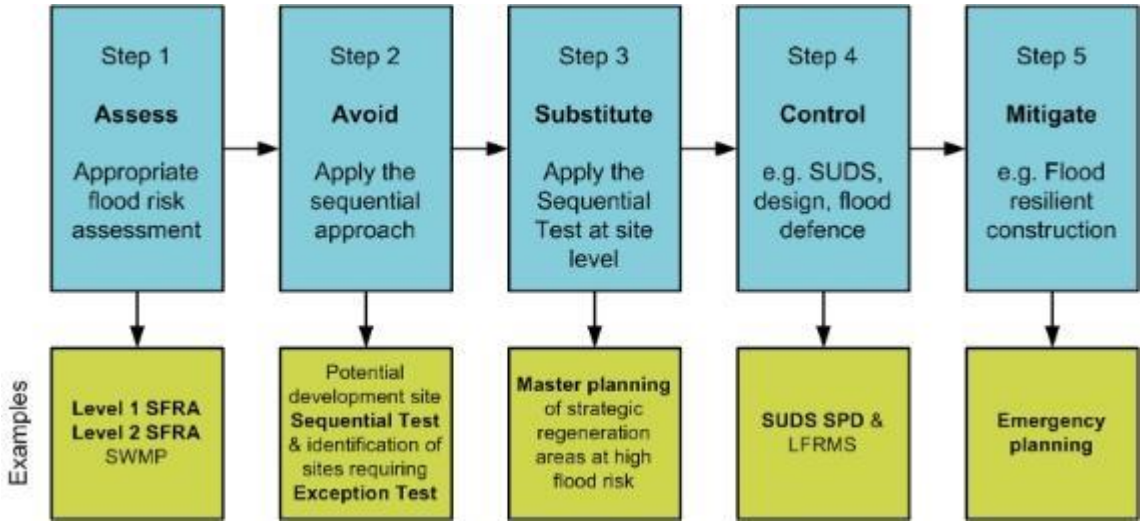
6.2 The Sequential Approach

The Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG) provides the basis for the Sequential Approach. It is this approach, integrated into all stages of the development planning process, which provides the opportunities to reduce flood risk to people, their property and the environment to acceptable levels.

The approach is based around the flood risk management hierarchy, in which actions to avoid, substitute, control and mitigate flood risk is central. For example, it is important to assess the level of risk to an appropriate scale during the decision making process, (starting with this Level 1 SFRA). Once this evidence has been provided, positive planning decisions can be made and effective flood risk management opportunities identified.

Figure 6-1 illustrates the flood risk management (FRM) hierarchy with an example of how these may translate into the council’s management decisions and actions.

Figure 6-1: Flood Risk Management hierarchy



The overall aim of the Sequential Approach should be to steer new development to low risk Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, the flood risk vulnerability of land uses and reasonably available sites in Flood Zone 2 should be considered, applying the Exception Test if required.

Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in higher risk Flood Zone 3, be considered. This should take into account the flood risk vulnerability of land uses and the likelihood of meeting the requirements of the Exception Test if required.

There are two different aims in carrying out the Sequential Approach depending on what stage of the planning system is being carried out i.e. LPAs allocating land in Local Plans or determining planning applications for development. This SFRA does not remove the need for a site-specific Flood Risk Assessment at a development management stage.

The following sections provide a guided discussion on why and how the Sequential Approach should be applied, including the specific requirements for undertaking Sequential and Exception Testing.

6.3 Local Plan Sequential & Exception Test

LCiC, as the LPA, should seek to avoid inappropriate development in areas at risk of flooding by directing development away from areas at highest risk and ensuring that all development does not increase risk and where possible can help reduce risk from flooding to existing communities and development.

(Guidance on the application of the Sequential and Exception tests through the development management process is provided at Section 6.7.1 of this report).

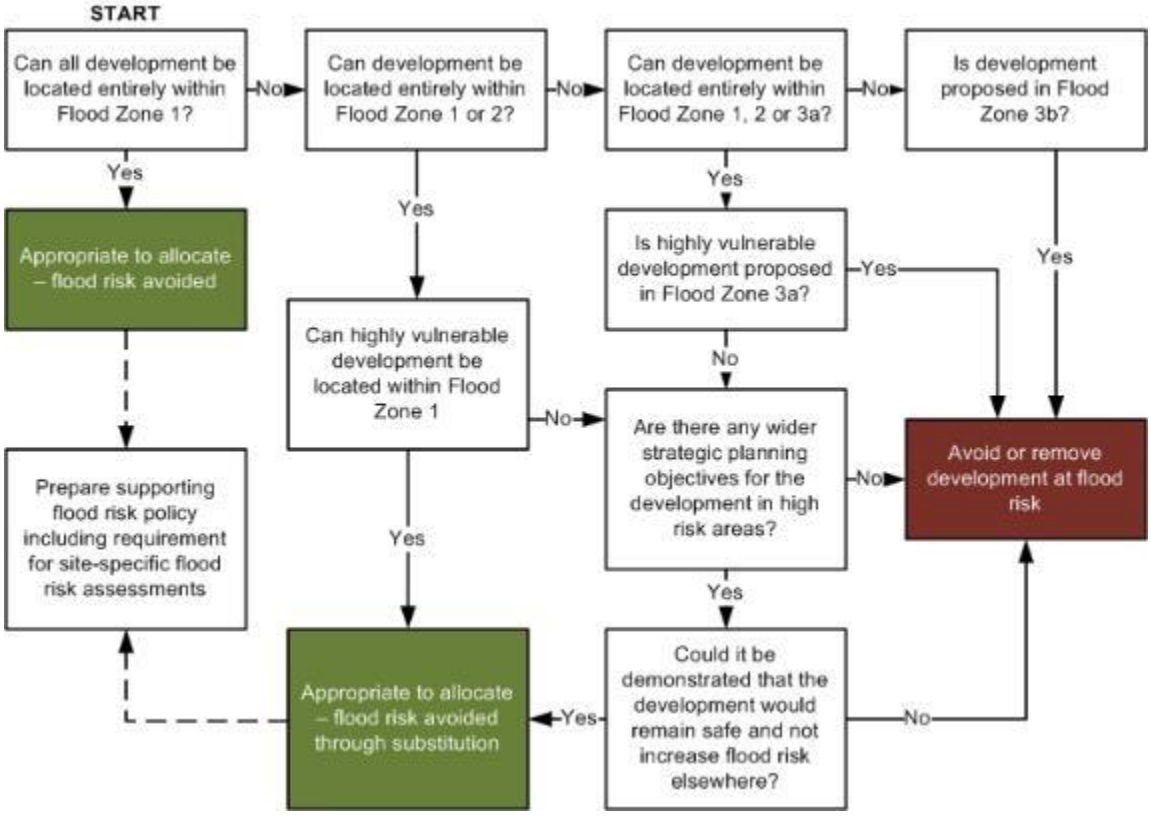
At a strategic level, this should be carried out as part of LCiC's Local Plan. This should be done by:

1. Applying the Sequential Test and if the Sequential Test is passed, applying the Exception Test, if required;
2. Safeguarding land from development that is required for current and future flood management;
3. Using opportunities offered by new development to reduce the causes and impacts of flooding and where climate change is expected to increase flood risk so that existing development may not be sustainable in the long term;
4. Seeking opportunities to facilitate the relocation of development including housing to more sustainable locations.

Figure 6-2 illustrates the Sequential and Exception Tests as a process flow diagram using the information contained in this SFRA to assess potential development sites against the EA's Flood Map for Planning flood zones and development vulnerability compatibilities.

This is a stepwise process, but a challenging one, as a number of the criteria used are qualitative and based on experienced judgement. The process must be documented and evidence used to support decisions recorded.

Figure 6-2: Local Plan sequential approach to site allocation



This SFRA provides the main evidence required. This process also enables those sites that have passed the Sequential Test, and may require the Exception Test, to be identified.

For the Exception Test to be passed, the NPPF Paragraph 102 states:

a. *It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and*
b. *A site-specific Flood Risk Assessment (FRA) must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

Both elements of the test will have to be passed for development to be allocated or permitted.

Although actually passing the Exception Test will require the completion of a site-specific FRA, LCiC should be able to assess the likelihood of passing the test at the Local Plan level by using the information contained in this SFRA to answer the following questions:

a. Can development within higher risk areas be avoided or substituted?
b. Is flood risk associated with possible development sites considered too high; and will this mean that the criteria for Exception Testing are unachievable?
c. Can risk be sustainably managed through appropriate development techniques (resilience and resistance) and incorporate Sustainable Drainage Systems without compromising the viability of the development?
d. Can the site, and any residual risks to the site, be safely managed to ensure that its occupiers remain safe during times of flood if developed?

Where it is unlikely that the Exception Test can be passed due to few wider sustainability benefits, the risk of flooding being too great, or the viability of the site being compromised by the level of flood risk management work required, then LCiC should consider avoiding the site all together.

Once the process has been completed LCiC should then be able to allocate appropriate development sites through the Local Plan as well as prepare flood risk policy including the requirement to prepare site-specific FRAs for all allocated sites that remain at risk of flooding.

6.4 Local Plan Sites Assessment

This assessment has considered sites from two different sources: Strategic Housing Land Availability Assessment (SHLAA) and the Local Plan Strategic Housing Allocations.

The SHLAA is an evidence base document that will inform the preparation of the council's Local Plan. LCiC carried out an assessment between March 2014 and October 2015, and the final SHLAA report was published in October 2015. LPAs have a requirement under the National Planning Policy Framework (NPPF) to demonstrate a sufficient supply of potential sites suitable for residential development to meet local housing requirements as well as sites for economic development uses.

