International Advanced Manufacturing Park Area Action Plan Level 1 Strategic Flood Risk Assessment

Final

May 2024

Prepared for:

Sunderland City Council

South Tyneside Council

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This report describes work commissioned by Sunderland City Council and South Tyneside Council by an instruction dated 5 March 2024. The Client's representative for the contract was Gary Baker of Sunderland City Council. Laura Thompson and Freya Nation of JBA Consulting carried out this work.

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Abbreviations

AAP	Area Action Plan
AEP	Annual Exceedance Probability
Defra	Department for Environment Food & Rural Affairs
DLUHC	Department for Levelling Up, Housing and Communities
EA	Environment Agency
FAS	Flood Alleviation Scheme
FCERM	Flood and Coastal Erosion Risk Management
FMfP	Flood Map for Planning
FRA	Flood Risk Assessment
FRM	Flood Risk Management
FRCC-PPG	Flood Risk and Coastal Change planning Practice Guidance
FWMA	Flood and Water Management Act
HFM	Historic Flood Map
IAMP	International Advanced Manufacturing Park
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
mAOD	Metres above Ordnance Datum
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
NW	Northumbrian Water
PFR	Property Flood Resilience
PPG	Planning Practice Guidance
RFCC	Regional Flood and Coastal Committee
RFO	Recorded Flood Outline
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water
SCC	Sunderland City Council
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection
STC	South Tyneside Council
SuDS	Sustainable Drainage System
SWMP	Surface Water Management Plan
WFD	Water Framework Directive

WwNP	Working with Natural Processes

Executive Summary

The purpose of this Level 1 Strategic Flood Risk Assessment (SFRA) is to inform the latest update to the Area Action Plan (AAP) for the International Advanced Manufacturing Park (IAMP). This SFRA uses the latest flood risk information available, at the time of writing, together with the most current flood risk and planning policy available from the National Planning Policy Framework (NPPF) (2023) and Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG). The latest SFRA guidance has also been considered, including 'How to prepare a strategic flood risk assessment' guidance, March 2022, and the 'Strategic flood risk assessments a Good Practice Guide' guidance, November 2021. The latest climate change guidance for strategic flood risk assessment and site-specific flood risk assessments has also been considered.

This Level 1 SFRA is focused on collecting readily available flood risk information from key stakeholders, the aim being to help identify the spatial distribution of all sources of flood risk present throughout the IAMP area to inform the AAP.

Sunderland City Council (SCC) provided the AAP development site boundaries for consideration within this SFRA. An assessment of flood risk has been undertaken for each site to assist with the decision making within the AAP. The supplied sites are shown to be at varying risk from fluvial and surface water flooding. Development consideration assessments for all sites are summarised through recommended next steps within Appendix D and the development sites assessment spreadsheet in Appendix B.

SFRA Recommendations

The main planning policy and flood risk recommendations to come out of this SFRA are outlined briefly below and are based on the fundamentals of the National Planning Policy Framework and the Flood Risk and Coastal Change Planning Practice Guidance.

SFRA recommendations:

- No development within the functional floodplain, unless development is water compatible and has passed the exception test;
- Ensure site-specific Flood Risk Assessments are carried out to a suitable standard, where required, with full consultation required with the Local Planning Authority, the Lead Local Flood Authority, the Environment Agency, and Northumbrian Water as a minimum;
- Appropriate investigation and use of SuDS;
- Natural Flood Management techniques must be considered for mitigation; and
- Phasing of development must be carried out to avoid possible cumulative impacts.

Included within this Level 1 SFRA, along with this main report, are:

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

- Development site assessment spreadsheet detailing the risk to each site with recommended next steps – Appendix B Site screening assessment spreadsheet;
- Discussion of the recommendations outlined in the site screening spreadsheet – Appendix C Site screening summary; and
- A technical note on the delineation of the present day and future functional floodplain – Appendix D Functional floodplain delineation;
- IAMP AAP Level 1 SFRA User Guide – Appendix E.

1 Introduction

1.1 Commission

Sunderland City Council (SCC) and South Tyneside Council (STC) commissioned JBA Consulting to undertake a Level 1 Strategic Flood Risk Assessment (SFRA) to inform the latest update to the Area Action Plan (AAP) for the emerging International Advanced Manufacturing Park (IAMP). This SFRA updates the Level 1 SFRA assessments previously undertaken in support of the Sunderland Core Strategy and Development Plan, Sunderland Draft Allocations and Designations Plan, Draft South Tyneside Local Plan, and the current adopted IAMP AAP. The National Planning Policy Framework (NPPF) and Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG) have since been updated. This SFRA accounts for these updates.

1.2 Purpose

The purpose of this Level 1 Strategic Flood Risk Assessment (SFRA) is to inform the latest update to the Area Action Plan (AAP) for the International Advanced Manufacturing Park (IAMP). This SFRA uses the latest flood risk information available, at the time of writing, together with the most current flood risk and planning policy available from the National Planning Policy Framework (NPPF) (2023)[1] and Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG)[2]. The latest SFRA guidance has also been considered, including 'How to prepare a strategic flood risk assessment' guidance, March 2022[3], and the 'Strategic flood risk assessments a Good Practice Guide' guidance, November 2021[4]. The latest climate change guidance for strategic flood risk assessment and site-specific flood risk assessments has also been considered[5].

1.3 International Advanced Manufacturing Park Overview

The IAMP is located on land to the north of the existing Nissan car manufacturing plant, to the west of the A19 and to the south of the A184, benefitting from close transport links via rail, port and road. The IAMP AAP boundary is shared by both Sunderland City Council and South Tyneside Council administrative areas, as shown in Figure 1-1. At the time of writing,

1 National Planning Policy Framework; Ministry of Housing, Communities & Local Government, 2021

2 Flood Risk and Coastal Change Planning Practice Guidance; Ministry of Housing, Communities & Local Government, 2022

3 How to prepare a Strategic Flood Risk Assessment, Defra and Environment Agency, 2022

4 Strategic flood risk assessments A GOOD PRACTICE GUIDE, Report produced using Environment Agency research on 'using flood risk information in spatial planning' (2019-2020), 2021

5 Flood risk assessments: climate change allowances - GOV.UK (www.gov.uk)

the site mainly comprises arable farmland and some already developed areas, with the River Don running through the centre of the manufacturing park.

The vision for the IAMP is:

‘A nationally important and internationally respected location for advanced manufacturing and European-scale supply chain industries. A planned and sustainable employment location that maximises links with Nissan and other high value automotive industries as well as the local infrastructure assets, including the ports, airports and road infrastructure’[6].

6 International Advanced Manufacturing Park Area Action Plan 2017-2032 | SCC and STC | 2017

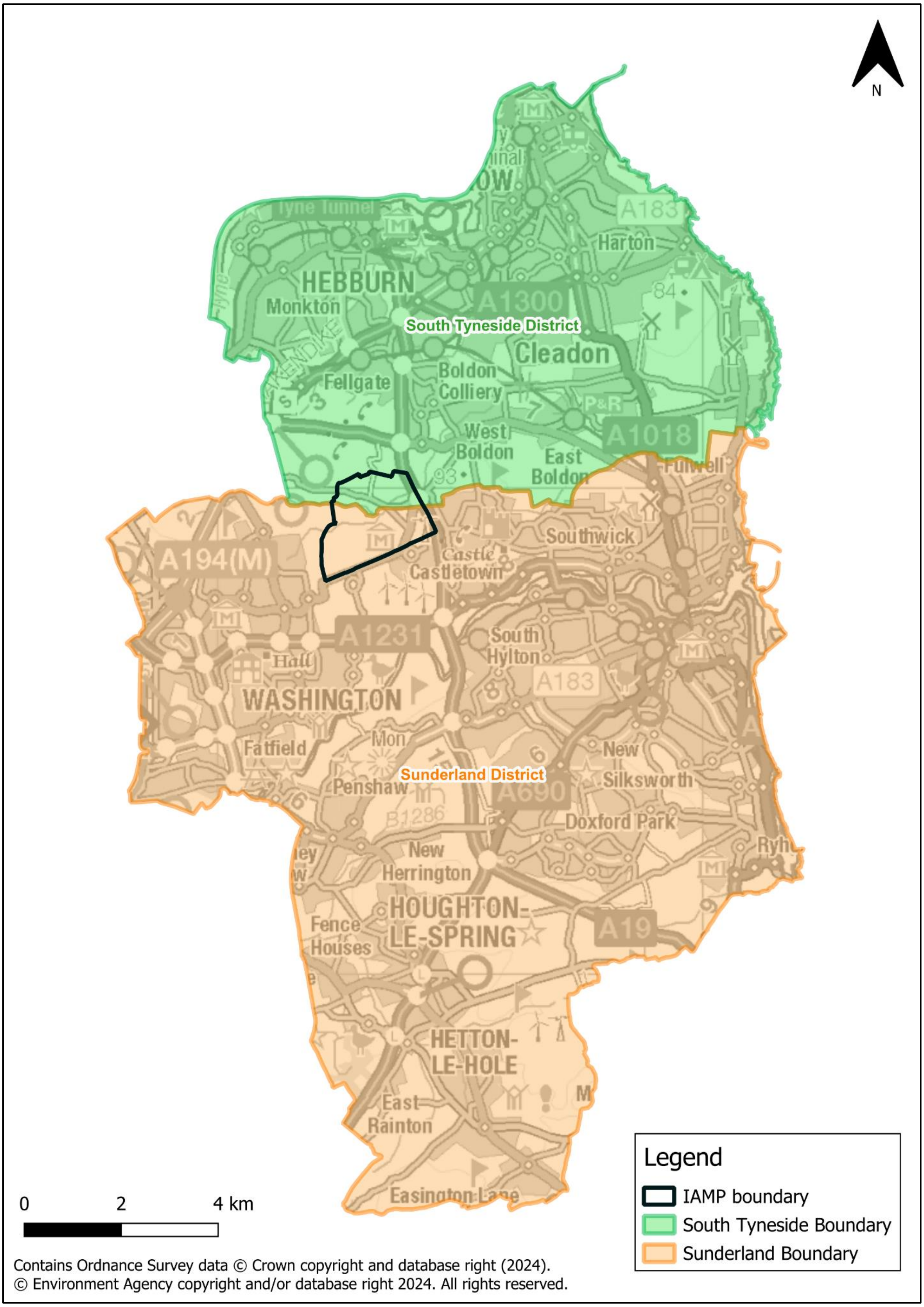

Figure 1-1 District boundaries covering the IAMP

1.4 IAMP Area Action Plan

The AAP was adopted by both Sunderland City Council and South Tyneside Council in November 2017 and forms part of the statutory development plan for both councils. The AAP provides the planning policy framework for the comprehensive development of the IAMP for principal uses, including production, supply chain and distribution activities directly related to the Automotive and Advanced Manufacturing sectors. The AAP should be read alongside policies within the development plans for both respective councils, as these will continue to be applied within the IAMP area, except where there is a site-specific policy set out within the AAP.

1.5 Purpose of the Strategic Flood Risk Assessment

All local planning authorities (LPA) should produce a Level 1 SFRA for the area covered by the local plan. A Level 2 SFRA may also be required depending on whether the LPA has plans for development in flood risk areas, including those identified through this IAMP-specific Level 1 SFRA. The EA's SFRA guidance for LPAs (updated March 2022, at the time of writing) states:

"*Your SFRA will help your planning authority make decisions about:*

- *your local plan or spatial development strategy*
- *individual planning applications*
- *how to adapt to climate change*
- *future flood management*
- *emergency planning (the resources needed to make development safe)*
- *site masterplans and local design guidance or codes*
- *infrastructure planning*
- *community infrastructure levy and planning obligations*

You also need it to help you:

- *carry out the sequential test for the local plan or spatial development strategy, and individual planning applications*
- *do the exception test, when you're proposing to allocate land for development in flood risk areas*
- *establish if a development can be made safe without increasing flood risk elsewhere*
- *decide when a flood risk assessment will be needed for individual planning applications*
- *identify if proposed development is in functional floodplain*
- *do the sustainability appraisal of the local plan or spatial development strategy*."

1.6 SFRA Objectives

The aims and objectives of this Level 1 SFRA, in line with the NPPF (2023), FRCC-PPG (2022), EA SFRA guidance (2022), EA Good Practice guide (2021) and more specifically included in SCC/STC's Brief, are to:

- Update previous SFRA work undertaken for Sunderland and South Tyneside Councils with respect to their Local Plans to take into consideration the revised scale and quantum of development anticipated within the IAMP area over the plan period;
- Update the main Level 1 SFRA report to take into consideration changes to legislation and government guidance which have taken place since the preparation of previous reports;
- Identify any necessary mitigation schemes required to appropriately mitigate the impacts of development;
- Model the current Environment Agency climate change allowances for peak river flows on the River Don;
- Update the functional floodplain and future functional floodplain on the River Don within the IAMP; and
- Update the Level 1 SFRA mapping for the IAMP.

1.7 Consultation

The EA's 2022 SFRA guidance recommends consultation with the following parties, external to the LPA:

- The EA;
- The LLFA;
- Emergency planners;
- Emergency services;
- Water and sewerage companies;
- Highways authorities;
- District councils; and
- Regional flood and coastal committees.

1.8 SFRA future proofing

This SFRA update 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 organisations (SCC and STC) that the latest information is being used when decisions concerning development and flood risk are being considered in the IAMP. The 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's 2022 SFRA guidance states a review of a SFRA should be carried out when there are changes to:

- *The predicted impacts of climate change on flood risk;*
- *Detailed flood modelling - such as from the EA or LLFA;*
- *The Area Action Plan, local plan, spatial development strategy or relevant local development documents;*

- *Local flood management schemes;*
- *Local flood risk management strategies; and*
- *National planning policy or guidance.*

The SFRA should also be reviewed after a significant flood event. It is in any authority's interest to keep the SFRA as up to date as possible.

Ideally, the SFRA should be kept as a 'live' entity and continually updated when new information becomes available. The EA requests for reports and maps to be published online and be easily updateable, when required. This includes any updates to the River Don IAMP TWO model which impacts the study area, or any updates to peak river flow uplift allowances.

This SFRA uses the EA's Flood Map for Planning (FMfP) version issued in February 2024 to assess fluvial risk in the IAMP. The Flood Map for Planning is updated by the EA, as and when accepted new modelling data becomes available. The reader should therefore refer to the online version of the Flood Map for Planning[7] to check whether the flood zones have been updated since February 2024.

To assess surface water risk, this SFRA uses the EA's Risk of Flooding from Surface Water (RoFSW) dataset, last updated May 2021 at the time of writing. This dataset can be updated periodically when applicable local surface water modelling is carried out that adheres to the EA's required methodology. The reader should therefore refer to the online version of the RoFSW map[8] to check whether the surface water flood outlines have been updated.

At the time of writing, the RoFSW is being updated and is due for release in late 2024.

7 Flood Map for Planning | Environment Agency
8 Check long term flood risk | Environment Agency

2 Study Area

2.1 Geology and topography

Given the relatively small size of the study area, the geology and topography across the region are relatively consistent. According to the British Geological Survey (BGS) records[9], bedrock is a combination of Pennine Middle Coal Measures and Pennine Upper Coal Measures formations. Superficial deposits within the study area are a combination of clay, silt, sand and gravel.

The topography across the IAMP is fairly similar, largely flat, with a maximum variation in elevation of approximately 15 m. The areas of highest elevation are along the western boundary of the IAMP area, with the lowest elevations present along the floodplain of the River Don.

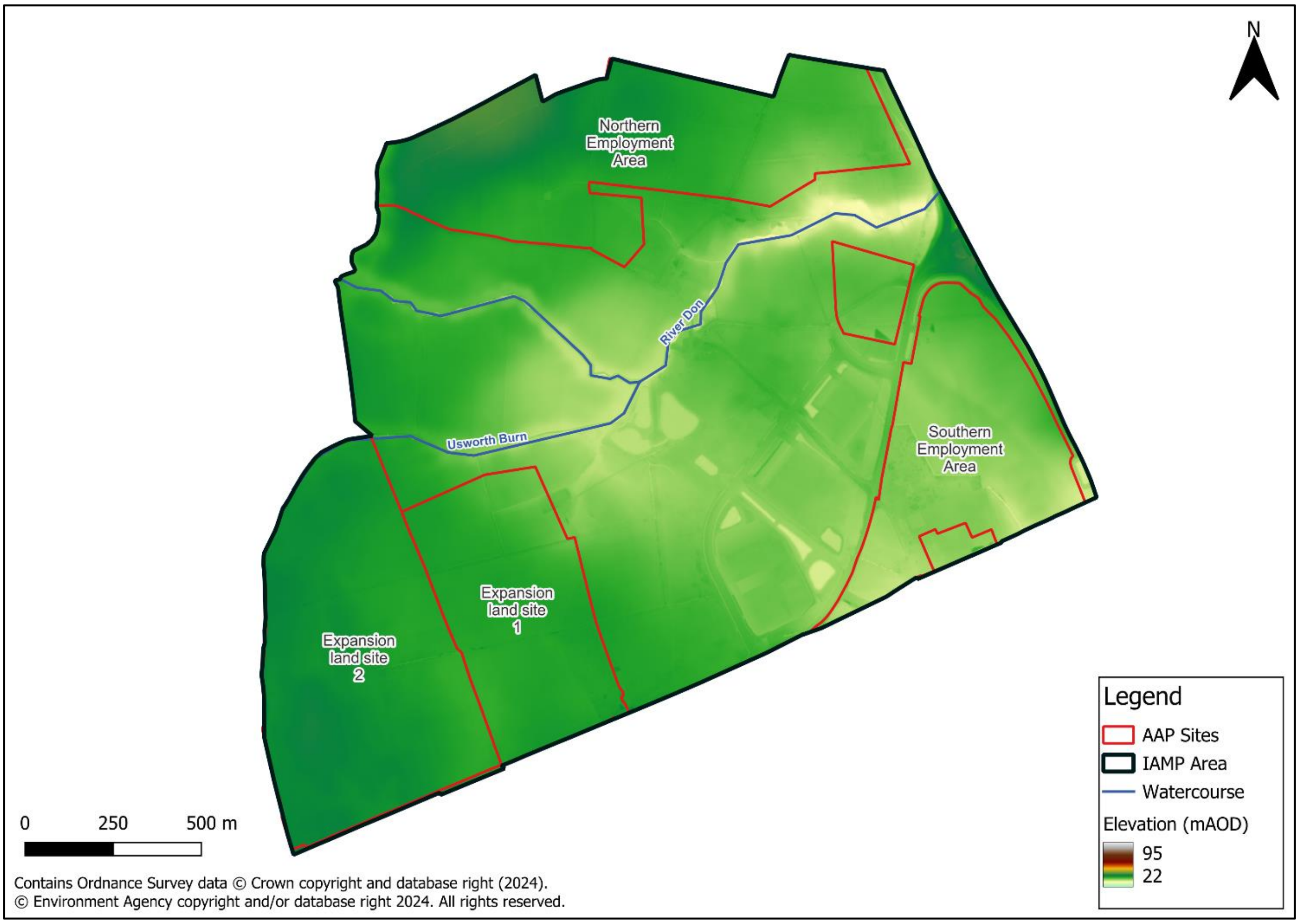

Figure 2-1 Topography and watercourses within the IAMP

2.2 Main rivers

Main rivers are generally major watercourses for which the EA has permissive powers to carry out maintenance, improvement, or construction work to manage flood risk. The EA

9 BGS Geology - British Geological Survey

also regulate development or works in, on, over, under or within 8 metres of fluvial main river watercourses under the Environmental Permitting (England and Wales) Regulation 2016. This also includes within the floodplain if works do not have planning permission and require quarrying or excavation within 16 metres of any main river, flood defence or culvert. The range of activities subject to regulation are listed online.

Whilst the EA has permissive powers to undertake works, the maintenance of main rivers is primarily the responsibility of riparian owners.

The main rivers within the IAMP are the River Don and the tributary Usworth Burn (Figure 2-2).

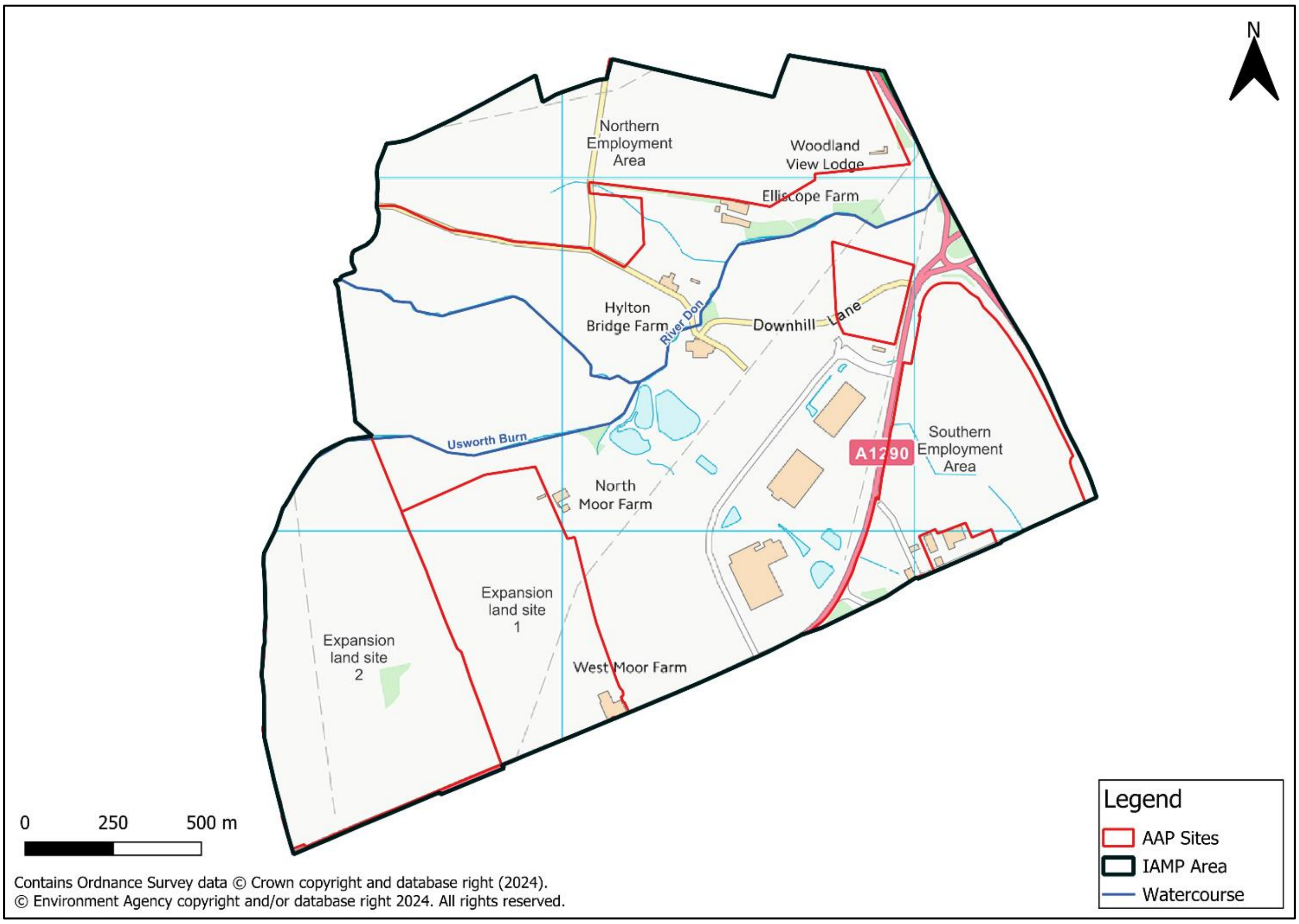

Figure 2-2 Main rivers within the IAMP

2.3 Ordinary watercourses

Ordinary watercourses are any watercourse that is not designated main river. These watercourses can vary in size considerably and can include rivers, streams and all ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers within the meaning of the Water Industry Act 2014) and passages, through which water flows. Ordinary watercourses do not always contain flowing water all year long; there may be times where the watercourses run dry, particularly over prolonged dry spells. Such watercourses can be described as ephemeral watercourses.

Ordinary watercourses come under the regulation of the LLFA, which has permissive powers to carry out works, should this be deemed necessary, and have regulatory control over certain development activities within the watercourse channel. However, the responsibility for the maintenance of ordinary watercourses lies with the riparian owner. A riparian owner is anyone who owns a property where there is a watercourse within or adjacent to the boundaries of their property; they are responsible for watercourses or culverted watercourses passing through their land.

There are no known ordinary watercourses located within the IAMP.

3 Understanding flood risk

3.1 Sources of flooding

Flooding 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 human or environmental assets are present in the area that floods. Assets at risk from flooding can include housing, transport, and public service infrastructure (including vulnerable services such as hospitals and schools), commercial and industrial enterprises, agricultural land, and environmental and cultural heritage. Flooding in the IAMP can occur from many different and combined sources such as fluvial (from main rivers), surface water, groundwater, or indirectly from infrastructure failure.

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.

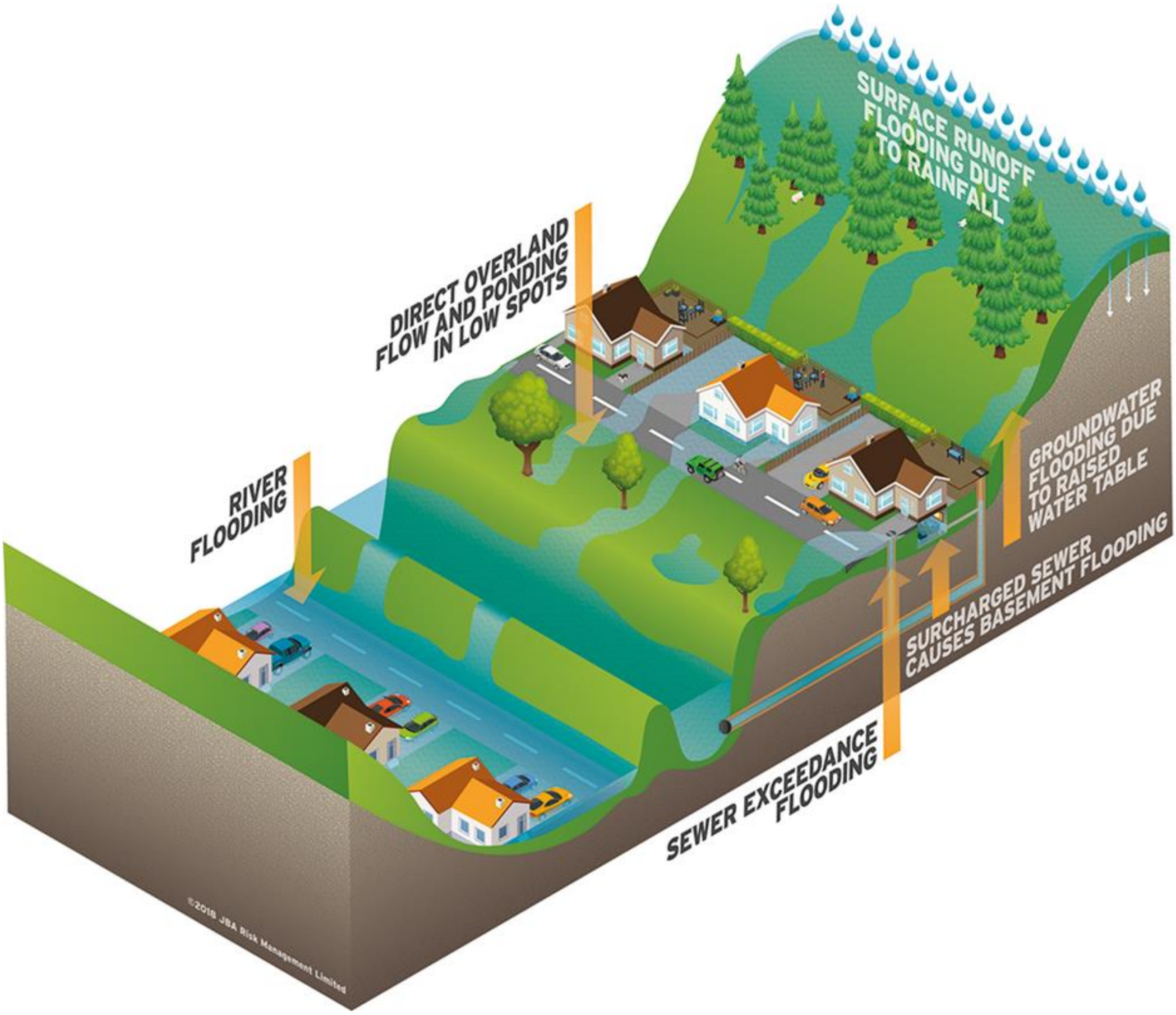

Figure 3-1 Flooding from all sources

3.1.1 Rivers

River flooding is the inundation of floodplains from rivers and smaller watercourses; the inundation of areas outside the floodplain due to the influence of bridges, embankments and other features that artificially raise water levels; overtopping or breaching of defences; blockages of culverts or flood channels/corridors.