The sites are assessed on their suitability, availability and achievability for housing development. The assessment is used to inform the Local Plan, but it does not make policy decisions on future site allocations.

6.4.1 Potential Development Sites

A total of 447 sites were identified as being deliverable or having development potential in the period 2016-2031, and have been assessed and subdivided into several proposed uses including:

- Residential: 398 sites
- LP Strategic Housing Allocations: 7 sites
- Employment: 39 sites
- Mixed use: 3 site

In order to inform the first part of the Sequential Approach for allocation of development through the Local Plan (illustrated in Figure 6-2), this SFRA has carried out a high level GIS screening exercise which involved overlaying the potential sites against Flood Zones 1, 2, 3a and 3b.

Surface water risk to sites has also been assessed through the EA's updated Flood Map for Surface Water dataset to help identify those sites that may have critical drainage problems. The Development Site Assessment Excel spreadsheet, included in Appendix B, provides a breakdown of each site and the area (ha) and percentage coverage of each flood zone and each surface water flood zone.

Zones 3b, 3a and 2 are considered in isolation. Any area of a site within the higher risk Flood Zones 3b that is also within Flood Zone 3a is excluded from Flood Zone 3a and any area within Flood Zone 3a is excluded from Flood Zone 2. This allows the sequential assessment of risk at each site by addressing those sites at higher risk first. Table 6-1 provides a count of the number of sites within each Flood Zone.

Table 6-1: Number of potential development sites at risk from Flood Map for Planning flood zones

Potential Development Site	Number of sites within…			
	Flood Zone 1*	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Residential	283	28	61	29
LP Strategic Housing Allocation	3	1	2	1
Mixed Use	0	0	0	1
Employment	16	2	16	4
Total	**302**	**31**	**79**	**35**
*Sites with 100% area within Flood Zone 1				

LCiC should use the Development Site Assessment spreadsheet in Appendix B to identify which sites should be avoided during the Sequential Test. If this is not the case, or where wider strategic objectives require regeneration in areas already at risk of flooding, then LCiC should consider the compatibility of vulnerability classifications and Flood Zones (refer to FRCC-PPG) and whether or not the Exception Test will be required before finalising sites. The decision making process on site suitability should be transparent and information from this SFRA should be used to justify decisions to allocate land in areas at high risk of flooding.

6.4.2 Sustainability Appraisal and Flood Risk

The Sustainability Appraisal should help to ensure that flood risk is taken into account at all stages of the planning process with a view to directing development away from areas at flood risk, now and in the future, by following the sequential approach to site allocation, as shown in Figure 6-2.

By avoiding sites identified in this SFRA as being at significant risk, such as those listed in Section 6.5.1.1, or by considering how changes in site layout can avoid those parts of a site at flood risk, such as any site included within Recommendation C (Section 6.5.1.3), the Council would be demonstrating a sustainable approach to development.

In terms of surface water, the same approach should be followed whereby those sites at highest risk should be avoided or site layout should be tailored to ensure sustainable development. This should involve investigation into appropriate SuDS techniques (see Section 6.8).

Once the Council has decided on a final list of sites following application of the Sequential Test and, where required, the Exception Test following a site-specific FRA, a phased approach to development should be carried out to avoid any cumulative impacts that multiple developments may have on flood risk. For example, for any site where it is required to develop in Flood Zone 3, detailed modelling would be required to ascertain where water displaced by development may flow and to calculate subsequent increases in downstream flood volumes. The modelling should investigate scenarios based on compensatory storage techniques to ensure that downstream or nearby sites are not adversely affected by development on other sites.

Using a phased approach to development, based on modelling results of floodwater storage options, should ensure that any sites at risk of causing flooding to other sites are developed first in order to ensure flood storage measures are in place before other sites are developed, thus ensuring a sustainable approach to site development. Also, it may be possible that flood mitigation measures put in place at sites upstream could alleviate flooding at downstream or nearby sites.

6.5 Potential Development Sites Review

This section of the report assesses flood risk to potential sites. Section 6.5.1 provides high level broad-brush recommendations for those sites within the flood zones of the Flood Map for Planning. Section 6.5.2 reviews the surface water risk to the potential sites by way of the updated Flood Map for Surface Water.

It is important to note that each individual site will require further investigation, as local circumstances may dictate the outcome of the recommendation. 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 event outlines, including climate change (using the EA's February 2016 allowances), as part of a site-specific FRA.
- 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 sites have planning permission but construction has not started, the SFRA will only be able to influence the design of the development e.g. finished floor levels. New, more extensive 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 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 EA may have already passed comment and/or agreed to appropriate remedial works concerning flood risk. Previous flood risk investigations/FRAs may already have been carried out at some sites.

6.5.1 Flood Map for Planning Site Assessment

The following recommendations provide only a guide, based on the flood risk information made available for this Level 1 SFRA. Information regarding local, site specific information is beyond the scope of this SFRA. It is LCiC's responsibility to carry out sequential testing of each site using the information provided in this SFRA and more specifically using their local, site specific knowledge and advice from the EA. These sections should be read alongside the Development Site Assessment spreadsheet in Appendix B.

6.5.1.1 Recommendation A – Consider withdrawal of site

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

Recommendation A applies to any site within the functional floodplain where the following criteria is true:

- 10% or greater of the site area is within Flood Zone 3b. The FRCC-PPG flood risk vulnerability classification states that only water-compatible uses and essential infrastructure should be permitted in Flood Zone 3b, though any essential infrastructure must pass the Exception Test. Land allocated for housing falls in to the more vulnerable category and sites for employment; retail; recreation and leisure; and mineral and waste are in the less vulnerable category, though waste management sites for hazardous materials fall with the more vulnerable category. Gypsy and traveller sites fall within the highly vulnerable category. Mixed use sites should be placed into the higher of the relevant classes of flood risk sensitivity. Development should not be permitted for sites within the more vulnerable and less vulnerable categories that fall within Flood Zone 3b. If the developer is able to avoid 3b however, then part of the site could still be delivered.

The 10% threshold is not included within any policy, it is merely considered that it would likely prove difficult for developers to deliver a site where 10% or more of the site area is considered as undevelopable, based on the NPPF. This 10% threshold does not account for local circumstances therefore it may be possible to deliver some of the sites included with Recommendation A upon more detailed investigation. It may also be possible to deliver part of some of the larger sites, dependent upon further investigation, where a significant area is not within Flood Zone 3b. Recommendation A applies to 48 of the 447 potential development sites. Table 6-2 lists those sites where Recommendation A should apply based on the 10% threshold of site area within the functional floodplain. Nevertheless, there are sites with recommendation A that have high percentages of residential development located in flood zone 3A (more vulnerable).

Table 6-2: Sites to consider withdrawing that are within Flood Zone 3b (including 3A residential)

Site ID	Site Name	Proposed use	Site Area (ha)	% Area within FZ3A	% Area within FZ3B
46	Land West Of Boundary Lane, Kellet Road Industrial Estate	Residential	0.30	4.65	68.87
49	Land North Of Railway Lines, Warton Road	Residential	5.57	33.06	33.89
57	Land South Of Carnforth Cemetery, Kellet Road	Residential	0.39	45.69	54.21
141	Land East Of A6 And North Of River Conder	Residential	1.80	58.85	0.08

75	Keer Bridge, Warton Road	Residential	2.43	73.23	0.00
384	Land North Of Lune Aquaduct, Halton Road	Residential	0.47	3.40	5.83
679	Railway Farm, Main Road	Residential	1.47	63.84	1.18
46	Land West Of Boundary Lane, Kellet Road Industrial Estate	Residential	0.30	4.65	68.87
45	Stonecroft, 86 Crag Bank Road	Residential	0.21	82.52	0.00
47	Land South Of 24-25 Greengate Lane, Crag Bank	Residential	0.36	62.97	0.00
433	Montressa, Green Lane	Employme nt	0.43	99.02	0.00
51	Land South West Of 109 Crag Bank Road	Residential	0.58	100.00	0.00
152	Garden Of Station House, Glasson Dock Road	Residential	0.68	100.00	0.00
153	Land West Of Glasson Dock Church, School Lane	Residential	0.35	100.00	0.00
564	Land Between 22 And 26 Middleton Road	Residential	1.02	86.67	0.00
449	Land West Of Green Lane	Residential	0.53	84.08	0.00
239	Castle Hotel, 49 Main Street	Residential	0.17	99.97	0.00
463	Land And Buildings South Of Back Calton Street	Residential	0.29	57.46	0.00
154	Marina Car Park, Glasson Dock Road	Residential	0.52	100.00	0.00
498	Masons Carpets Warehouse, White Lund	Employme nt	0.20	60.44	0.00
108	Sand Villa Farm, Marsh Lane	Residential	0.34	100.00	0.00
312	Land North Of Lentworth Drive	Residential	0.79	100.00	0.00
505	Land South East Of Railway Line, Oxcliffe Road	Residential	1.24	99.51	0.00
323	Damside Street Car Park, North Of 50-62 Church Street	Residential	0.07	49.59	0.00
111	Braides Farm, Marsh Lane	Residential	0.87	100.00	0.00
71	Land West Of 11 Greengate Lane	Residential	2.14	96.23	0.00
349	Standfast Works, Caton Road	Employme nt	3.65	63.75	0.00