River flooding is associated with the exceedance of channel capacity during higher flows or because of obstruction (residual risk). The process of flooding from a watercourse depends on several 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.

The EA's Flood Map for Planning (Rivers and Sea) (Section 4.1.1) is used to assess flood risk from rivers in this Level 1 SFRA. The Flood Map for Planning is presented on the interactive GeoPDF maps in Appendix A.

3.1.2 Surface water

Surface water or 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 lower areas or natural depressions. Areas at risk of pluvial flooding can, therefore, lie outside of the fluvial flood zones.

Pluvial flooding within urban areas will typically be associated with events equal to or greater than the 1 in 30 year (3.3% AEP) design standard of new sewer systems. Some older sewer and highway drainage networks will have a lower capacity than is required to mitigate for the 3.3% AEP event. There is also residual risk associated with these networks due to possible network failures, blockages, or collapses.

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

Surface water flood risk is afforded equal standing in importance and consideration as fluvial risk, given the increase in rainfall intensities due to climate change and the increase in impermeable land use due to development. 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.

The EA’s Risk of Flooding from Surface Water (RoFSW) map (Section 4.2.1) is used to assess surface water flood risk in this Level 1 SFRA. Also, Section 5.6.2 provides guidance on SuDS options for developers. The RoFSW is presented on the interactive GeoPDF maps in Appendix A.

3.1.3 Groundwater

Groundwater water flooding occurs when the water table rises after prolonged rainfall to emerge above ground level remote from a watercourse. It is most likely to occur in low-lying areas underlain by permeable rock (aquifers) and groundwater recovery areas, after pumping for mining or industry has ceased. Warmer, wetter winters due to climate change may have significant impacts on groundwater levels.

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, 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 infiltration SuDS; however, this is dependent on detailed site investigation and risk assessment at the FRA stage.

JBA’s 5m Groundwater Flood Risk Map (Section 4.3) is used to assess potential risk from groundwater in this Level 1 SFRA and is presented on the interactive GeoPDF maps in Appendix A.

3.1.4 Sewers

Flooding from the sewer network can occur 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.

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 surface water systems during times of high flows. Some areas may also be served by separate waste and surface water sewers which convey wastewater to treatment works and surface water into local watercourses or combined sewers.

Northumbrian Water (NW) is the water company responsible for the management of the public sewer drainage network in the IAMP.

3.1.5 Reservoirs

A reservoir can usually be described as an artificial or non-natural lake where water is stored for use. The risk of flooding associated with reservoirs is residual (Section 3.2.3.2) and is associated with failure of reservoir outfalls or dam breaching. This risk is reduced through regular inspection and 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's Reservoir Flood Map (RFM) shows the locations at risk from reservoir flooding (Section 4.5.1) though the IAMP is not at risk.

3.1.6 Canals

The risk of flooding from a canal is considered to be residual and is dependent on a number of factors. As canals are manmade systems that are heavily controlled, it is unlikely they will respond in the same way as a natural watercourse during a storm event. Flooding is more likely to be associated with residual risks, like those associated with river defences, such as overtopping of canal banks, breaching of embanked reaches or asset (gate) failure as highlighted in Table 3-1. Canals can also have a significant interaction with other sources, such as watercourses that feed them and minor watercourses or drains that cross underneath.

Table 3-1 Canal flooding

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

There are no canals with the potential to cause flooding within the IAMP.

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 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 Figure 3-2.

Figure 3-2 Source - pathway - receptor model

The principal flood sources within the IAMP include fluvial and surface water; the most common pathways are rivers, drains, sewers, overland flows; and the receptors include property and people. All three elements must be present for flood risk to arise. Mitigation, i.e. flood defence, measures have little or no effect on sources of flooding, but they can block or impede pathways or remove receptors.

3.2.1 Likelihood

The likelihood of flooding is expressed as the percentage probability based on the average frequency measured or extrapolated from records over many years. A 1% AEP (Annual Exceedance Probability) event indicates the flood level that is expected to be reached on average once in a hundred years, i.e. it has a 1 in 100 (1%) chance of occurring in any one year, not that it will occur once every one hundred years.

Table 3-2 provides an example of the flood probabilities used to describe the flood zones as defined in the FRCC-PPG and as used by the EA in its Flood Map for Planning (Rivers and Sea).

NOTE: Paragraph 078 of the FRCC-PPG states: - *"flood zones shown on the Flood Map for Planning do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding".*

The Flood Map for Planning can be accessed online[7].

Table 3-2 NPPF flood zones[10]

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 0.1% annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map for Planning – all land outside Zones 2, 3a and 3b)
Zone 2 Medium Probability	Land having between a 1% and 0.1% annual probability of river flooding; or land having between a 0.5% and 0.1% annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1% or greater annual probability of river flooding; or Land having a 0.5% or greater annual probability of sea. (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. LPAs should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the EA. (Not separately distinguished from Zone 3a on the Flood Map for Planning)

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, 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

3.2.3 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. It is also clear that risk will increase with climate change.

10 Table 1: Flood Zones, Paragraph 001 of the Flood Risk and Coastal Change Planning Practice Guidance, August 2022

3.2.3.1 Existing risk

Existing risk describes the primary, or prime, risk from a known and understood source managed to a known 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, it is important to recognise that risk comes from many different sources and that the SoP provided will vary within a river catchment. The existing risk of flooding from the river may be low to a settlement behind the defence but moderate from surface water, which may pond behind the defence in low spots and is unable to discharge into the river during high water levels. However, the residual risk may be high in that the impact of flood defence failure would likely have a major impact.

3.2.3.2 Residual risk

Defended areas remain at residual risk as there is a risk of defence failure during significant flood events. Areas behind flood defences are at particular risk from rapid onset of fast-flowing and deep-water flooding, with little or no warning if defences are overtopped or breached.

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 considered. Because of this, it is never appropriate to use the term "flood free".

Developers must be able to demonstrate that development will be safe for the lifespan of the development. To that end, Paragraph 042 of the FRCC-PPG states:

"Where residual risk from flood risk management infrastructure affects large areas, the Strategic Flood Risk Assessment will need to indicate the nature, severity and variation in risk within this area, 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 strategic policies their preferred mitigation strategy for ensuring development will be safe throughout its lifetime in relation to urban form, risk management and where flood mitigation measures are likely to have wider sustainable design implications".

Residual flood risk from breach or overtopping of defences must be managed for any new development. Detailed mitigation must be agreed through site-specific FRAs or through Level 2 SFRAs where it would be necessary to demonstrate site allocations would be safe for their lifetime.

3.3 Climate change

Following on from the UK Climate Projections 2009 (UKCP09), the UK Climate Projections 2018 (UKCP18) delivered a major upgrade to the range of UK climate projection tools designed to help decision-makers assess their risk exposure to our changing climate.

The UKCP18 project used cutting-edge climate science to provide updated observations and climate change projections up to the year 2100 across the UK. The project builds upon

UKCP09 to provide the most up-to-date assessment of how the climate of the UK may change over the 21st century.

UKCP18 updates the projections over land and provides a set of detailed future climate projections for the UK at a 12km scale. Models of high impact events such as from localised heavy rainfall in summer the months were created. UKCP18 enables the UK to adapt to the challenges and opportunities presented by climate change.

In relation to flood risk and climate change in the planning system, the NPPF states:

"All plans should apply a sequential, risk-based approach to the location of development – taking into account the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property" (para 167).

Local plans should do this by safeguarding land from development that is required, or likely to be required, for current or future flood management; and to seek opportunities for the relocation of development, including housing, to more sustainable locations from areas where climate change is expected to increase flood risk.

The likely impacts of climate change are well documented and will have an impact on flood risk across the IAMP area. Increases in duration and intensity of extreme rainfall events because of climate change will increase flood risk from multiple sources. The impacts of climate change on each flooding source are outlined throughout Section 4.7.

4 Flood risk within the IAMP

4.1 Flood risk from rivers

4.1.1 EA Flood Map for Planning (Rivers and Sea)

The Flood Map for Planning is the main dataset used by planners for predicting the location and extent of flooding from rivers. This is supported by the CFMPs along with several detailed hydraulic river modelling reports that provide further detail on flooding mechanisms.

The Flood Map for Planning provides the flooding from rivers flood extents for the 1 in 100 year (1% AEP) flood event (Flood Zone 3) and the 1 in 1000 year (0.1% AEP) flood event (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 its flood zones with detailed hydraulic model outputs as part of its national flood risk mapping programme.

The 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 from rivers or the sea and do not take account of climate change. As directed by the FRCC-PPG, this SFRA subdivides Flood Zone 3 into Flood Zone 3a and Flood Zone 3b, also known as the functional floodplain (Section 4.1.2).

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 4.1.3.

Figure 4-1 shows the EA's Flood Map for Planning (Rivers and Sea), which identifies the areas within the IAMP that are at risk of flooding from rivers. Fluvial risk within the study area comes from the River Don and its tributary the Usworth Burn which flow through the centre of the IAMP. Most risk is around the confluence of both watercourses. Flood Zone 3a impacts the northern boundary of the 'Expansion land site 2' AAP site. Flood Zone 2 is more extensive, impacting the northern boundary of the 'Expansion land site 2' AAP site and the south western corner of the 'Southern Employment Area' AAP site.

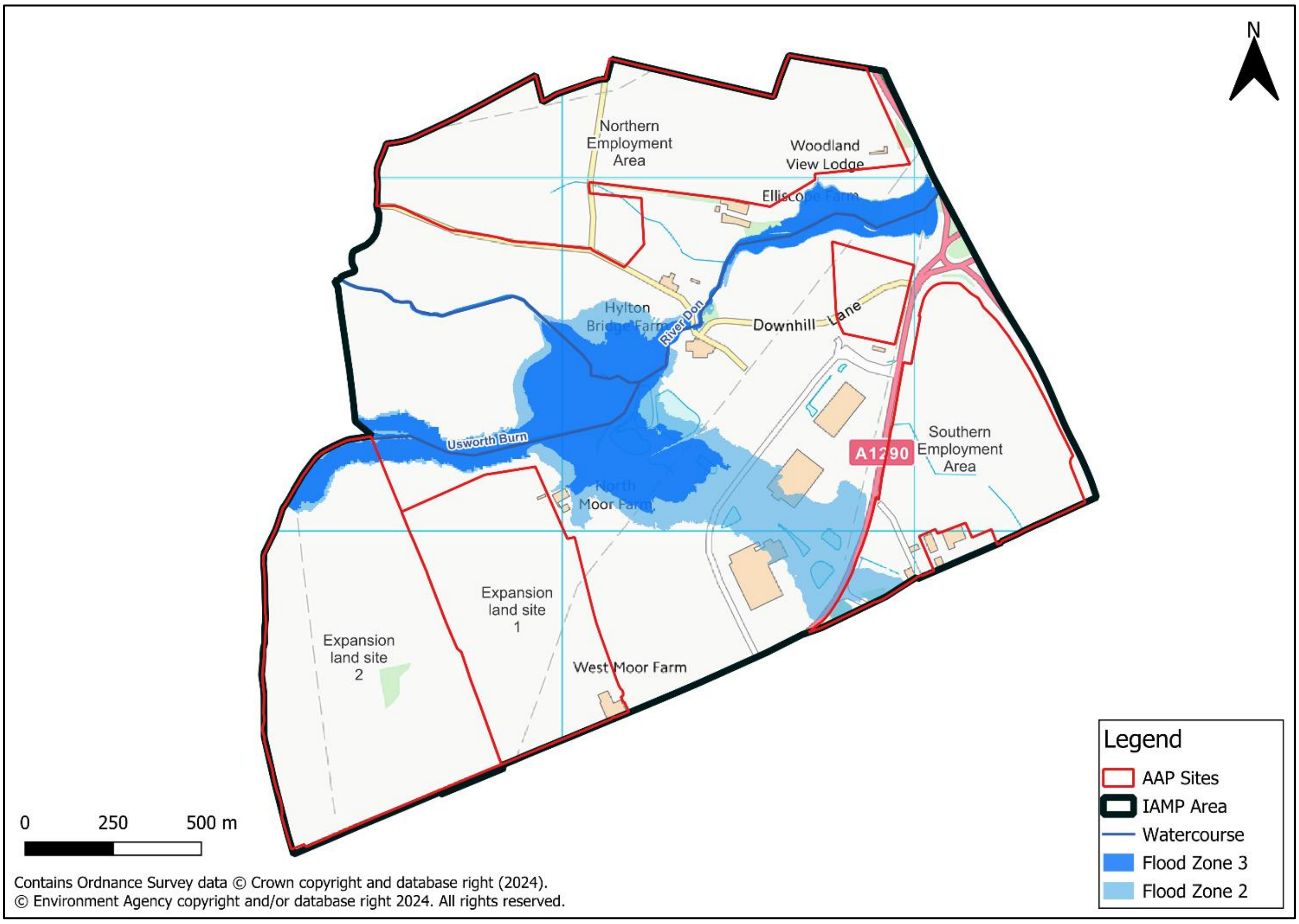

Figure 4-1 Flood Map for Planning showing the risk of flooding from rivers within the IAMP

4.1.2 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 078 of the FRCC-PPG defines Flood Zone 3b as:

"…*land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise:*

- *land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or*
- *land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding)".*

Paragraph 078 also explains that:

"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."