365	Kingsway South	Mixed Use	0.90	41.65	0.00
373	Land North Of New Quay	Residential	1.96	73.15	0.00
549	Mellishaw South Existing Allocation	Employment	22.70	98.37	0.00
550	Mellishaw North Development Site	Employment	4.25	85.85	0.00
77	Rickerby, Ltd, Scotland Road	Residential	0.59	99.11	0.00
82	Land At The Corner Back Lane And Windermere Road	Residential	0.16	89.88	0.00
650	Land South Of Middleton Road	Residential	1.47	96.43	0.00
653	Land North of 154-182 Coastal Road	Residential	3.05	97.98	0.00
655	Land East of A588	Residential	2.46	100.00	0.00
697	Land East of Mill Lane	Residential	0.75	48.66	0.00
681	Land South East of 89 Oxcliffe Road	Residential	0.87	44.36	0.00
711	Paddock, 87 White Lund Road	Residential	0.25	49.77	0.00
725	Land West of Forge Lane	Residential	0.73	44.70	0.00
LA18	Glasson Industrial Area	Employment	5.41	80.51	0.00
LPSA804	Land off Lancaster Road, White Lund	Employment	5.23	99.86	0.00
LPSA810	Land off Imperial Way	Residential	11.21	70.80	0.00
LPSA821	Land at The Shore	Residential	5.41	93.89	0.00

6.5.1.2 Recommendation B – Exception Test

Recommendation B applies to sites where it is likely the Exception Test would be required. This does not include any recommendation on the likelihood of a site passing the Exception Test. These sites may need to be examined as part of a more in-depth Level 2 SFRA. The developer / LPA should attempt to avoid the risk area where possible.

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

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

- 10% or greater of any residential site or essential infrastructure site that is within Flood Zone 3a. Water-compatible and less vulnerable uses of land do not require the Exception Test if in Flood Zone 3a.
- 10% or greater of any mixed use site that may entail residential use that is within Flood Zone 3a.

All development proposals in Flood Zone 3a must be accompanied by a FRA.

The 10% threshold is not included within any policy; it is merely considered that it would be very difficult for developers to avoid Flood Zone 3a when 10% or more of the site area is within it. This 10% threshold does not account for local circumstances therefore it may be possible to avoid Flood Zone 3a altogether for some of the sites included with Recommendation B. It may also be possible to deliver part of some of the larger sites, dependent upon further investigation, where a significant area is not within the FZ3b.

It should be considered that, based on climate change, the 1 in 20 and 1 in 25 year flood event outlines used to create the functional floodplain, may increase in extent in 100 years' time meaning a larger number of sites or a larger percentage area of these sites may be at risk from the 1 in 20 / 25 year flood events.

Strategic Recommendation B does not apply to any of the sites provided for assessment.

6.5.1.3 Recommendation C – Consider site layout and design

This recommends a review of site layout and / or design at the development planning stage in order for development to proceed. A Level 2 SFRA may be required or a site-specific FRA would be required to inform on site layout and design.

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

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

- <10% of the area of any site type is within Flood Zone 3b.
- <10% of any residential site is within Flood Zone 3a.
- <10% of any mixed use site that may entail residential use is within Flood Zone 3a.
- <10% of any essential infrastructure site is within Flood Zone 3a.

The 10% threshold is not included within any policy, it is merely considered that it may be possible for developers to avoid Flood Zone 3b and Flood Zone 3a when less than 10% of the site area is at risk. This 10% threshold does not account for local circumstances.

The Development Site Assessment spreadsheet in Appendix B categorises those sites with <10% of their area within Flood Zone 3b where site layout should be examined with a view to removing the site footprint from Flood Zone 3b. Depending on local circumstances, if it is not possible to adjust the site boundary to remove the site footprint from Flood Zone 3b to a lower risk zone then development should not be permitted.

Also listed within the spreadsheet are the residential and mixed use sites with <10% of their area within Flood Zone 3a and where site layout and / or design should be examined with a view to removing the site footprint from Flood Zone 3a or incorporating on-site storage of water into site design. Depending on local circumstances, if it is not possible to adjust the site boundary to remove the site footprint from Flood Zone 3a to a lower risk zone or to incorporate on-site storage of water within the site design, then the Exception Test should be undertaken and passed as part of a site-specific FRA.

Overall there are 71 potential sites to which Recommendation C applies.

Site ID	Site Name	Proposed use	Site Area (ha)
LPSA789	Land Associated with Hillam Lane Farm	Residential	13.02
LPSA793	Land West of Scotland Road	Mixed Use	17.10
LPSA791	Land East of Crag Bank Crescent	Residential	2.30
42	Land North Of Brewers Barn, North Road	Residential	1.70
43	Brewers Barn, North Road	Residential	7.37
2	Arna Wood, Aldcliffe	Residential	39.02
406	Land South Of Carr Lane	Residential	3.94
431	Former Glass Fibre Works, White Lund	Residential	2.14
253	Mariners View, Bridge Lane	Residential	0.04
256	Lune Industrial Estate, New Quay Road	Residential	8.70
185	Heysham Moss Sidings, Lancaster Morecambe Bypass	Residential	3.57
140	Galgate Mill, Chapel Lane	Residential	0.90

162	Halton Mill, Mill Lane	Residential	4.55
278	Playing Fields, Barton Road	Residential	8.07
282	Halton Training Camp, Halton Road	Residential	6.84
198	Power Station Curtilage	Residential	13.25
462	Church Lane Car Park	Residential	0.29
492	Club, Victoria Street	Residential	0.10
500	Venture Caravan Park	Residential	6.61
244	Land West Of Hornby C Of E Primary School	Residential	1.25
89	Land North Of 11-75 Hornby Road	Residential	1.57
509	Regent Caravan Park	Residential	9.13
511	Land West Of 113 White Lund Road, Oxcliffe Road	Residential	0.23
221	Fanny House Farm, Oxcliffe Road	Residential	0.72
631	Forgewood, Wray Road	Residential	0.64
334	Land North And East Of Bailrigg Lane	Residential	45.57
533	Westview Road Car Park	Residential	0.34
341	Land At Whinney Carr, Carr Lane	Residential	60.86
603	Land West Of Road	Residential	3.12
536	Former Bubbles Site, Marine Road	Residential	5.58
414	Land East Of Unit 38, Workshop Road	Residential	0.52
377	Land South Of Lune Business Park	Residential	14.55
380	Land North Of Lune Aquaduct Road	Residential	1.73
383	Former Filter House, Scotforth Road	Residential	0.55
78	Land South Of Windermere Road	Residential	14.05
104	WCF Premises, Hornby Road	Residential	1.31
149	Land West Of A6	Residential	5.61
150	Laund Fields, Stoney Lane	Residential	2.11
40	Land South Of Hornby Road	Residential	12.47
81	Dock Acres, South Lakeland Leisure Village	Residential	10.62
246	Brades Farm, Hornby Road, Farleton	Residential	1.33
568	Land North Of Overton Primary School, Lancaster Road	Residential	1.64
101	Land East And South Of Caton Community Primary School	Residential	5.22
151	Land West of Highland Brow	Residential	5.09

418	Former Pontins Holiday Camp, Carr Lane	Residential	22.38
419	Middleton Business Park, Middleton Road	Employment	2.47
420	Middleton Business Park, Middleton Road	Employment	1.29
421	Middleton Business Park, Middleton Road	Employment	26.62
422	Middleton Business Park, Middleton Road	Employment	3.14
658	Land North of A683	Residential	16.52
703	Battery Hotel, Sandylands Promenade	Residential	0.13
710	Land South Of Lancaster Leisure Park, Wyresdale Road	Residential	2.13
718	Land East (Rear) of Dragon's Head, Main Street	Residential	0.67
720	Land South of Whinney Carr	Residential	27.04
719	Land South Of Low Road 2	Residential	6.39
680	Land South of Forge Lane	Residential	5.23
SA14	Port of Heysham Expansion	Employment	46.20
LA06	Kellet Road Industrial Estate	Employment	1.51
LA05	Heysham Industrial Estate	Employment	19.47
SA19	Port of Heysham	Employment	33.57
LA07	Lancaster West Business Park	Employment	32.14
LA04	Caton Road Industrial Estate	Employment	34.49
LA12	White Lund Industrial Estate	Employment	100.23
LA15	Claughton Brickworks and Buffer Store	Employment	7.39
LA19	Halton Mills	Employment	0.96
SA20	Port of Heysham Industrial Estate	Employment	12.48
LA17	Galgate Mill	Mixed Use	0.56
SA01	Whinney Carr and Burrow Heights	LP Strategic Housing Allocation	159.58
SA02	Bailrigg Lane	LP Strategic Housing Allocation	46.33
SA12	South of Windermere Road, Carnforth	LP Strategic Housing Allocation	28.70
LPSA799	Land at Home Farm	Residential	51.50

As discussed in Section 6.1, a precautionary approach to accounting for climate change should be considered by assuming that Flood Zone 2 will become Flood Zone 3a in 100 years' time and Flood Zone 3a could become Flood Zone 3b, though depending on local circumstances.

Any site layout and design should take account of the 8m easement buffer along watercourses, from the top of the bank or the landward toe of a defence on main rivers, where development is

not permitted. This easement buffer is recommended by the EA to allow ease of access to watercourses for maintenance works. Any site redesign, where Flood Zone 3a is included within the site footprint, should allow water to flow naturally or be stored in times of flood through application of suitable SuDS.