Flood Zone 3b within the IAMP has been updated through this SFRA and is based on the modelled 3.33% AEP defended event along the River Don and Usworth Burn. The extent of the functional floodplain is assessed and agreed upon by the LPA, the LLFA and the EA, based on their local knowledge.

4.1.3 EA Risk of Flooding from Rivers and Sea

This Risk of Flooding from Rivers and Sea map (RoFRS) 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, and is shown on the interactive GeoPDF maps in Appendix A. The RoFRS map splits the likelihood of flooding into four risk categories:

- High – greater than or equal to a 1 in 30 year event. Also termed as a 3.3% AEP chance of occurring in any one year;
- Medium – less than a 1 in 30 year event but greater than or equal to a 1 in 100 year event. Also termed as a 1% AEP chance of occurring in any one year;
- Low – less than a 1 in 100 year event but greater than or equal to a 1 in 1000 year event. Also termed as a 0.1% AEP chance of flooding in any one year; and
- Very Low – less than a 1 in 1000 year event..

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.

4.2 Surface water flood risk

4.2.1 Risk of Flooding from Surface Water (RoFSW)

The Risk of Flooding from Surface Water (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.

NOTE: EA guidance on the use of the RoFSW states: *"This dataset is not suitable for identifying whether an individual property will flood. It should not be used with basemapping more detailed than 1:10,000 as the data is open to misinterpretation if used at a more detailed scale. Because of the way the map has been produced and the fact that it is indicative, the map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence."*

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

- 1 in 30 year event (3.3% AEP) – high risk;
- 1 in 100 year event (1% AEP) – medium risk; and

- 1 in 1000 year event (0.1% AEP) – low risk.

The EA produced a guidance document, updated in April 2019[11], explaining the methodology applied in producing the map.

Note: The national map of surface water flood risk is, at the time of writing, undergoing a significant update. However, the updated map is unlikely to made available until late 2024.

The Risk of Flooding from Surface Water (RoFSW) map is shown in Figure 4-2 and illustrates that surface water flood risk is scattered across the study area. Key areas of surface water flood risk occur within the River Don and Usworth Burn floodplains. Within the AAP sites, there are some areas of high risk surface water ponding within topographic low spots.

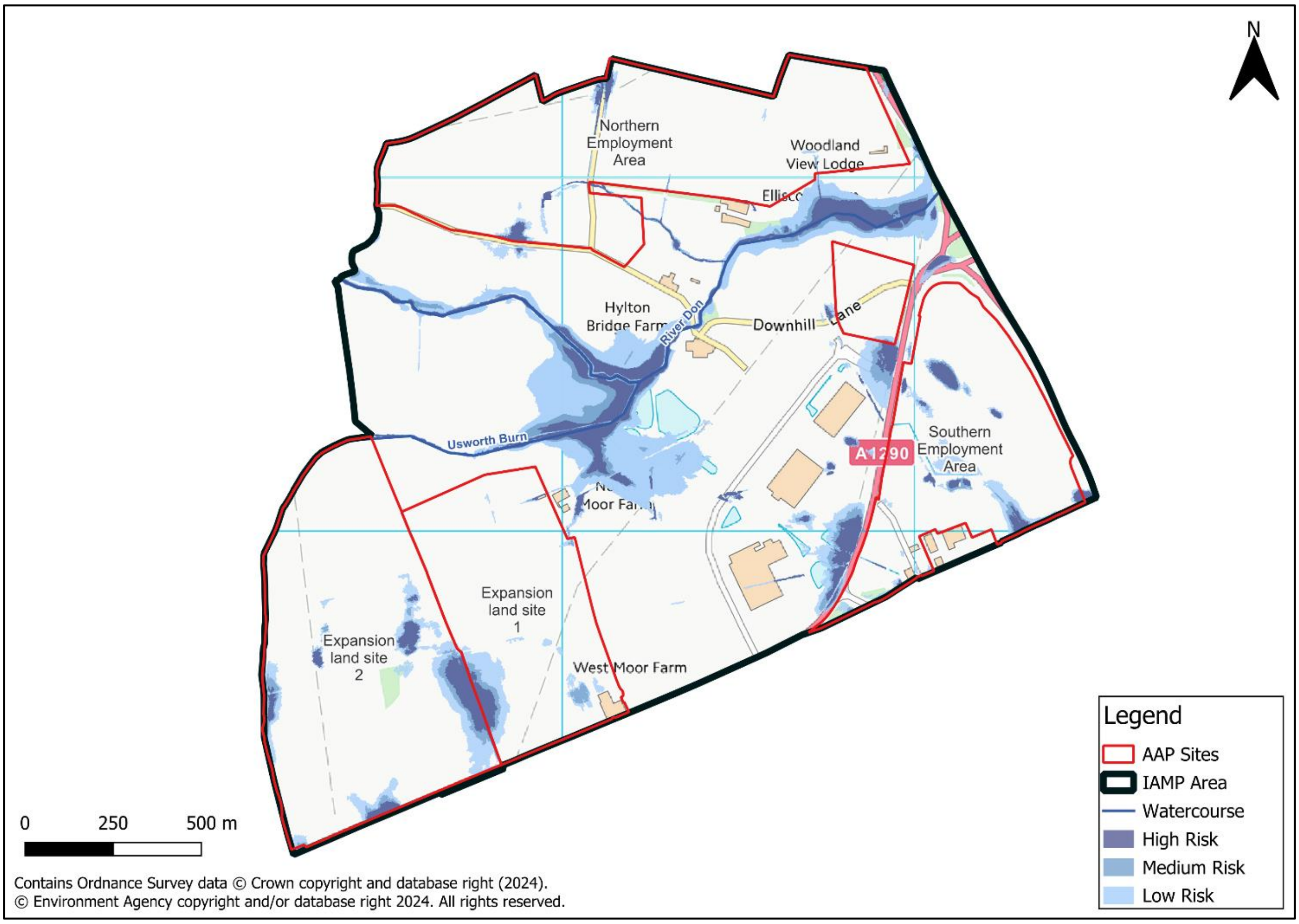

Figure 4-2 Risk of Flooding from Surface Water map showing the surface water flood risk within the IAMP

4.2.1.1 Locally agreed surface water information

EA guidance, from within the FWMA[12], on using surface water flood risk information recommends that SCC and STC, as LLFAs, should:

11 What is the Risk of Flooding from Surface Water map? | Environment Agency | 2019
12 Flood and Water Management Act, 2010

"…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".

At the time of writing, locally agreed surface water information for the IAMP consists of a combination of both the RoFSW map and local mapping, which covers a small area of the IAMP within South Tyneside. This production of this model, namely 'Flood Mapping Model - Different ICs_V2', followed on from the Surface Water Management Plan (SWMP) for the area. See Section 4.7.2 for further information on how this local model impacts the surface water climate change modelling.

4.3 Groundwater flood risk

This SFRA assesses groundwater flood risk through JBA's 5m Groundwater Flood Risk Map, which provides a general broadscale assessment of the groundwater flood hazard. The good practice guide to producing SFRAs[13], developed by the EA and published in December 2021, recommends the use of this dataset in SFRAs. The map is categorised by grid code where each code is explained in Table 4-1.

13 Strategic flood risk assessments A GOOD PRACTICE GUIDE, Report produced using Environment Agency research on 'using flood risk information in spatial planning' (2019-2020), 2021

Table 4-1 Groundwater flood hazard classification of JBA groundwater map

Groundwater head difference (m)*	Grid Code	Class label
0 to 0.025	4	Groundwater levels are either at, or very near (within 0.025m of), the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	3	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	2	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event. There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	1	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	0	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.		

Figure 4-3 shows the groundwater flood risk across the IAMP. Refer to Table 4-1 for grid code definitions. Within the south eastern corner of the 'Southern Employment Area' AAP site, there is a risk of groundwater flooding to both surface and subsurface assets, where groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots. Significant groundwater risk is also present through the centre of the IAMP area.

There are some areas within the 'Northern Employment Area' and 'Southern Employment Area' AAP sites where there is a risk of groundwater flooding to surface and subsurface assets, with a possibility of groundwater emerging at the surface locally.

It is important to make sure that future development is not placed at unnecessary risk therefore groundwater flood risk should be considered on a site-by-site basis in development planning.

Groundwater flood risk should be considered particularly when determining the acceptability of SuDS schemes as a way of managing surface water drainage. Developers should consult with the LPA, the LLFA and the EA at an early stage of any site-specific groundwater assessment.

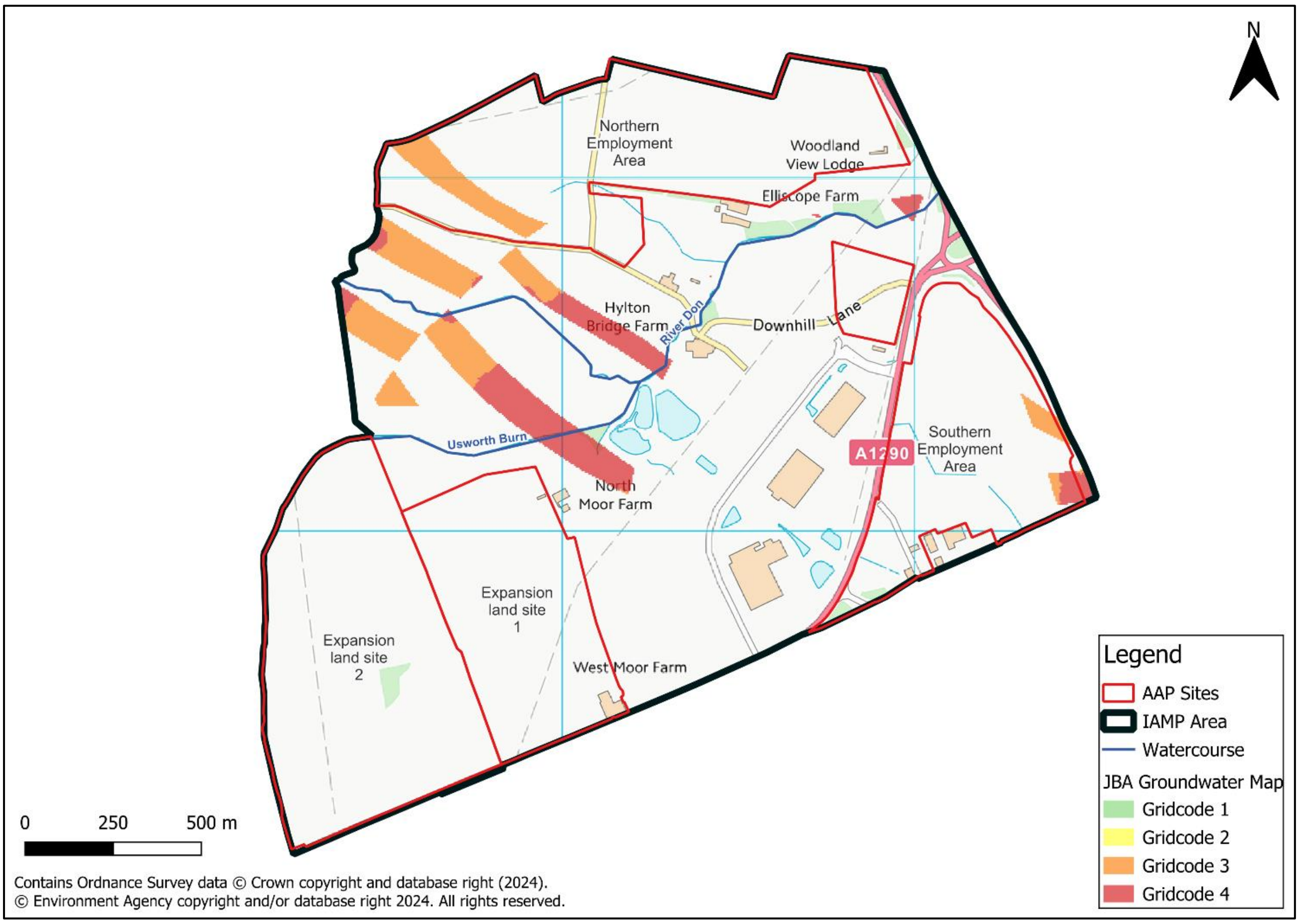

Figure 4-3 JBA groundwater map showing the risk of flooding from groundwater within the IAMP

4.4 Flood risk from sewers

NW confirmed that they do not have any wastewater assets within the IAMP. There are some private sewers which serve the industrial units including a pumping station. A 24 inch diameter water main crosses the north western corner of the IAMP. However, NW state that this would not have the potential to cause a flood event.