6.5.1.4 Recommendation D – Development could be allocated subject to FRA

This recommends that development could be allocated, assuming a site-specific FRA shows the site can be safe and it is demonstrated that the site is sequentially preferable. A site within Flood Zone 2 could still be rejected if the conclusions of the FRA decide development is unsafe or inappropriate.

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

Recommendation D applies to sites where the following criteria is true:

- Any site within Flood Zone 2 that does not have any part of its footprint within Flood Zone 3a, with the exception of highly vulnerable developments (such as gypsy and traveller sites) which would be subject to, and have to pass, the Exception Test.
- Employment, retail, recreation and leisure sites within Flood Zone 3a assuming the site use falls within the less vulnerable or water-compatible category of the flood risk vulnerability classification of the FRCC-PPG. No part of the site can be within Flood Zone 3b.
- Any site 100% within Flood Zone 1 where surface water flood risk is considered to be significant enough so as to require investigation through a site-specific FRA. Surface water risk to sites is assessed in Section 6.5.2.
- Any site 100% within Flood Zone 1 that is greater than or equal to 1 hectare in area.

Recommendation D applies to 254 potential sites overall, 31 of which are partially within Flood Zone 1.

As discussed previously for other recommendations, a precautionary approach to accounting for climate change should be considered by assuming that Flood Zone 2 will become Flood Zone 3a in 100 years' time.

All development proposals within Flood Zone 2 or Flood Zone 3a must be accompanied by a site-specific Flood Risk Assessment. Any sites 100% within Flood Zone 1 that are equal to or greater than 1 hectare in area must be accompanied by a site-specific Flood Risk Assessment to determine vulnerability to flooding from other sources as well as fluvial and tidal. The FRA should determine the potential of increased flood risk elsewhere as a result of the addition of hard surfaces on-site and the effect of new development on surface water runoff.

The FRCC-PPG states:

"Local authorities and developers should seek opportunities to reduce the overall level of flood risk in the area and beyond. This can be achieved, for instance, through the layout and form of development, including green infrastructure and the appropriate application of sustainable drainage systems, through safeguarding land for flood risk management, or where appropriate, through designing off-site works required to protect and support development in ways that benefit the area more generally." (Paragraph 50).

6.5.1.5 Recommendation E - Should be allocated on flood risk grounds subject to consultation with the LPA / LLFA

This recommends that development should be allocated on flood risk grounds, based on the evidence provided within this SFRA. Further investigation may be required by the developer and an FRA is required to assess further or new information that may not have been included within this SFRA. Recommendation E applies to 74 sites which equates to 16%.

As discussed previously for other recommendations, a precautionary approach to accounting for climate change should be considered. For these 74 sites, the SFRA Maps in Appendix A should

be consulted to ascertain which sites are in close proximity to Flood Zones 2 and 3a and may therefore be at risk from either flood zone in 100 years' time.

Recommendation E applies to any site with its area 100% within Flood Zone 1 and with either no risk or minimal risk from surface water, based on the updated Flood Map for Surface Water.

6.5.2 Surface Water Risk to Potential Sites

This section assesses surface water risk to each site according to the RoFSW. The Development Site Assessment spreadsheet in Appendix B isolates each of the surface water outlines so that any area of a site within the higher risk 1 in 30 year outline is excluded from the medium risk 1 in 100 year outline and any area within the 1 in 100 year outline is excluded from the lower risk 1 in 1000 year outline. This allows a sequential assessment of risk at each site.

Table 6-3 shows the number of sites at risk for each event. A number of these sites are also at fluvial and / or tidal flood risk.

NOTE: This assessment of surface water risk to sites DOES NOT take account of local circumstances, only that part of a site area falls within a surface water flood outline of the updated Flood Map for Surface Water.

Table 6-3: Number of sites at risk from surface water flooding

RoFSW event outline	Number of sites at risk	Number of sites with >=10% / >=20% area at risk
1 in 30 year	190	17
1 in 100 year	239	14
1 in 1000 year	323	33
In reality, sites within the 1 in 30 year outline will also be in the 1 in 100 year outline and those within the 1 in 100 year outline will also be in the 1000 year outline.		

Table 6-3 summarises the number of sites at risk from each surface water flood zone. Of the 190 sites at risk from the higher risk 1 in 30 year event, 17 have 10% or more of their site area at risk. 14 sites have 10% or more of their area at risk from the medium risk 1 in 100 year event and for the lower risk 1 in 1000 year extreme event, 33 sites have 20% or more of their area at risk.

As explained with the fluvial / tidal flood zones, the percentage thresholds are not included within any policy, it is merely considered that where a site has 10% or greater of its area at risk from the 1 in 30 or 1 in 100 year event outlines, or 20% or greater for the 1 in 1000 year event, then it could prove difficult to manage this surface water on-site. Therefore, a site-specific FRA should be carried out to investigate possible mitigation measures for flood storage or infiltration techniques through appropriate SuDS. The percentage thresholds do not consider local conditions.

Table 6-4 lists the sites where surface water flood risk is considered to be significant enough that it may be difficult to develop these sites. Overall there are 64 development sites that have potential significant surface water flooding issues, however the table below lists the 5 sites that are considered the most difficult sites to develop due to significant surface water.

Table 6-4: Sites requiring further investigation based on surface water risk

Site ID	Proposed use	Site Area (ha)	% Area within 1 in 30 Year Outline (RoFSW)	% Area within 1 in 100 Year Outline (RoFSW)	% Area within 1 in 1000 Year Outline (RoFSW)
LPSA795	Residential	1.39	9.68	20.60	**42.71**
22	Residential	0.05	0.00	0.00	**45.27**
604	Residential	0.50	0.00	4.79	**75.26**
394	Residential	0.35	0.73	7.24	**54.50**
553	Residential	0.73	0.00	0.00	**56.90**

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

Possible withdrawal, redesign or relocation of the site, certainly for those sites at higher risk from the 1 in 30 year event and those with a large percentage area at risk. This applies to the sites listed in

- Table 6- where further investigation is recommended;
- A detailed site-specific Flood Risk Assessment incorporating surface water flood risk management;
- A FRA 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, 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;
- Larger sites could leave surface water flood prone areas as open greenspace, incorporating social and environmental benefits;
- Effective surface water management should ensure risks on and off site are controlled;
- SuDS should be used where possible. Appropriate SuDS may offer opportunities to control runoff to Greenfield rates. Developers should refer to the LCoC SuDS Design Guidance[29]. 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;
- Whether the delineation of areas of critical drainage may be appropriate for areas particularly prone to surface water flooding. Detailed analysis and consultation with the LLFA, UU and the EA would be required. It may then be beneficial to carry out a Surface Water Management Plan (SWMP) or drainage strategy for targeted locations with any such areas of critical drainage. Investigation into the capacity of existing sewer systems would be required in order to identify critical parts of the system. Drainage model outputs could be obtained to confirm the critical parts of the drainage network and subsequent recommendations could then be made for future development i.e. strategic SuDS sites, parts of the drainage system where any new connections should be

29 http://m.northyorks.gov.uk/CHttpHandler.ashx?id=30769&p=0

avoided, and parts of the system that may have any additional capacity and recommended runoff rates.

6.6 Summary of Assessment Options

6.6.1 Rejection of site

A site which fails to pass the Sequential Test and / or the Exception Test would be rejected. Rejection would also apply to any residential (including gypsy and traveller) or employment site, or mixed use schemes with an element of residential development, as this falls into the more vulnerable, less vulnerable or highly vulnerable categories within Flood Zone 3b for which development should not be permitted. The Flood Risk and Coastal Change PPG flood risk vulnerability classification states that only water-compatible uses and essential infrastructure should be permitted in Flood Zone 3b, though any essential infrastructure must pass the Exception Test and clearly demonstrate that it does not increase or exacerbate flood risk. If the developer is able to avoid 3b, part of the site could still be delivered.

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 rejected.

6.6.2 Exception Test required

For those sites that, according to the FRCC-PPG vulnerability tables, would require the Exception Test. Only water-compatible and less vulnerable uses of land would not require the Exception Test in Flood Zone 3a. More vulnerable uses, including residential, and essential infrastructure are only permitted if the Exception Test is passed and all development proposals in Flood Zone 3a must be accompanied by a Flood Risk Assessment. To avoid having to apply the Exception Test, the developer / LPA should attempt to avoid the risk area altogether.

6.6.3 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 within Flood Zone 3a. 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. Developers should refer to Lancashire County Council's advice on SuDS, which provides details when and where SuDS are required. This is available at:

http://www.lancashire.gov.uk/council/planning/sustainable-drainage-systems.aspx

LCiC has also produced a Surface Water Drainage, Flood Risk Management and Watercourses Planning Advisory Note, published in 2015, which sets out how LCiC expects developers to manage surface water and flood risk on development sites. This supplements guidance in the Development Management DPD, following the removal of SuDS Approval Bodies (SABs).

Depending on local circumstances, if it is not possible to adjust the site boundary to remove the site footprint from Flood Zone 3b 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 from Flood Zone 3a to a lower risk zone or to incorporate the on-site storage of water within site design, then the Exception Test would have to be passed as part of a site-specific Flood Risk Assessment.

Any site layout and design options should take account of the 8 metre easement buffer along watercourses, from the top of the bank or the landward toe of a defence on main rivers, where development is not permitted. This easement buffer is recommended by the EA to allow ease of access to watercourses for maintenance works. Any site redesign, where Flood Zone 3a is included within the site footprint, should allow water to flow naturally or be stored in times of flood through application of appropriate SuDS techniques.

6.6.4 Site-Specific Flood Risk Assessment

According to the FRCC-PPG (Para 030), a site-specific FRA is:

"*…carried out by (or on behalf of) a developer to assess the flood risk to and from a development site. Where necessary (see footnote 20 in the National Planning Policy Framework), the assessment should accompany a planning application submitted to the local planning authority. The assessment should demonstrate to the decision-maker how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users (see Table 2 – Flood Risk Vulnerability of PPG)."*

The objectives of a site-specific FRA are to establish:

Whether a proposed development is likely to be affected by current or future flooding (including effects of climate change) from any source. This should include referencing this SFRA to establish sources of flooding. Further analysis should be performed to improve understanding of flood risk including agreement with the council on areas of functional floodplain that have not been specified within this SFRA. Key objectives:

- Whether the development will increase flood risk elsewhere;
- Whether the measures proposed to deal with these effects and risks are appropriate;
- The evidence for the local planning authority to apply (if necessary) the Sequential Test, and;
- Whether the development will be safe and pass the Exception Test, if applicable.

The FRCC-PPG doesn't contain any further detail on the minimum requirements for site-specific FRAs. It is therefore important that the EA's FRA guidance[30] is referred to and also the site-specific Flood Risk Assessment Checklist in paragraph 068 of the FRCC-PPG should be consulted. CIRIA's report 'C624 Development and Flood Risk' also provides useful guidance.

When is a Site-Specific FRA Required?

According to NPPF footnote 20, a site-specific FRA should be prepared when the application site is:

- Situated in Flood Zone 2 and 3; for all proposals for new development (including minor development and change of use)
- 1 hectare or greater in size and located in Flood Zone 1
- Located in Flood Zone 1 where there are critical drainage problems
- At risk of flooding from other sources of flooding, such as those identified in this SFRA
- Subject to a change of use to a higher vulnerability classification which may be subject to other sources of flooding

The LPA may also like to consider further options for stipulating FRA requirements, such as:

- Situated in an area currently benefitting from defences
- Situated within 20 metres of the bank top of a Main River
- Situated over a culverted watercourse or where development will require controlling the flow of any river or stream or the development could potentially change structures known to influence flood flow

These further options should be considered during the preparation and development of the Local Plan

30 https://www.gov.uk/flood-risk-assessment-local-planning-authorities

6.6.5 Sites passing the Sequential and Exception Tests

Development sites can be allocated or granted planning permission where the Sequential Test and the Exception Test (if required) are passed. In addition, a site is likely to be allocated without the need to assess flood risk where the proposed use is for open space. Assuming the site is not to include any development and is to be left open then the allocations is likely to be acceptable from a flood risk point of view. For such sites, opportunities for flood storage should be explored however as part of an FRA.

All development proposals within flood zones 2 or 3 must be accompanied by a Flood Risk Assessment. Any sites 100% within Flood Zone 1 that are 1 hectare or more in area must be accompanied by a Flood Risk Assessment to determine vulnerability to flooding from other sources as well as fluvial. The FRA should determine the potential of increased flood risk elsewhere as a result of the addition of hard surfaces on-site and the effect of new development on surface water runoff.

The Flood Risk and Coastal Change PPG states:

"Local authorities and developers should seek opportunities to reduce the overall level of flood risk in the area and beyond. This can be achieved, for instance, through the layout and form of development, including green infrastructure and the appropriate application of sustainable drainage systems, through safeguarding land for flood risk management, or where appropriate, through designing off-site works required to protect and support development in ways that benefit the area more generally." (Paragraph 50).

6.7 Guidance for Developers

This SFRA provides the evidence base for developers to assess flood risk at a strategic level and to determine the requirements of an appropriate site-specific FRA.

The aim of this section is to provide guidance for developers on using this SFRA.

When initially considering the development options for a site, developers should use this SFRA, the NPPF and the Planning Practice Guidance to:

- ***Identify whether the site is***
  - *A windfall development, allocated development, within a regeneration area, single property or subject to a change of use to identify if the Sequential and Exception Tests are required.*
- ***Check whether the Sequential Test and / or the Exception Test have already been applied***
  - *Request information from the LPA on whether the Sequential Test, or the likelihood of the site passing the Exception Test, have been assessed;*
  - *If not, provide evidence to the LPA that the site passes the Sequential Test and will pass the Exception Test.*
- ***Consult with the LPA Development Control, the LLFA and the EA and the wider group of flood risk consultees, where appropriate, to scope an appropriate FRA if required***
  - *Guidance on FRAs provided in Section 6.6.4 of this SFRA;*
  - *Also refer to the EA Standing Advice, CIRIA Report C624, LCoC SuDS Design Guidance, the NPPF and the Planning Practice Guidance;*
  - *Consult LLFA.*
- ***Submit FRA to Development Control and the EA for approval, where necessary***

Table 6-5 identifies, for developers, when the Sequential and Exception Tests are required for certain types of development and who is responsible for providing the evidence and those who should apply the tests if required.

Table 6-5: Development types and application of Sequential and Exception Tests for developers

Development	Sequential Test Required	Who Applies the Sequential Test?	Exception Test Required?	Who Applies the Exception Test?
Allocated Sites	No (assuming the development type is the same as that submitted via the allocations process)	LPA should have already carried out the test during the allocation of development sites	Dependent on land use vulnerability	LPA to advise on the likelihood of test being passed. The developer must also provide evidence that the test can be passed by providing planning justification and producing a detailed FRA
Windfall Sites	Yes	Developer provides evidence, to the LPA that the test can be passed. An area of search will be defined by local circumstances relating to the catchment and for the type of development being proposed	Dependent on land use vulnerability	Developer must provide evidence that the test can be passed by providing planning justification and producing a detailed FRA
Regeneration Sites Identified Within Local Plan	No	-	Dependent on land use vulnerability	LPA to advise on the likelihood of test being passed. The developer must also provide evidence that the test can be passed by providing planning justification and producing a detailed FRA
Redevelopment of Existing Single Properties	No	-	Dependent on land use vulnerability	Developer must provide evidence that the test can be passed by providing planning justification and producing a detailed FRA
Changes of Use	No (except for any proposal involving changes of use to land involving a caravan, camping or chalet site	Developer provides evidence, to the LPA that the test can be passed	Dependent on land use vulnerability	Developer must provide evidence that the test can be passed by providing planning justification and producing a detailed FRA

6.7.1 Development Management Sequential & Exception Test

This section of the SFRA has been developed to provide a useful tool to inform the development management process regarding the potential risk of flooding associated with future planning applications and the basis for requiring site-specific FRAs.

According to the NPPF Paragraph 103:

"When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific flood risk assessment following the Sequential Test, and if required the Exception Test, it can be demonstrated that:

- *Within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and*
- *Development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems."*

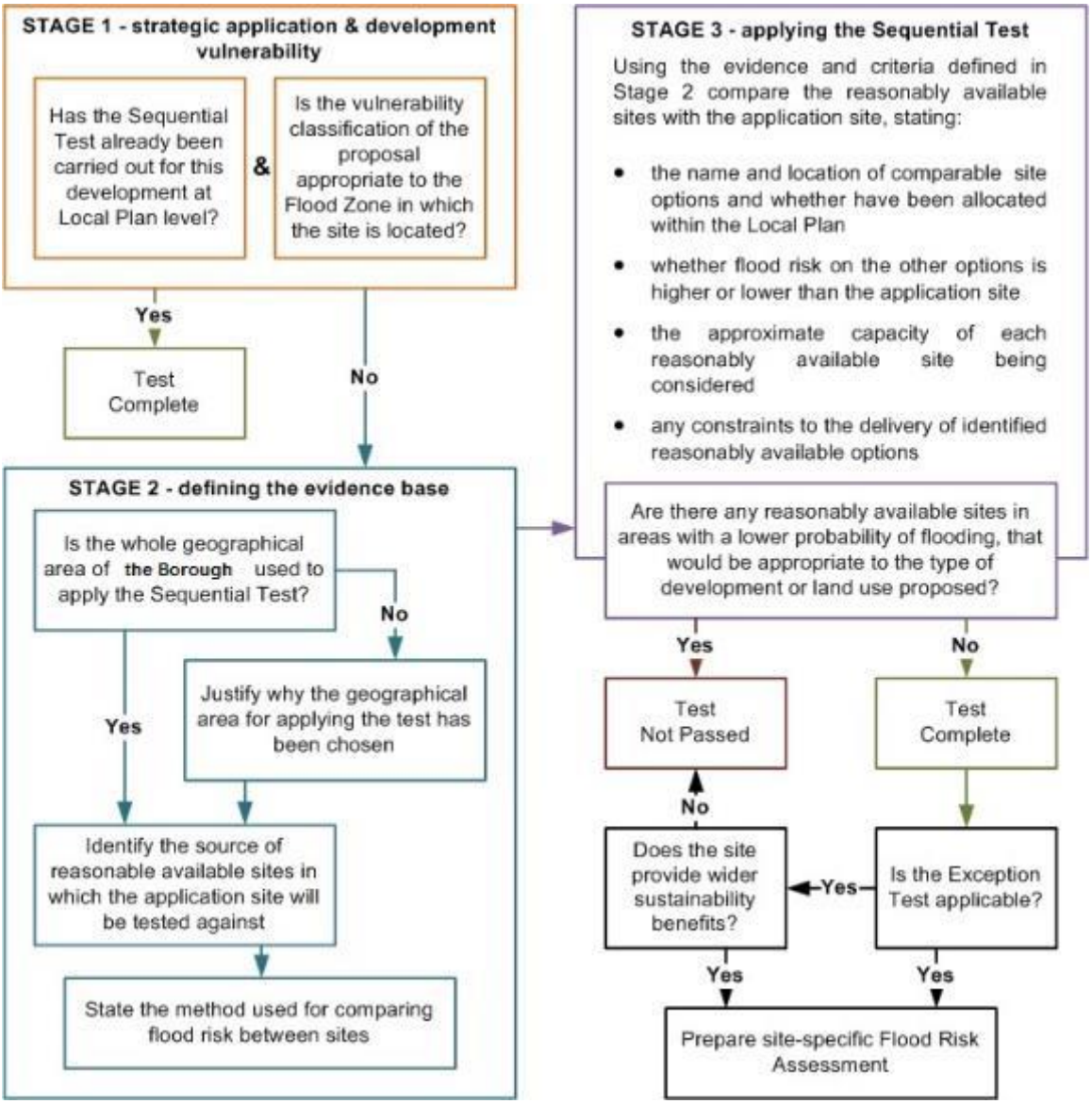
6.7.1.1 Demonstrating the Sequential Test for Planning Applications

The EA provides advice via:

https://www.gov.uk/guidance/flood-risk-assessment-the-sequential-test-for-applicants

This advice recommends the approach illustrated by Figure 6-3 is used by LPAs to apply the Sequential Test to planning applications located in flood zones 2 or 3.