The SCC Local Flood Risk Management Strategy[14] indicates that there is a low risk of sewer flooding within the study area.

4.5 Flood risk from reservoirs

The EA is the enforcement authority for the Reservoirs Act 1975 in England and Wales, with the FWMA amending this Act. All large reservoirs must be regularly inspected and supervised by reservoir panel engineers. Local authorities are responsible for coordinating emergency plans for reservoir flooding and ensuring communities are well prepared. The LPA should work with other members of the Northumbria Local Resilience Forum to develop these plans. See Section 5.7.1.1 for more information on the Northumbria Local Resilience Forum.

Paragraph 046 of the FRCC-PPG states that, in relation to development planning and reservoir dam failure:

"the local planning authority will need to evaluate the potential damage to buildings or loss of life in the event of dam failure, compared to other risks, when considering development downstream of a reservoir. Local planning authorities are also advised to consult with the owners/operators of raised reservoirs, to establish constraints upon safe development."

4.5.1 Reservoir Flood Map (RFM)

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 metres of water). The FWMA updated the Reservoirs Act and targeted a reduction in the capacity at which reservoirs should be regulated from 25,000m^3 to 10,000m^3. 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.

In November 2021, the EA published the RFM guidance 'Reservoir flood maps: when and how to use them[15]', which provides information on how the maps were produced and what they contain.

The IAMP area is not modelled to be at risk from reservoir flooding.

4.6 Cumulative impacts

The NPPF states that strategic policies…

"…*should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk*

14 Local Flood Risk Management Strategy | Sunderland City Council | 2016
15 Reservoir flood maps: when and how to use them | Environment Agency | 2021

management authorities, such as lead local flood authorities and internal drainage boards" (para 166).

Previous policies have relied on the assumption that if each individual development does not increase the risk of flooding, the cumulative impact will also be minimal. However, if there is a lot of development occurring within one catchment, particularly where there is flood risk to existing properties or where there are few opportunities for mitigation, or proposed developments of less than 10 dwellings that are not referred to the LLFA for consultation under the Town and Country Planning (Development Management Procedure) Order (DMPO) 2015, the cumulative impact may be to change the flood response of the catchment.

In plan making and development planning, consideration should be given to the following:

- The importance of the phasing of development;
- Cross boundary impacts i.e. there should be dialogue between the relevant authorities (Sunderland City Council and South Tyneside Council) upstream and downstream of the IAMP on flood risk management practices and plans for development;
- Leaving space for floodwater by safeguarding land through the Area Action Plan and utilising greenspace for flood storage and slowing the flow (see Sections 4.6.2 and 4.9.4);
- Ensuring floodplain connectivity;
- Use of appropriate SuDS and the containment of surface water onsite as opposed to directing elsewhere (see Section 5.5); and
- The loss of floodplain storage volume, as well as the impact of increased flows on flood risk downstream. Whilst the loss of storage for individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe.

All development plans are required to comply with the NPPF and FRCC-PPG and demonstrate they will not increase flood risk elsewhere. Therefore, providing all new development complies with the latest guidance and legislation relating to flood risk and sustainable drainage, in theory there should not be any increase in flood risk downstream.

Strategic solutions may include upstream flood storage, integrated major infrastructure/Flood Risk Management schemes, new defences, and watercourse improvements as part of regeneration and enhancing green infrastructure, with opportunities for Working with Natural Processes and retrofitting of SuDS to existing development.

Through the Area Action Plan, the LPA should consider the following strategic solutions:

- Seeking a betterment of existing flood risks both within the IAMP and in surrounding areas, with developments meeting national and local standards for Flood Risk Assessments and Surface Water Drainage Strategies;
- Use of sustainable flood storage and mitigation schemes to store water and manage surface water runoff in locations that provide overall flood risk reduction

as well as environmental benefits, including the implementation of NFM where possible;

- In areas where flood risk is being managed effectively, there will be a need in the future to keep pace with increasing flood risk as a result of climate change;
- Assessment of long-term opportunities to move development away from the floodplain and to create blue/green river corridors within and surrounding the IAMP;
- Safeguarding the natural floodplain from inappropriate development;
- Where possible, changes in land management should look to reduce runoff rates from development whilst maintaining or enhancing the capacity of the natural floodplain to retain water. Land management and uses that reduce runoff rates in upland areas should be supported;
- Development of the IAMP should maintain conveyance of the River Don and Usworth Burn and smaller watercourses or drains to help reduce the impact of more frequent flood events and to improve the natural environment and WFD targets;
- Implementation of upstream catchment management i.e. slow the flow and flood storage schemes could be implemented in upper catchments to reduce risk downstream and across neighbouring authority boundaries; and
- Promotion and consideration of SuDS at the earliest stage of development planning, considering the requirements of Schedule 3 of the FWMA, although yet to be implemented at the time of writing.

According to the NPPF, neighbouring authorities should consider strategic cross-boundary issues and infrastructure requirements. Local authorities also have a duty to cooperate whereby councils work together on strategic matters and produce effective and deliverable policies on strategic cross boundary matters.

The FWMA requires all RMAs to cooperate with relevant authorities regarding exercising flood and coastal risk management. SCC and STC are represented by the Northumbria Regional Flood and Coastal Committee (RFCC) where cross-boundary resources, projects and data are shared between neighbouring authorities.

4.6.1 Hydrological linkages and cross boundary issues

The main river within the study area, the River Don, originates along the border between the SCC and Gateshead authority areas, before flowing through the IAMP and into the STC authority area to the north. Therefore, major land use changes within the SCC and Gateshead authority areas have the potential to impact flow regimes and flood risk within South Tyneside. Development control and responsible land management within the catchment area of the River Don is crucial to ensuring sustainable development within downstream authorities.

Were strategic solutions, outlined in Section 4.6, not considered in upstream development planning, the following issues may occur:

- Reduction in upstream floodplain storage capacity; and

- Increases in impermeable areas leading to a reduction in rainfall infiltration and subsequent increased runoff to the detriment of downstream communities.

The need for consistent regional development policies controlling runoff or development in floodplains within contributing districts is therefore crucial as this would have wider benefits for neighbouring areas. This should be carried out by the successful implementation of the sequential test.

4.6.2 Safeguarding land for flood storage

Where possible, the councils may look to allocate land designed for flood storage functions through the Area Action Plan upstream or downstream of the IAMP. Such land can be explored by using this SFRA to assess the flood risk within areas of open space and to ascertain what benefit could be gained by leaving at risk areas undeveloped.

Paragraph 167 of the NPPF states *"to avoid where possible, flood risk to people and property, the LPAs should manage any residual risk by*:

safeguarding land from development that is required, or likely to be required, for current or future flood management".

Applicable locations may include any current greenfield sites:

- Considered to be large enough to store floodwater to achieve effective mitigation (modelling would be required to establish required storage volumes);
- With large areas of their footprint at high or medium surface water flood risk (based on the RoFSW);
- Within the functional floodplain (Flood Zone 3b);
- With large areas of their footprint at risk from Flood Zone 3a; and
- That are large enough and within a suitable distance to receive floodwater from a nearby development site using appropriate SuDS techniques which may involve pumping, piping or swales/drains.

4.7 Climate change

NPPF para 8 states that mitigating and adapting to climate change is an important objective that is key to delivering sustainable development that should be delivered through local plans.

In relation to flood risk and climate change in the planning system, the NPPF states:

"New development should be planned for in ways that:

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure" (Para 154).

The Level 1 SFRA should be the starting point for the councils to assess the effects of climate change on flood risk in the IAMP. See Section 4.7.2 details the climate change modelling carried out as part of this SFRA.

Along with the NPPF, FRCC-PPG and EA guidance, the councils should refer to the Royal Town Planning Institute and Town & Country Planning Association's new edition of their joint guidance: 'The Climate Crisis – a guide for local authorities on planning for climate change[16]'.

4.7.1 EA climate change allowances

The EA previously revised the climate change allowances for peak river flows in July 2021, and peak rainfall in May 2022, for use in FRAs and SFRAs and will, at the time of writing, use these revised allowances when providing advice. These updates are based on the release of UKCP18.

Climate change guidance is continually evolving therefore developers should refer to the climate change allowances on Government's website[17] to ensure those outlined below are the most up-to-date available.

4.7.1.1 Peak river flow allowances

Peak river flow allowances show the anticipated changes to peak flow by EA management catchment. The management catchments are sub-catchments of river basin districts. Broadly, both the central and higher central allowances for the 2080s epoch are required to be assessed for SFRAs.

16 The Climate Crisis – a guide for local authorities on planning for climate change | The Royal Town Planning Institute and Town & Country Planning Association | 2023

17 Flood risk assessments: climate change allowances | Environment Agency | 2022

Table 4-2 lists the allowances for each management catchment which cover the IAMP. As shown on Figure 4-4, only one management catchment covers the River Don and Usworth Burn, however the central and higher central climate change allowances for both catchments have been modelled for the 1% AEP event given the influence of both catchments on the inflows within the model.

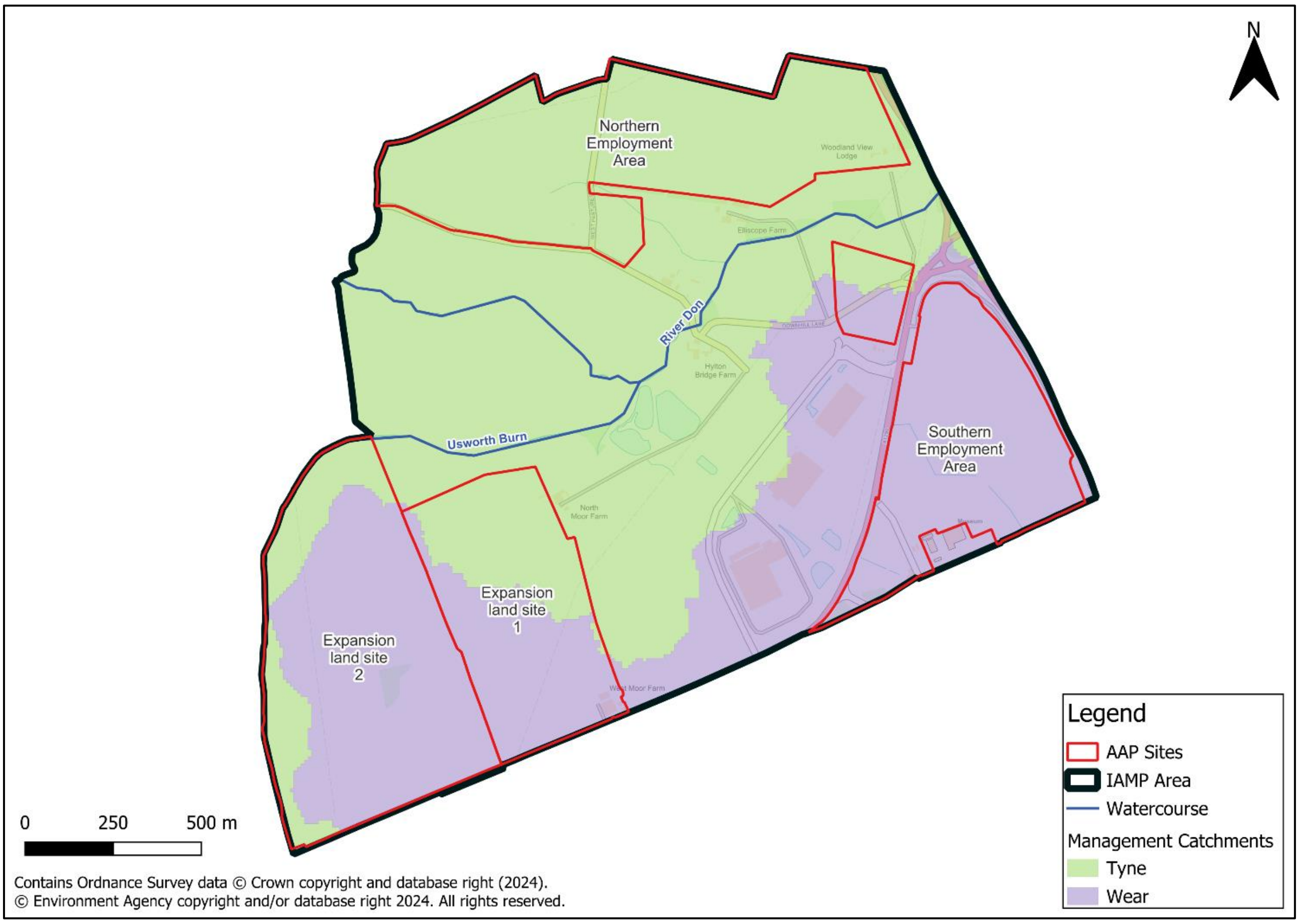

Figure 4-4 EA Management Catchments covering the IAMP

Table 4-2 Recommended peak river flow allowances for the Wear and Tyne management catchments

Management catchment	Allowance category	Total potential change anticipated for peak river flows (based on a 1981 to 2000 baseline)		
		2020s (2015-2039)	**2050s (2040-2069)**	**2080s (2070-2125)**
Wear	Upper end	28%	33%	50%
	Higher central	20%	21%	32%
	Central	16%	16%	25%
Tyne	Upper end	31%	42%	64%
	Higher central	22%	28%	42%
	Central	18%	22%	34%

4.7.1.2 Peak rainfall intensity allowances

To gauge the impacts of climate change on surface water and for small scale drainage design, the EA has produced allowances for peak rainfall intensities based on EA management catchments, provided in Table 4-3

Table 4-3 Peak rainfall intensity allowances in small and urban catchments for England

Management catchment	Allowance category	Total potential change in anticipated change for peak rainfall intensities (based on a 1961 to 1990 baseline)			
		3.3% annual exceedance rainfall event		**1% annual exceedance rainfall event**	
		2050s (up to 2060)	**2070s (2061-2125)**	**2050s (up to 2060)**	**2070s (2061-2125)**
Wear	Upper end	35%	40%	40%	45%
	Central	20%	30%	25%	30%
Tyne	Upper end	35%	40%	40%	45%
	Central	25%	30%	25%	35%

4.7.2 Climate change data within the IAMP

4.7.2.1 Fluvial climate change modelling

To represent the increase flood risk from climate change on flooding from rivers, peak river inflows on the River Don and Usworth Burn were uplifted according to the EA allowances listed within

Table 4-2 using the River Don at Washington 2015 model, which is a private model owned by IAMP LLP.