Figure 6-3: Development management Sequential Test process



The approach provides an open demonstration of the Sequential Test being applied in line with the NPPF and the FRCC-PPG. The EA works with local authorities to agree locally specific approaches to the application of the Sequential Test and any local information or consultations with the Lead Local Flood Authority should be taken into account.

In accordance with the EA's advice, the following process should be followed:

- *First, check the Local Plan for sites that have already been allocated for development and could be suitable for the development you are proposing,*
- *Also look at sites that have not been allocated in the Local Plan, but that have been granted planning permission for a development that is the same or similar to the development you are proposing,*
- *Finally, check whether there are any 'windfall sites' in your search area. Windfall sites are sites that are not allocated in the Local Plan and do not have planning permission, but could be available for development. You can look for windfall sites yourself and also reference the Council's SHLAA.*

The Sequential Test does not apply to change of use applications unless it is for change of land use to a caravan, camping or chalet site, or to a mobile home site or park home site. The Sequential Test can also be considered adequately demonstrated if both of the following criteria are met:

- The Sequential Test has already been carried out for the site (for the same development type) at the strategic level (Local Plan); and
- The development vulnerability is appropriate to the Flood Zone (see Table 3 of the FRCC-PPG).

If both these criteria are met, reference should be provided for the site allocation of the Local Plan document and the vulnerability of the development should be clearly stated.

When applying the Sequential Test, the following should also be considered:

- **The geographic area in which the Test is to be applied. For LCiC, this would be the whole district;**
- **The source of reasonable available sites in which the application site will be tested against; and**
- **The evidence and method used to compare flood risk between sites.**

Sites should be compared in relation to flood risk; Local Plan status; capacity; and constraints to delivery including availability, policy restrictions, physical problems or limitations, potential impacts of the development on the local area, and future environmental conditions that would be experienced by the inhabitants of the development.

The test should conclude if there are any reasonably available sites, in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.

The LPA should now have sufficient information to be able to assess whether or not the proposed site has passed the Sequential Test. If the Test has been passed, then the developer should apply the Exception Test in the circumstances set out by tables 1 and 3 of the FRCC-PPG.

In all circumstances, where the site is within areas at risk of flooding and where a site-specific FRA has not already been carried out, a site-specific FRA should be completed in line with the NPPF and the FRCC-PPG. More detailed guidance on site-specific FRAs is provided in Section 6.6.4.

In addition to the formal Sequential Test, the NPPF sets out the requirement for developers to apply the sequential approach to locating development within the site. As part of their application and masterplanning discussions with applicants, LPAs should seek whether or not:

- Flood risk can be avoided by substituting less vulnerable uses or by amending the site layout;
- Less vulnerable uses for the site have been considered; or
- Density can be varied to reduce the number or the vulnerability of units located in higher risk parts of the site.

6.7.2 Taking Climate Change into Account

Climate change will increase flood risk over the lifetime of a development. This SFRA has considered a precautionary approach to climate change, as discussed in Section 6.1. The Level 1 SFRA screening is based on current flood outlines. Flood Zone 2 outlines may be used to provide an indication of future climate change impacts in term of flood depths and extents. Climate change impacts can be determined through more detailed appraisals as part of a Level 2 assessment or site specific Flood Risk Assessments. The SFRA is a screening review, sites will need to be safe and sustainable for the lifetime of the development as demonstrated by a site specific FRA.

A more detailed assessment of the impacts of climate change on flooding from the land and rivers should be carried out as part of a Level 2 SFRA or FRA. This should be carried out using the sensitivity ranges presented in this section which will provide an appropriately robust response to the uncertainty about climate change impacts on rainfall intensities and river flow.

Considering the impacts of climate change within a FRA / Level 2 SFRA will have implications for both the type of development that is appropriate according to its vulnerability to flooding and design standards for any SuDS or mitigation schemes proposed. For example, through very flat floodplains, using the +30 per cent from 2070 to 2115 allowance for peak river flows, could see an area currently within lower risk zones (Flood Zone 2), in future be re-classified as lying within a higher risk zone (Flood Zone 3a). Therefore, residential development may not be appropriate without suitable flood mitigation measures or flood resilient or resistant houses. In well-defined floodplains the same climate change allowance could have significant impacts on flood depths influencing building type and design (e.g. finished floor levels).

The EA revised the climate change allowances, in February 2017, for use in FRAs and SFRAs and will use these revised allowances when providing advice:

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

The revised climate change allowances are predictions of anticipated change for:

- Peak river flow by River Basin District;
- Peak rainfall intensity;
- Sea level rise; and
- Offshore wind speed and extreme wave height.

Deciding on which of the peak river flow allowances to use is based on the flood zone the development is within and the associated vulnerability classification (see Table 2 of the FRCC-PPG). Table 6-6 shows the peak river flow allowances for the North West River Basin District.

Table 6-6: Recommended Peak River Flow Allowances for the North West River Basin District

Allowance Category	Total Potential Change Anticipated for…		
	2020s (2015-2039)	2050s (2040-2069)	2080s (2070-2115)
Upper end	+20%	+35%	+70%
Higher central	+20%	+30%	+35%
Central	+15%	+25%	+30%

The peak rainfall intensity allowance applies to the whole of England. SFRAs and FRAs should assess both the central and upper end allowances to gauge the range of impacts. Table 6-7 shows these allowances.

Table 6-7: Peak Rainfall Intensity Allowance in Small and Urban Catchments for England

Allowance Category	Total Potential Change Anticipated for…		
	2015-2039	2040-2069	2070-2115
Upper end	+10%	+20%	+40%
Central	+5%	+10%	+20%

Allowances for sea level rise are based on different regions of England. The allowances for the North East of England are shown in Table 6-8. The number in brackets is the cumulative sea level rise for each year within each range.

Table 6-8: Sea Level Allowance for North West England

1990 - 2025	2026 - 2055	2056 - 2085	2086 - 2115	Cumulative Rise 1990 - 2115

				(metres)
2.5 mm (87.5 mm)	7 mm (210 mm)	10 mm (300 mm)	13 mm (390 mm)	0.99 m

The EA will also require consideration, if appropriate, of the 'high++ allowances' for peak river flows and mean sea level rise where a development is considered to be very sensitive to flood risk and with lifetimes beyond the end of the century. This could include infrastructure projects or developments that significantly change existing settlement patterns. The high++ allowances can be found in the EA's *Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities*[31], which uses science from UKCP09. This guidance is based on Government's policy for climate change adaptation, and is specifically intended for projects or strategies seeking Government Flood Defence Grant in Aid (FDGiA) funding. However, RMAs in England may also find it useful in developing plans and making Flood and Coastal Erosion Risk Management (FCERM) investment decisions even if there is no intention of applying for central government funding. This is important for any future large scale infrastructure used to support the delivery of strategic sites such as flood defence schemes.

Although, it is anticipated that increases in river flows will lie somewhere within the range of the central to upper end estimates of the February 2016 allowances, more extreme change cannot be discounted. The high++ allowances can be used to represent more severe climate change impacts and help to identify the options that would be required. The UKCP09 high++ allowances for peak river flows and relative mean sea level rise are presented in Table 6-9 and Table 6-10 respectively.

Table 6-9: UKCP09 High++ Allowances for Peak River Flow for the North West River Basin District (relative to 1961-90 baseline)

River Basin District	Total Potential Change Anticipated for…		
	2020s (2015-39)	2050s (2040-69	2080s (2070-2115
North West	+25%	+45%	+95%

Table 6-10: UKCP09 High++ Mean Sea Level Allowance (compared to 1990 baseline, includes land movements)

Sea Level Rise mm/yr up to 2025	Sea Level Rise mm/yr 2026 to 2050	Sea Level Rise mm/yr 2051 to 2080	Sea Level Rise mm/yr 2081 to 2115
6	12.5	24	33

Modelled climate change outputs, using the February 2016 allowances, are not available at the time of writing for this Level 1 SFRA. However, any Level 2 assessment, following on from this Level 1, could involve the modelling of appropriate climate change events, where fully functioning EA hydraulic models are available.

6.8 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.

As previously noted, both the County Council as the LLFA and LCiC as LPA have guidance on SuDS and the planning process for developers which should be referred to alongside this SFRA.

31 Environment Agency Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities

The FWMA, 2010, originally transferred the adoption and maintenance of SuDS to Sustainable Drainage Systems Approval Bodies (SABs) that were supposed to be established by local authorities, or LLFA's, under Schedule 3 of the Act. Nevertheless, Schedule 3 was not enacted and an alternative was introduced through the Town and County Planning Order. The designation of a SAB has since been removed following lengthy consultation, with the announcement from the Department for Communities and Local Government (DCLG) in December 2014 that local planners will be responsible for delivering SuDS[32]. Changes to planning legislation give 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. This builds on the existing planning system, the NPPF, which developers and local authorities are already using. Policy changes to the planning system can also be introduced relatively quickly ensuring that flood risk benefits from sustainable drainage systems can be brought forward as part of planning application proposals.

The NPPF continues to reinforce how planning applications that fail to deliver SuDS above conventional drainage techniques could be rejected and sustainable drainage should form part of integrated design secured by detailed planning conditions so that the SuDS to be constructed must be maintained to a minimum level of effectiveness.

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, EA and UU.

The non-statutory technical standards for sustainable drainage systems (March 2015) set 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.

In addition, the Local Planning Authority 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. CIRIA has also produced a

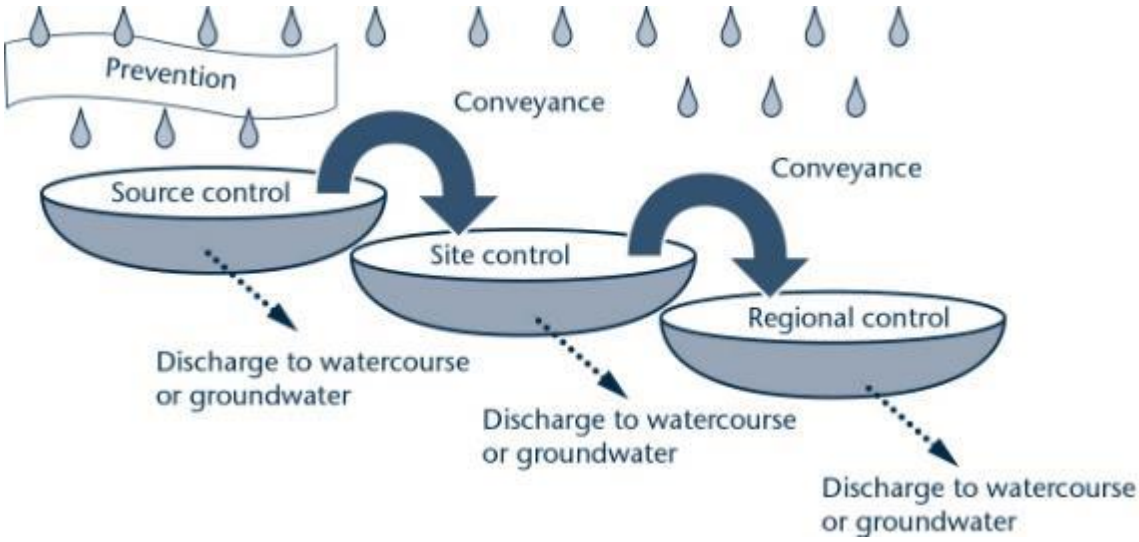
32 http://www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2014-12-18/HCWS161/

33 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

number of guidance documents relating to SuDS that should be consulted by the LPA and developers.

Many different SuDS techniques can be implemented. As a result, there is no one standard correct drainage solution for a site. In most cases, a combination of techniques, using the Management Train principle (see Figure 6-4), will be required, where source control is the primary aim.

Figure 6-4: SuDS Management Train Principle[34]



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 FRA. 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.

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

7 Emergency Planning

The provisions for emergency planning for local authorities as Category 1 responders are set out by the Civil Contingencies Act, 2004 and the National Flood Emergency Framework for England, December 2014[35]. 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 the Government's strategic approach to:

- Ensuring all delivery bodies understand their respective roles and responsibilities when planning for and responding to flood related emergencies,
- Give all players in an emergency flooding situation a common point of reference which includes key information, guidance and key policies,
- Establish clear thresholds for emergency response arrangements,
- Place proper emphasis on the multi-agency approach to managing flooding events,
- Provide clarity on the means of improving resilience and minimising the impact of flooding events,
- Provide 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 EA 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 SFRA 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 SFRA 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.

7.1 Civil Contingencies Act

Under the Civil Contingencies Act (CCA, 2004)[36], LCiC is classified as a Category 1 responder and has duties to assess the risk of emergencies occurring, and uses this to:

- inform contingency planning;
- put in place emergency plans;
- put in place Business continuity management arrangements;
- 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;
- 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 EA) to provide the core response.

7.1.1 Lancashire Resilience Forum

LCiC is a partner of the Lancashire Resilience Forum (LRF)[37]. The role of the Resilience Forum is to ensure an appropriate level of preparedness to enable an effective multi-agency response

35 https://www.gov.uk/government/publications/the-national-flood-emergency-framework-for-england

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

37 http://www.lancsresilience.org.uk/

to emergency incidents that may have a significant impact on the communities of Lancaster City Council and other districts in Lancashire. LRF consists of Category 1 and Category 2 responders from the Lancashire area. Category 1 responders include representatives from the Emergency Services, all fourteen of Lancashire's local authorities (including LCiC), Lancashire City Council, Lancashire Constabulary, the EA and the Maritime and Coastguard Agency. Category 2 responders include the Highways England, Network Rail, United Utilities and NHS North West.

7.1.1.1 Community Risk Register

As a strategic decision-making organisation, the LRF prepared a Community Risk Register (CRR)[38], last updated in December 2013, which considers the likelihood and consequences of the most significant risks and hazards the area faces, including fluvial and urban flooding. This SFRA 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.

7.1.1.2 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 the government's website[39].

7.1.1.3 Household Emergency Checklists

The LRF recommends individual families should complete a Household Emergency Checklist and Grab Bag to prepare for emergencies. A template checklist and advice on how to prepare for floods, and how to cope during and after flooding, is available from:

http://www.lancsresilience.org.uk/Pages/Advice/Flooding.html

7.1.2 Lancaster City Council Multi-Agency Flooding Plan (2016)

The Multi-Agency Flooding Plan (MAFP) sets out how LCiC will respond to any warning of potential flooding in the Council area. The plan only covers the response to flooding anticipated through EA Flood Alerts or Flood Warnings, as unexpected flooding incidents are notoriously difficult to predict and deal with. The plan has been developed in conjunction with the LRF's MAFP and the District Emergency Plan.

7.1.3 Lancaster City Council Severe Weather Plan (2010)

The Sever Weather Plan, the latest version of which was published in July 2010, details the command arrangements for severe or extreme weather events and the responsibilities of various Council services. It complements the severe weather guidance produced for Lancashire by the LRF and also LCiC's MAFP (see above).

7.1.4 Local Flood Plans

This SFRA provides a number of flood risk data sources that should be used when producing or updating flood plans. LCiC will be unable to write specific flood plans for new developments at flood risk. Developers should write their own. Guidance can be found on the EA web site[40]. 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 SFRA can help to:

38 http://www.lancsresilience.org.uk/Pages/General/RiskRegister.html

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

- 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 SFRA);
- 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; such as local community Flood Action Groups. The EA is working closely with Lancaster City Council who have been proactive in supporting new Community Groups following Dec 2015
- Support emergency responders in planning for and delivering a proportionate, scalable and flexible response to the level of risk;
- Provide flood risk evidence for further studies.

7.2 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 EA or the emergency services to approve evacuation plans, LCiC is accountable under its 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 nature of flooding, it is recommended that further discussions are held internally to LCiC between emergency planners and policy planners / development management officers, the LLFA, drainage engineers and also to external stakeholders such as the emergency services, the EA, UU and Canal & River Trust.

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 Local Plan, and discussions within the Lancashire 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 LCiC regarding maintenance and updating of the plan.

7.2.1 What should the Plan Include?

Flood warning and evacuation plans should include the information stated in Table 7-1. Advice and guidance on plans is accessible from the EA website and there are templates available for businesses and local communities

Table 7-1: Flood warning and evacuation plans

Consideration	Purpose
Availability of existing flood warning system	The EA offers a flood warning service that currently covers designated Flood Warning Areas in England and Wales. In these areas they are able to provide a full Flood Warning Service.

Consideration	Purpose
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 EA 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 access routes, preparing evacuation routes and the identification of safe locations for evacuees	Dry routes will be critical for people to evacuate as well as emergency services entering the site. The extent, depth and 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 FRCC-PPG. 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.

7.3 Flood Awareness

Emergency planners may also use the outputs from this SFRA 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 more resilient to flooding from all sources whilst also encouraging all those at fluvial flood risk to sign up to the EA's Floodline Warnings Direct[41] 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.

41 https://fwd.environment-agency.gov.uk/app/olr/home

8 Conclusions and Recommendations

8.1 Conclusions

This SFRA provides a single repository planning tool relating to flood risk and development in Lancaster District. Key flood risk stakeholders namely the EA, UU, Lancashire County Council, Lead Local Flood Authority and Canal & River Trust were consulted to collate all available and relevant flood risk information on all sources into one comprehensive assessment. Together with this report, this SFRA also provides a suite of interactive GeoPDF flood risk maps (Appendix A) and a Development Site Assessment spreadsheet (Appendix B) illustrating the level of risk to sites identified in the SHLAA, with subsequent recommendations.