The flood risk modelling study was initially used to support an outline planning application for the IAMP on undeveloped land upstream of the A19 and to refine the existing Flood Map for Planning in this area. An update to the model was completed in 2018 to consider changes to development on the IAMP. The previous study included modelling for climate change for the events outlined in Table 4-4. Therefore, to further inform this SFRA, only the extreme 1000-year plus climate change was required to be modelled.

The 100-year plus climate change events are not modelled to have a significant impact on any of the AAP sites. The modelled 1000-year extreme event plus climate change is predicted to increase fluvial flood risk to the Southern Employment Area, Expansion Land Site 1 and Expansion Land Site 2.

The fluvial climate change flood extents are presented on the interactive GeoPDF maps in Appendix A.

Table 4-4 Existing modelled climate change outputs

Return period	Central allowance modelled	Higher central allowance modelled
30-year	34%	-
100-year	25% / 34%	32% / 42%
1000-year	25%	32%

4.7.2.2 Surface water climate change modelling

EA climate change guidance[17] states that, for SFRAs, the upper end allowance on peak rainfall for the 2070s should be modelled for the 3.3% and 1% AEP events.

For the Tyne and Wear Management Catchments, this entails:

- 3.3% AEP rainfall event +40%
- 1% AEP rainfall event +45%

Both scenarios have been modelled for this SFRA and assessed appropriately against the AAP sites. The modelled climate change extents indicate a greater risk across all AAP sites than the present day extents with larger areas of ponding, particularly significant within the Expansion Land Site 2 and Southern Employment Area. The surface water climate change flood extents are presented on the interactive GeoPDF maps in Appendix A.

It is important to note that the hydraulic models run as part of this Level 1 SFRA are the original national generalised models developed as part of the updated Flood Map for Surface Water (uFMfSW) during 2012-13 (now referred to as the Risk of Flooding from Surface Water, as summarised within Section 4.2.1). This is the case for a small area within the north east of the IAMP within South Tyneside, which is based on local surface water models (Figure 4-5). Therefore, in areas where the outputs from a local surface water model have been supplied to the EA for inclusion in the RoFSW mapping the climate change outlines will be inconsistent with the available published data.

The reasons for these inconsistencies are summarised below:

- Differing post-processing methods - there may be instances where there are small, isolated patches of surface water flood risk in the present day local modelled extents that are not present in the modelled climate change scenarios. This is a result of the 'cleaning' of the local modelling to remove very small shallow patches of flooding being done to a differing specification to the national generalised mapping used to inform the impact of climate change on surface water.
- Updated DTM - the climate change modelling completed for this Level 1 SFRA uses a DTM with incisions through key raised embankments to represent a channel flowing beneath, whereas it doesn't appear the local mapping has used the same approach. Therefore, there are instances where ponding behind embankments is greater within the present day scenario than the climate change scenarios.
- Channel draining - the local modelling used in the RoFSW map utilises a drainage rate within the channels to remove the fluvial influence on predicted flood risk. This approach was not applied within the national mapping, and therefore is not represented within the climate change modelling.

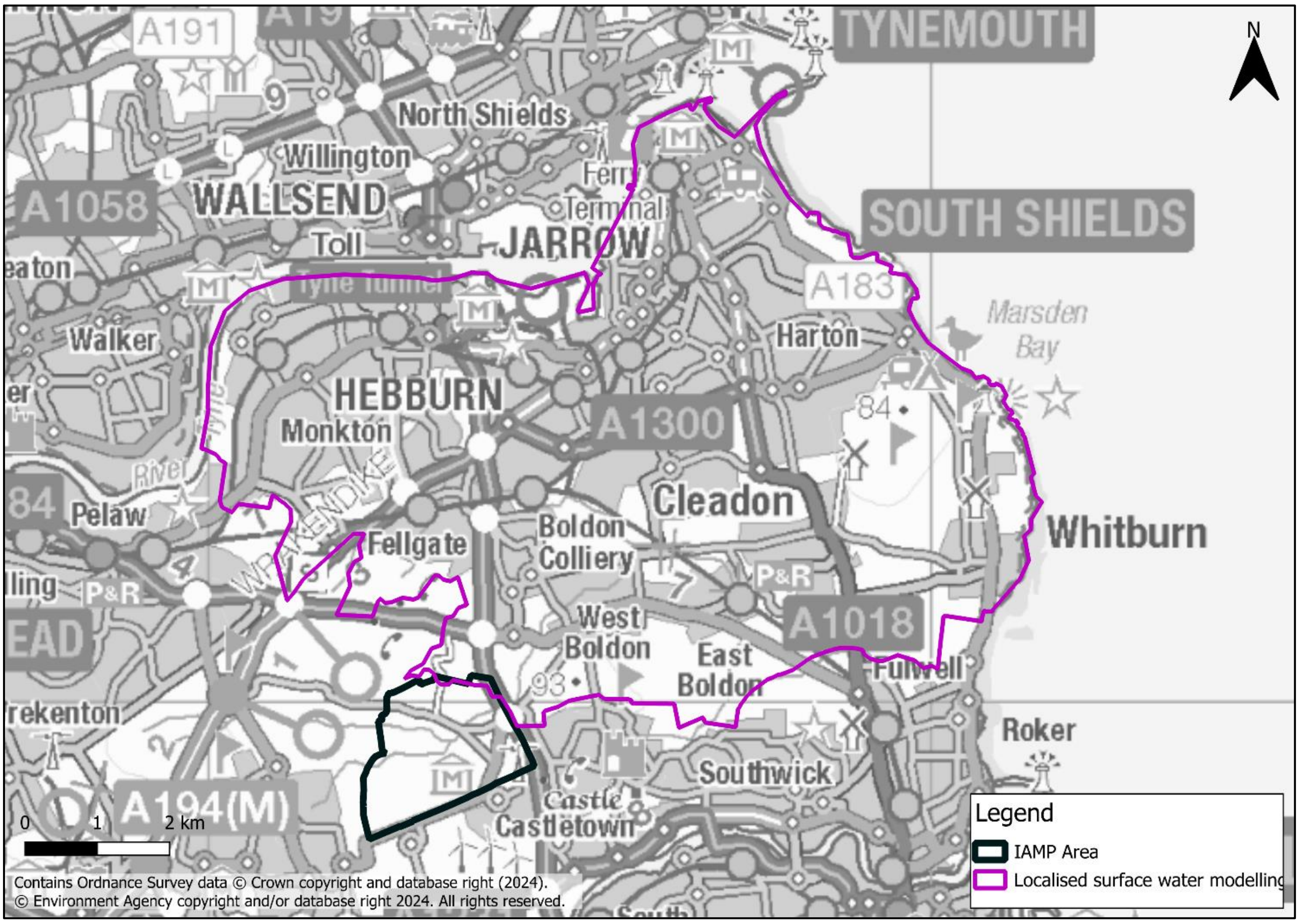

Figure 4-5 Area of local surface water modelling

4.8 Historic risk

Records of past flood events can help to build a picture of areas that may be prone to flooding and to help confirm flood modelling outputs. Historic flood events can also help Risk Management Authorities to target where flood risk management or resilience works may be required based on tangible evidence.

SCC and STC, as LLFAs, provided their historic flood incident datasets to inform historic flood risk within the IAMP. Historic flood events have been recorded within the south west of the IAMP, impacting the Southern Employment Area, noted to be a result of insufficient drainage leading to surface water flooding.

STC confirmed the authority do not hold any historic flood risk information relevant to the IAMP. However, this is not to say historic flooding has not occurred, only that there are no records.

NW confirmed that they do not hold any historic sewer flood event information within the IAMP, stating that they do not have any wastewater assets in the area.

Historic flood events, aggregated by ward, are displayed on the interactive GeoPDF maps in Appendix A.

4.8.1 EA Historic Flood Map and Recorded Flood Outlines

The Historic Flood Map (HFM) is a spatial dataset showing the maximum extent of all recorded historic flood outlines from river, sea and groundwater and shows areas of land that have previously been flooded across England. Records began in 1946 when predecessor bodies to the EA started collecting information about flooding incidents. The HFM accounts for the presence of defences, structures, and other infrastructure where such existed at the time of flooding. It includes flood extents that may have been affected by overtopping, breaches or blockages. It is also possible that historic flood extents may have changed and that some areas would not flood at present i.e. if a flood defence has been built.

The HFM does not contain any information regarding the specific flood source, return period or date of flooding, nor does the absence of the HFM in an area mean that the area has never flooded, only that records of historic flooding do not exist. The Recorded Flood Outlines (RFO) dataset however does include details of flood events. The difference between the two datasets is that the HFM only contains flood outlines that are ‘considered and accepted’ by the EA following adequate verification of the RFO dataset using certain criteria.

There are no areas of the IAMP that are covered by the HFM or RFO datasets.

4.9 Flood risk management

The aim of this section of the SFRA is to identify existing Flood Risk Management (FRM) assets and proposed FRM schemes. 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.

4.9.1 EA inspected assets (Spatial Flood Defences)

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

- Asset type (flood wall, embankment, high ground, demountable defence, bridge abutment);
- Flood source;
- Design Standard of Protection (SoP);
- Asset length;
- Asset age;
- Asset location; and
- Asset condition.

This dataset does not include flood defence assets on non-main rivers. See Figure 4-6 for the condition assessment grades using the EA's Condition Assessment Manual[18] (CAM).

The design SoP for a flood defence is a measure of how much protection a flood defence gives. If the SoP is 100, the defence is designed to protect against a flood with the probability of occurring once in 100 years (1% AEP event).

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

Figure 4-6 EA flood defence condition assessment grades

Table 4-5 Major flood defences along the River Don within to the IAMP

Defence location	Asset type	Flood source	Design standard	Condition grade
Between 432981, 559571 and 433364, 559581	2 embankments	Fluvial	Both 5 years	Unknown
Between 432205, 559074 and 433220, 559414	2 embankments	Fluvial	10 years (1) 20 years (1)	Unknown

18 Environment Agency. (2012). Visual Inspection Condition Grades. In: EA Condition Assessment Manual. Bristol: Environment Agency. P9.

The embankments on Usworth Burn to the north of Expansion Land Site 2 are located on the left bank of the channel, which protect the area of farmland to the north. The embankments that extend along both the River Don and Usworth Burn protect the surrounding areas of farmland. The defences along these channels are unlikely to contribute to the protection of the AAP sites.

The full Spatial Flood Defences dataset, which displays the defences by asset type, is shown on the interactive GeoPDF maps in Appendix A.

As well as the ownership and maintenance of a network of formal defence structures, the EA carries out several 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 the existing flood defences, structures and watercourses;
- 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 flood warning services for areas within designated Flood Warning Areas (FWA) or Flood Alert Areas (FAA). EA FAAs are shown on the interactive GeoPDF maps in Appendix A. There are no FWAs within the study area;
- 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; and
- Promoting resilience measures for existing properties that are currently at flood risk or may be in the future as a result of climate change (Property Flood Resilience - see Section 5.6.5).

4.9.2 SCC and STC assets and future Flood Risk Management schemes

LLFAs, under the provisions of the FWMA, have a duty to maintain a register of structures or features that have a significant effect on flood risk, including details of 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 FWMA places no duty on the LLFA to maintain any third-party features, only those for which the authority has responsibility as land/asset owner. The LLFA may carry out a strategic assessment of structures and features within the asset register to inform partners' capital programmes and prioritise maintenance programmes.

At the time of writing, there are no proposed flood risk management schemes with the potential to alleviate flood risk within the IAMP.

4.9.3 Water company assets

The sewerage infrastructure within the IAMP may have a risk of localised flooding associated with the existing drainage capacity and sewer system. Northumbrian Water (NW) is responsible for the management of the adopted sewerage system. This includes surface water and foul sewerage. Water company assets include Wastewater Treatment Works, Combined Sewer Overflows, pumping stations, detention tanks, sewer networks and manholes. NW confirmed they do not own any wastewater assets within the IAMP.

4.9.4 Natural Flood Management and Working with Natural Processes

Natural flood management (NFM) or Working with Natural Processes (WwNP) is a type of nature-based flood risk management solution used to protect, restore and re-naturalise the function of catchments and rivers to reduce flood and coastal erosion risk. WwNP has the potential to provide environmentally sensitive approaches to minimising flood risk, to reduce flood risk in areas where hard flood defences are not feasible and to increase the lifespan of existing flood defences.

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

The EA is actively encouraging the implementation of WwNP measures within catchments and coastal areas in order to assist in the delivery of environmental protection and national policies. The implementation of WwNP will continue to become a fundamental component of the flood risk management tool kit due to climate change.

4.9.4.1 Evidence base for WwNP to reduce flood risk

The EA has produced a WwNP evidence base[19], which includes three interlinked projects:

- Evidence directory;
- Mapping the potential for WwNP; and
- Research gaps.

The evidence base can be used by those planning projects that include WwNP measures to help understand:

- Their potential FCRM benefits and multiple benefits;
- Any gaps in knowledge;
- Where it has been done before and any lessons learnt; and

19 Working with natural processes to reduce flood risk | GOV.UK | 2021

- Where in a catchment they might be most effective.

A guidance document sits alongside the evidence directory and the WwNP maps that explains how to use them to help make the case for implementing WwNP when developing business cases.

4.9.4.2 Mapping the potential for WwNP

National maps for England make use of different mapping datasets and highlight the potential areas for tree-planting (for three different types of planting), runoff attenuation storage, gully blocking and floodplain reconnection. The maps can be used to signpost potential areas for WwNP and do not consider issues such as landownership and drainage infrastructure, but they may well help start the conversation and give indicative estimates of, for example, additional distributed storage in upstream catchments.

These maps are intended to be used alongside the evidence directory to help practitioners think about the types of measure that may work in a catchment and the best places in which to locate them. There are limitations with the maps, however it is a useful tool to help start dialogue with key partners. The maps are provided as spatial data for use in GIS and interactive GeoPDF format, supported by a user guide and a detailed technical guide.

The WwNP types are listed in Figure 4-7.

WWNP Type	Open data licence details
Floodplain reconnection	• Risk of Flooding from Rivers and Seas (April 2017). • Data derived from the Detailed River Network, which is not displayed, rescinding the licence requirements for displaying the dataset (to be superseded by OS Water Network but not available for project in time). • Constraints data.
Run-off attenuation features	• Data derived from Risk of Flooding from Surface Water (Depth 1% AEP and Depth 3.3% AEP) (October 2013). The original data is not displayed due to licensing restrictions. • Constraints data. • Gully blocking potential (a subset of run-off attenuation features on steeper ground). • Data derived from OS Terrain 50 (2016) to classify each run-off attenuation feature based on median slope.
Tree planting (3 categories)	• Floodplain: Flood Zone 2 from Flood Map for Planning (April 2016) and new constraints layer. • Riparian: 50m buffer OS water features with constraints layer • Wider catchment woodland: o Based on slowly permeable soils. o BGS Geology 50,000 Superficial and Bedrock layers (both V8, 2017). Used with new science to derive new 100m gridded open data. This new layer can be used to signpost areas of SLOWLY PERMEABLE SOILS and can be checked in more detail on the BGS portal. o To the north of the line of Anglian glaciation, the presence of till-diamicton has been shown to be a strong predictor of slowly permeable soils. o To the south of this line, particular bedrock geologies have shown a similarly strong spatial relationship to the presence of slowly permeable soils.

Figure 4-7 WwNP measures and data

The WwNP datasets should be used to highlight any sites or areas where the potential for WwNP should be investigated further as a means of flood mitigation:

- Floodplain Reconnection:
    - Floodplain Reconnection Potential – areas of low or very low probability based on the Risk of Flooding from Rivers and Sea dataset (see Section 4.1.3) that are near a watercourse and that do not contain properties, are possible locations for floodplain reconnection. It may be that higher risk areas can be merged, depending on the local circumstances.

- Runoff Attenuation Features (Run-off attenuation features are based on the premise that areas of high flow accumulation in the RoFSW) maps are areas where the runoff hydrograph may be influenced by temporary storage if designed correctly):
    - Runoff Attenuation Features 1% AEP
    - Runoff Attenuation Features 3.3% AEP
- Tree Planting
    - Floodplain Woodland Potential and Riparian Woodland Potential – woodland provides enhanced floodplain roughness that can dissipate the energy and momentum of a flood wave if planted to obstruct significant flow pathways. Riparian and floodplain tree planting are likely to be most effective if close to the watercourse in the floodplain, which is taken to be the 0.1% AEP flood extent (Flood Zone 2) and within a buffer of 50 metres of smaller watercourses where there is no flood mapping available. There is a constraints dataset that includes existing woodland; and
    - Wider Catchment Woodland Potential – slowly permeable soils have a higher probability of generating 'infiltration-excess overland flow' and 'saturation overland flow'. These are best characterised by gley soils, so tree planting can open up the soil and lead to higher infiltration and reduction of overland flow production.

4.9.5 Potential for WwNP schemes within the IAMP area

Table 4-6 indicates the potential for WwNP schemes both within the IAMP and surrounding areas. These are also included on the interactive GeoPDF maps in Appendix A. An interactive map of nature-based flood risk management projects and potential projects can be found at JBA Trust Mapping[20].

Table 4-6 WwNP potential

WwNP measure	Potential for schemes
Floodplain reconnection	Significant potential in the areas along both banks adjacent to the River Don
Floodplain woodland potential	
Riparian woodland potential	
Wider catchment woodland potential	There is no mapped potential for wider catchment woodland planting within the study area
Runoff Attenuation Features 1% AEP	Potential for runoff attenuation features scattered across the IAMP area and upstream
Runoff Attenuation Features 3.3% AEP	

20 Working with Natural Processes Mapping | JBA Trust

4.9.6 WwNP Limitations

The effectiveness of WwNP measures is site-specific and depends on many factors, including the location and scale at which they are used. It may not always be possible to guarantee that these measures alone will deliver a specified standard of defence. Consequently, flood risk management measures should be chosen from several options ranging from traditional forms of engineering through to more natural systems. The research gaps that need to be addressed to move WwNP into the mainstream are identified in the evidence directory.

4.9.7 EA flood risk management activities and Flood and Coastal Erosion Risk Management (FCERM) Research and Development

The FCERM Research and Development Programme is run by the EA and Defra and aims to serve the needs of all flood and coastal operating authorities in England. The strategic objectives for research include:

- better understand future flood and coastal erosion risk
- prepare for the scale and frequency of future incidents
- optimise the management of FCERM infrastructure
- improve responsibility and funding for flood and coastal risk
- understand the potential of new technology and innovation
- increase resilience to flood and coastal erosion risk
- completed and ongoing research can be researched online[21].

4.10 Summary of risk

- Fluvial risk within the IAMP comes from the River Don and Usworth Burn that flow from west to east through the centre of the IAMP. Risk is largely confined to the areas adjacent to the channel though the risk area around confluence is significant. A fluvial flow path, within Flood Zone 2, is present to the south of the study area, which impacts the Southern Employment Area.
- Key areas of surface water flood risk occur in a similar location to the fluvial risk. Across the IAMP, there are some high risk surface water flow paths and high risk ponding within topographic low spots, which impact all AAP sites.
- The majority of the IAMP is deemed as having a negligible risk of groundwater flooding due to the nature of the geological deposits. There are some areas deemed to be at high risk of groundwater flooding within both the Northern and Southern Employment Areas.
- There is a negligible risk of flooding within the IAMP area from sewers, reservoirs or canals.

21 FCERM research and development projects | GOV.UK | 2021

5 Development and flood risk

5.1 Introduction

The information and guidance provided in this chapter summarises the online guidance provided in the NPPF and FRCC-PPG and other government guidance on development and flood risk. Specifically, the basis from which to apply the sequential approach in the development allocation process.

5.2 Sequential approach

The 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, property, infrastructure, and the environment to acceptable levels. Land at the lowest risk of flooding from all sources should be considered for development, following the requirements of the sequential test.

The approach is based around the FRM 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 SFRA). Once this evidence has been provided, positive planning decisions can be made and effective FRM opportunities identified.

Figure 5-1 illustrates the FRM hierarchy with an example of how this may translate into development allocation and development management decisions and actions.

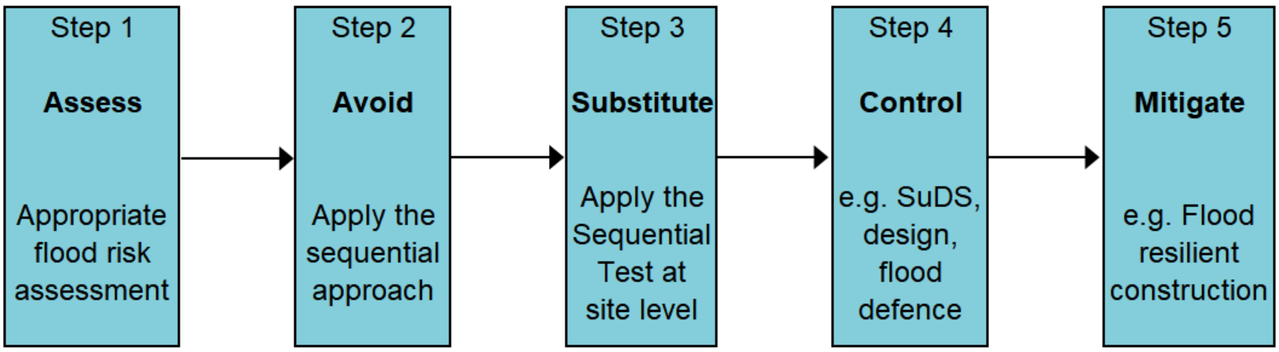

Figure 5-1 Flood risk management hierarchy

There are two different aims in carrying out the sequential test depending on what stage of the planning system is being carried out, i.e. allocating land in the Area Action Plan or when determining specific planning applications for development.

This Level 1 SFRA provides the basis for applying the sequential test. The LPAs should perform the test as part of the process by which the suitability of site parcels in the IAMP is tested through the development of site assessment reports, if considered appropriate.

Whether any further work is needed to decide if land is suitable for allocation will depend on both the vulnerability of the development and the flood zone it is proposed for. Table 2 of the FRCC-PPG[22] defines the flood risk vulnerability and flood zone 'incompatibility' of different development types to fluvial and / or tidal flooding, as shown in Figure 5-2.

For the proposed development outlined within the Area Action Plan, the Exception Test would be not required given all development is allocated for less vulnerable uses.

Flood Zones	**Flood Risk Vulnerability Classification**				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✔	✔	✔	✔	✔
Zone 2	✔	Exception Test required	✔	✔	✔
Zone 3a †	Exception Test required †	X	Exception Test required	✔	✔
Zone 3b *	Exception Test required *	X	X	X	✔ *

Key:

✔ Exception test is not required

X Development should not be permitted

Figure 5-2 Table 2 of the FRCC-PPG flood risk vulnerability and flood zone 'incompatibility'

Notes to Figure 5-2:

- *"This table does not show the application of the Sequential Test which should be applied first to guide development to the lowest flood risk areas; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea;*
- *The Sequential and Exception Tests do not need to be applied to those developments set out in National Planning Policy Framework footnote 56. The*

22 Flood risk and coastal change - GOV.UK | 2022

Sequential and Exception Tests should be applied to 'major' and 'non major' development;

- *Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.*

"†" In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

"" In Flood Zone 3b (functional floodplain) essential infrastructure that has passed the Exception Test, and water-compatible uses, should be designed 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"*.

5.3 The sequential test for Area Action Plan preparation

The FRCC-PPG, para 024, states the aim of the sequential test is:

"…*to steer new development to areas with the lowest risk of flooding, taking all sources of flood risk and climate change into account."*

The LPAs should seek to avoid inappropriate development in areas at risk of all sources of flooding, where applicable, 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.

Figure 5-3 presents Diagram 2 of the FRCC-PPG (para 026), which illustrates the sequential test process for plan preparation. The Test can be applied using the information provided in this Level 1 SFRA.

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.

This can be done using the site screening spreadsheet in Appendix B. This spreadsheet will help show that the LPAs, through the SFRA, have applied the Sequential Test for each IAMP site considered development options for each site parcel.