The flood risk information, assessment, guidance and recommendations of the SFRA will provide the City Council with the evidence base required to apply the Sequential and Exception Tests, as required under the NPPF, and demonstrate that a risk based, sequential approach has been applied in the preparation of its new Local Plan.

Whilst the aim of the sequential approach is the avoidance of high flood risk areas, in locations such as Lancaster, Morecambe, Heysham and Carnforth, where the council is looking for continued growth, this will not always be possible. This SFRA therefore provides 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. As this is a strategic study, detailed local information on flood risk is not fully accounted for. For a more detailed assessment of specific areas or sites, a Level 2 SFRA may be carried out following on from the completion of a Level 1 assessment, if required.

8.2 Planning Policy and Flood Risk Recommendations

The following planning policy recommendations relating to flood risk are designed to enable the Council to translate the information provided in this Level 1 SFRA into meaningful Local Plan policy for flood risk and water management:

Policy Recommendation 1: No development within Flood Zone 3b…

…as per the NPPF and FRCC-PPG, unless in exceptional circumstances such as for essential infrastructure or where development is water compatible.

Development must not impede the flow of water within Flood Zone 3b nor should it reduce the volume available for storage of flood water.

Refer to tables 1 to 3 of the FRCC-PPG.

Policy Recommendation 2: Consider surface water flood risk…

…alongside fluvial risk, including possible withdrawal, redesign or relocation for sites at significant surface water risk.

Flood Risk Assessments should always consider surface water flood risk management and options for on-site flood storage.

Policy Recommendation 3: Sequential approach to site allocation and site layout…

…must be followed by the LPA to ensure sustainable development when either allocating land in Local Plans or determining planning applications for development.

The overall aim of the Sequential Approach should be to steer new development to low risk Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, the flood risk vulnerability of land uses and reasonably available sites in Flood Zone 2 should be considered, applying the Exception Test if required.

Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in higher risk Flood Zone 3, be considered. This should take into account the flood risk vulnerability of land uses and the likelihood of meeting the requirements of the Exception Test, if required.

This SFRA, the NPPF and FRCC-PPG should be consulted throughout this process.

Policy Recommendation 4: Requirement for a site-specific Flood Risk Assessment…

…from a developer when a site is:

- Within Flood Zone 3a or Flood Zone 2
- Within Flood Zone 1 and 1 hectare or greater in size
- At risk from surface water flooding
- Situated in an area currently benefitting from defences
- Situated within 20 metres of the bank top of a Main River
- Situated over a culverted watercourse or where development will be required to control or influence the flow of any watercourse

Before deciding on the scope of the FRA, this SFRA should be consulted along with the LPA, LLFA and EA. The FRA should be submitted to and approved by the LPA including suitable consultation with the LLFA and the EA.

Policy Recommendation 5: Use of appropriately sourced of SuDS…

…required for all major developments of 10 or more residential units or equivalent commercial development. This is in accordance with the interim national standards published in March 2015.

SuDS scoping and design, as part of a site-specific FRA, must be included within the early stages of the site design in order to incorporate appropriate SuDS within the development.

The LPA, LLFA and UU must be consulted during the site design stage and the FRA must be submitted to and approved by the LPA, considering all consultation with key stakeholders.

The EA should be consulted with regards to the construction of any structure associated with the discharge of surface water to a Main River.

Policy Recommendation 6: Phasing of development…

…should be carried out by the LPA to avoid any cumulative impacts of flood risk.

Using a phased approach to development, should ensure that any sites at risk of causing flooding to other sites are developed first in order to ensure flood storage measures are in place before other sites are developed, thus contributing to a sustainable approach to site development.

It may be possible that flood mitigation measures put in place at sites upstream could alleviate flooding at downstream or nearby sites.

Policy Recommendation 7: Planning permission for at risk sites…

…can only be granted by the LPA where a site-specific FRA shows that:

- The NPPF and FRCC-PPG have been referenced together with appropriate consultation with the LLFA, the EA and UU, where applicable
- The effects of climate change have been taken into account using the February 2016 allowances developed by the EA, though modelled climate change outputs are not available and have not been used in this Update
- There is no loss in floodplain storage resulting from the development
- The development will not increase flood risk elsewhere
- There is no adverse effect on the operational functions of any existing flood defence infrastructure
- Proposed resistance / resilience measures designed to deal with current and future risks are appropriate
- Appropriate SuDS techniques have been considered and are to be incorporated into the design of the site, where applicable
- Whether the development will be safe and has passed the Exception Test, if applicable.

An FRA is to be completed in accordance with the Planning Practice Guidance found here: https://www.gov.uk/guidance/flood-risk-and-coastal-change#site-specific-flood-risk-assessment-all

8.3 Recommendations for Further Work

The SFRA process has developed into more than just a planning tool. Sitting alongside the Lancashire and Blackpool LFRMS and Lancashire PFRA, it can be used to provide a much broader and inclusive vehicle for integrated, strategic and local flood risk management and delivery.

There are a number of plans and assessments listed in Table 8-1 that would be of benefit to LCiC, in developing their flood risk evidence base to support the delivery of their Local Plan or to help fill critical gaps in flood risk information.

8.3.1 Level 2 SFRA

The Council should review the sites where they expect the main housing numbers and employment sites to be delivered, using Section 0 of this report, the SFRA Maps in Appendix A and the Development Site Assessment spreadsheet in Appendix B. A Level 2 SFRA will be required if a large site, or group of sites, are within Flood Zone 3 and have strategic planning objectives, which means they cannot be relocated or avoided. A Level 2 SFRA may also be required if the majority of the sites are within Flood Zone 2 or are at significant risk of surface water flooding. Residual flood risk should also be taken account of when considering options for future work.

As discussed in Section 6.7.2, a Level 2 assessment can be used to model the February 2016 climate change allowances, where current EA models are available.

A Level 2 SFRA should build on the source information provided in this Level 1 assessment and should show that a site will not increase risk to others and will be safe, once developed, and will pass the Exception Test, if required. A Level 2 study may also assess locations and options for the implementation of open space, or Green Infrastructure, to help manage flood risk in key areas.

The LPA will need to provide evidence in their Local Plan to show that the housing numbers (and other sites) can be delivered. The Local Plan may be rejected if a large number of sites require the Exception Test to be passed but with no evidence that this will be possible.

Once all sites within this Level 1 assessment have been reviewed by the LPA then further advice or guidance should be sought to discuss possible next steps.

Table 8-1: Recommended further work for LCiC

Type	Study	Explanation	Timeframe
Understanding of local flood risk	EA Flood Risk Mapping updates	EA modelling updates of older models e.g. River Lune tributaries 2007 and River Lune 2011 Updates of Flood Map for Planning upon completion	Medium term
	Level 2 SFRA	Further, more detailed assessment of flood risk to high risk sites, as notified by this Level 1 SFRA	Short term
	SWMP / drainage strategy	For those high surface water risk sites / areas as notified by this Level 1 SFRA	Short term
Climate change (February 2016 allowances)	Level 2 SFRA	Modelling of climate change for available EA models, where applicable	Short term
CDA designation	Level 2 SFRA	Exploration of the possibility of designating official CDAs as notified to the LPA by the EA or identification of areas of critical drainage for use in LCiC's Local Plan	Short term
Flood storage	Community Infrastructure Levy (CIL)	For new developments, GI assets can be secured from a landowner's 'land value uplift' and as part of development agreements. The LPA could include capital for the purchase, design, planning and maintenance of GI within its CIL programme.	Short term
Data Collection	Flood Incident Data	The City Council, in collaboration with LCoC, has a duty to investigate and record details of locally significant flood events within the city. 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 / Ongoing
	FRM Asset Register	The City Council should continue to update and maintain their flood risk management register of structures and features, which are considered to have an effect on flood risk. This should be shared with LCoC	Ongoing
Risk assessment	Asset Register Risk Assessment	The City Council, in collaboration with LCoC, should carry out a strategic assessment of structures and features on the FRM Asset Register to inform capital programme and prioritise maintenance programme.	Short Term

Type	Study	Explanation	Timeframe
Capacity	SuDS review / guidance	LCiC should identify internal capacity required to deal with SuDS applications, set local specification and set policy for adoption and maintenance of SuDS.	Specification adopted
Partnership	United Utilities	LCiC should continue to work with UU on sewer and surface water projects.	Ongoing
	EA	The City Council / LCoC should continue to work with the EA on fluvial and tidal flood risk management projects. LCiC should also identify potential opportunities for joint schemes to tackle flooding from all sources.	Ongoing
	Canal & River Trust	The City Council / LCoC should continue to work with the Canal & River Trust to understand the residual risks associated with the Lancaster Canal and also asset owners of reservoirs.	Ongoing
	Community	Continued involvement with the community through the City Council's and LCoC's existing flood risk partnerships.	Ongoing

Appendices

A SFRA Maps

Interactive GeoPDF Maps

Open the Overview Map in Adobe Acrobat (2016s5367_LCC_SFRA_Overview.pdf). The Overview Map contains a set of four index squares covering four quarters of the district. Clicking on one of the four index squares will open up an Index Map for that area, by way of a hyperlink.

Each of the four Index Maps contain a further set of index squares covering different areas of the district 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 Flood Zones 2, 3a and 3b as delineated through this SFRA, and also the Risk of Flooding from Surface Water map (RoFSW).

C Functional Floodplain Delineation

Technical note explaining the methodology behind the delineation of the functional floodplain (Flood Zone 3b) for this SFRA.

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