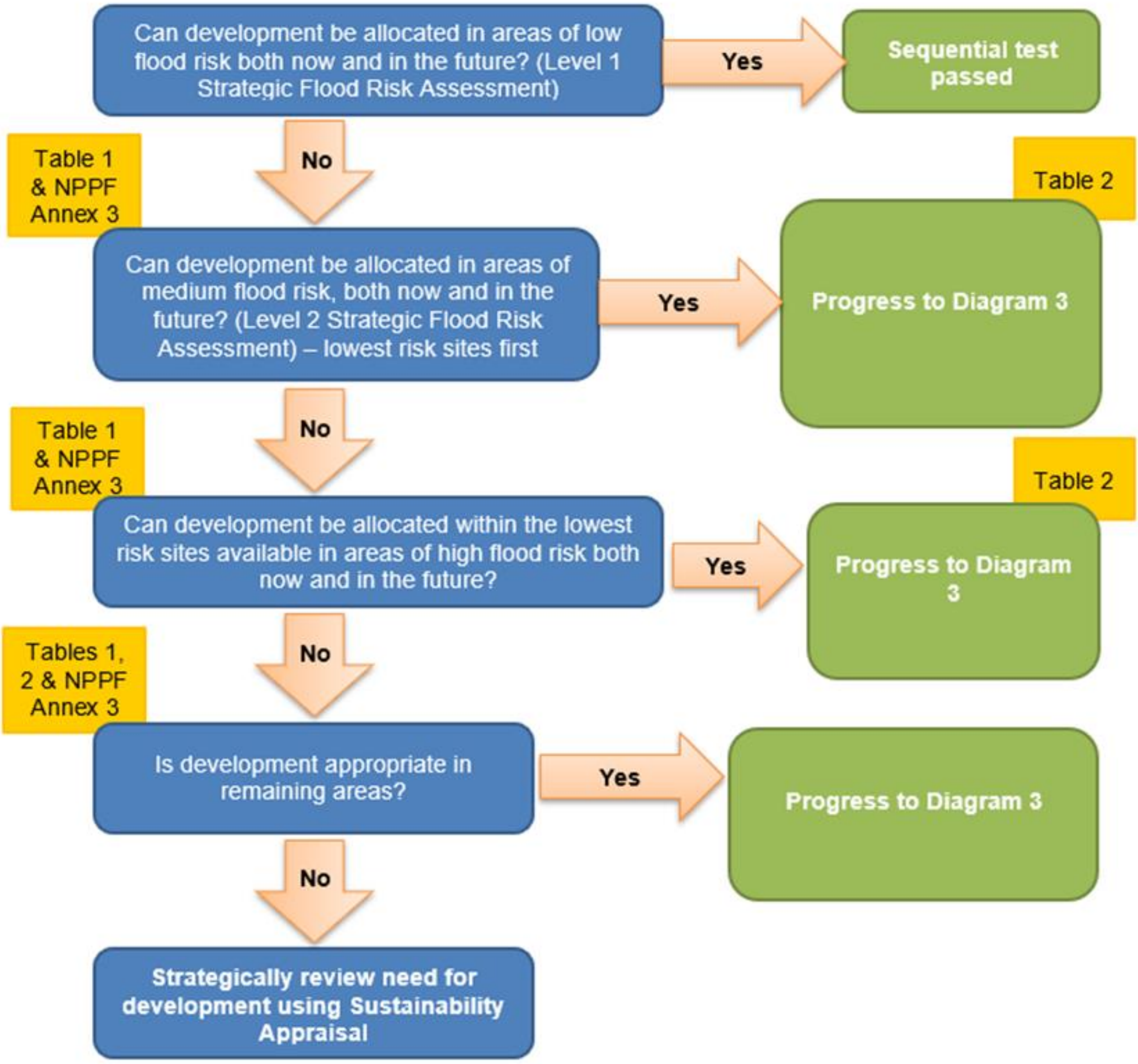

Figure 5-3 Diagram 2 - application of the sequential test for plan preparation[23]

Notes on Diagram 2:

- *'Tables 1 and 2' refer to the flood zone and flood risk tables of the FRCC-PPG Paragraphs 078-079*
- *'Areas of low flood risk' include:*
  - *Areas within Flood Zone 1 (rivers and sea),*
  - *Areas within the low risk surface water flood event extent of the Risk of Flooding from Surface Water map,*
  - *Areas not at additional risk from climate change.*
- *'Areas of medium flood risk' include:*
  - *Areas within Flood Zone 2 (rivers and sea),*

23 Flood risk and coastal change: paragraph 25 | GOV.UK | 2022

- *Areas within the medium risk surface water flood event extent of the Risk of Flooding from Surface Water map,*
- *Areas at risk from Flood Zone 2 plus climate change,*

- *'Areas of high flood risk' include:*
    - *Areas within Flood Zone 3a and Flood Zone 3b (rivers and sea),*
    - *Areas within the high risk surface water flood event extent of the Risk of Flooding from Surface Water map*
- *Areas at risk from Flood Zone 3a plus climate change and future functional floodplain.*

Sources of flooding other than fluvial and surface water also need to be considered. However, the dataset available for groundwater flooding *is* not of the appropriate level of detail required to be used to inform the sequential test (Section 4.3). At the strategic plan making level, this dataset can only be used to flag that there is risk from these sources that should be investigated in more detail at the site-specific FRA stage. Paragraph 23 of the FRCC-PPG states:

Other forms of flooding need to be treated consistently with river and tidal flooding in mapping probability and assessing vulnerability, so that the sequential approach can be applied across all areas of flood risk.

Therefore, as the groundwater dataset cannot be considered consistent with the Flood Map for Planning, it is advisable that it is not used in sequential testing, rather used to inform that groundwater risk exists and should be fully investigated at the FRA stage.

5.4 Site-specific Flood Risk Assessment

FRAs may be required to inform site design and layout options based on what is included in this SFRA. The principal aims of an FRA are to determine the level of flood risk to a site and to confirm that suitable flood management measures can be developed to control flooding, and safeguard life and property, without increasing risk to the surrounding area.

Once the site parcel has been sequentially tested using this Level 1 SFRA, a site-specific FRA including a drainage strategy will likely be required. The LPAs, LLFAs and EA should be consulted, as a minimum, to determine the content and scope of the FRA.

The production of a site-specific FRA can be seen as an iterative process by subdividing the FRA into three stages:

- Stage 1 is a screening study used to identify whether there are any flood risk issues that need to be considered further i.e. reviewing the SFRA outcomes;
- Stage 2 is a scoping study that should be undertaken if the Stage 1 FRA indicates that there are flood risk issues that need further consideration; and
- Stage 3 is a detailed study where further quantitative analysis is required to fully assess flooding issues and confirm that effective mitigation measures can be implemented to control flood risk and that the development can be safe for its lifetime.

It is appropriate to review the level of risk present and assess whether development is appropriate and achievable at each stage of the assessment.

The SFRA is an assessment of flood risk at a strategic level. This information can be used to provide evidence for Stages 1 and 2 of the FRA. Where a more detailed FRA is required (Stage 3), then a developer should undertake a detailed assessment of the flood risk at the site, which would likely include appropriate flood modelling. A suitable drainage strategy would also normally be required for new developments to ensure surface water is controlled to a rate set by the LLFA.

Significant consultation with the LPA and key consultees and stakeholders that are relevant to the site will be required for complex development proposals. Complex developments may need to include flood mitigation measures and compensatory storage.

Together with appropriate consultation, accepted FRA guidance should be followed by developers including:

- Find out when you need to do an FRA as part of a planning application, how to complete one and how it's processed:
    - Flood risk assessments if you're applying for planning permission[24]
    - Flood risk assessment in flood zones 2 and 3[25]
    - Flood risk assessment in flood zone 1 and critical drainage areas[26]
- EA standing advice:
    - Preparing a flood risk assessment: standing advice[27]

In summary, the FRA should address the following:

1. Development description and location
    - What is the type of development and where will it be located?
    - What is the vulnerability classification (Table 2 of FRCC-PPG (Figure 5-2)) of the current and future building use?
    - Has the development site been assessed in the SFRA? If so, has the sequential test been carried out? Has the exception test (if applicable) been applied and passed previously?
2. Access and escape routes
    - Can safe access and escape routes be achieved during the extreme flood event whilst accounting for climate change?
    - Safe access and escape routes should be explicitly identified as part of an agreed emergency plan tailored specifically to the site.
3. Definition of flood hazard
    - What are the sources of flooding at the site?

24 Flood risk assessments if you're applying for planning permission | GOV.UK | 2017
25 Flood risk assessment in flood zones 2 and 3 | GOV.UK | 2017
26 Flood risk assessment in flood zone 1 and critical drainage areas | GOV.UK | 2017
27 Preparing a flood risk assessment: standing advice | GOV.UK | 2022

- For each source how would flooding occur? Referencing any historical records
- What existing surface water drainage infrastructure is present on the site? Consultation required with LPA, LLFA, EA and water companies.

4. Probability
    - Confirm the flood zone designation for the site (refer to the Flood Map for Planning: Flood Map for planning)
    - Determine the actual and residual risks at the site
    - What are the discharge rates and volumes generated by the existing site and proposed development? How should these be attenuated and to what rates?
5. Climate change
    - How is flood risk at the site likely to be affected by climate change? Check appropriate allowances (see Section 4.7.1).[28]
6. Flood Risk Management measures
    - How will the site be protected from flooding, including from the potential impacts of climate change, over the lifetime of the development?
7. Residual risks
    - What are the consequences to the site of flood defence failure? Breach / overtopping scenarios should be modelled.
    - What are the consequences to the site of asset blockage? Culvert, bridge blockage scenarios should be modelled.
    - Is there residual risk from reservoirs? If so, how can this be mitigated and does the emergency plan for the site address such risk? Reference the EA's Reservoir Flood Map[15].
    - Is there residual from canals? If so, how can this be mitigated and does the emergency plan for the site address such risk? Consultation required with the EA, LLFA and Canal & River Trust, or private owner. Breach / overtopping scenarios should be modelled if applicable.
    - What flood-related risks will remain after mitigation measures have been implemented?
    - How, and by whom, will these risks be managed over the lifetime of the development?
8. Offsite impacts
    - How will the proposed development design make sure there are no impacts to other development downstream or nearby now and in the future?
    - What measures will be implemented to control surface water runoff? SuDS? What arrangements are in place for SuDS ownership, maintenance?
9. Groundwater

28 Flood risk assessments: climate change allowances | GOV.UK | 2022

- This mechanism of flooding should be considered particularly when determining the acceptability of SuDS schemes as a way of managing surface water drainage. Developers should consult with the LPA, LLFA and EA at an early stage of the assessment to establish any requirements for ground investigation.

10. Sewer systems
    - Where the SFRA has identified a risk of surface water flooding, any water that escapes from the sewer system would tend to follow similar flow paths and pond in similar locations.
    - Where required, liaison with the relevant water company should be undertaken at an early stage in the assessment process to confirm localised sewer flooding problems that could affect the site.

Future development should be designed so that it does not exacerbate existing sewer capacity problems. Developers should check with the relevant LPA whether a Water Cycle Study has been developed.

5.5 Surface water management and Sustainable Drainage Systems

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 and nearby. Carefully planned development can also play a role in reducing the number of properties that are directly at risk from surface water flooding.

The planning system has a key role to play in setting standards for sustainable drainage from new developments and ensuring that developments are designed to take account of the risk from surface water flooding. Sustainable drainage plays an important part in reducing flows in the sewer network and in meeting environmental targets, alongside investment in maintenance by the water companies on their assets. Water companies plan their investment on a five-year rolling cycle, in consultation with key partners, including the EA and local authorities.

The Department for Levelling Up, Housing and Communities (DLUHC) (formally the Department for Communities and Local Government (DCLG)) announced, in December 2014, that the local planning authority, in consultation with the LLFA, should be responsible for delivering SuDS[29] through the planning system. Changes to planning legislation gave provisions for major applications of ten or more residential units or equivalent commercial development to require sustainable drainage within the development proposals in accordance with the 'non-statutory technical standards for sustainable drainage systems[30],

29 Sustainable drainage systems | UK Parliament | 2014
30 Sustainable drainage systems: non-statutory technical standards | Defra | 2015

published in March 2015. A Practice Guidance[31] document has also been developed by the Local Authority SuDS Officer Organisation (LASOO) to assist in the application of the non-statutory technical standards.

Developers should be aware of Schedule 3 of the Flood and Management Act. The Act, which incorporates recommendations from the 2008 review includes the implementation of new SuDS standards and the removal of the automatic rights for developers to connect to public sewers. Schedule 3, when enacted, will provide a framework for the approval and adoption of drainage systems, a SuDS Approval Body (SAB), and national statutory standards on the design, construction, operation, and maintenance of SuDS.

The Design and Construction Guidance (DCG) for sewers became the regulated sewerage guidance on 1 April 2020. This allows water and sewerage companies to adopt SuDS components that meet the criteria of the DCG. Details on the sewerage sector guidance can be found online[32].

5.5.1 SCC / STC Sustainable Drainage requirements

To manage flood risk, all development, regardless of development type, flood zone and development size, must give priority use to SuDS. Particularly for major developments, there is a requirement to assess and include SuDS for managing surface water at the development unless it is demonstrated during the assessment that it is inappropriate for the site, i.e. due to high groundwater levels not allowing for infiltration SuDS.

The appropriate guidance for each LLFA should be followed for development falling within the respective local authority area.

5.5.1.1 Sunderland City Council SuDS Guidance[33]

SCC produced their 'SUDS approval and adoption guide', finalised in September 2018, which sets out how the adoption and approval of SuDS is considered in relation to reducing flood risk and improving water quality and sustainability within Sunderland. The guidance sets out the requirements for the planning application process, ensuring that SuDS are considered as early on in the planning and design process as possible.

5.5.1.2 North-East LLFA's Sustainable Drainage Local Standards[34]

The North-East LLFA's local standards for sustainable drainage, which covers both Sunderland and South Tyneside local planning authority areas, summarises the approach taken by the north eastern authorities to key questions asked by developers throughout the planning process. This ensures a consistent and best practice approach to flood risk assessments, drainage strategies and SuDS design.

31 Non-Statutory Technical Standards for sustainable drainage | LASOO | 2016

32 Sewerage Sector Guidance | Water UK

33 SUDS approval and adoption guide | Sunderland City Council | September 2018

34 North-East LLFA's Sustainable Drainage Local Standards | NE LLFA's | July 2020

5.5.2 SuDS and the NPPF

The NPPF, para 175, states:

"Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a. Take account of advice from the lead local flood authority;

b. Have appropriate proposed minimum operational standards;

c. Have maintenance arrangements, in place to ensure an acceptable standard of operation for the lifetime of the development; and

d. Where possible, provide multifunctional benefits".

All developments, both major and minor, are to include SuDS, providing multiple benefits that contribute to many other NPPF policies, including climate change, biodiversity net gain, amenity, and water quality improvements. Where site conditions may be more challenging, the SuDS components used will need to accommodate the site's opportunities and constraints. At a strategic level, this should mean identifying opportunities for a variety of SuDS components according to geology, soil type, topography, groundwater/mine water conditions, their potential impact on site allocation, and setting out local SuDS guidance and opportunities for in perpetuity adoption and maintenance.

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

Sustainable drainage should form part of an integrated design methodology secured by detailed planning conditions to make sure that the SuDS to be constructed is maintained to a minimum level of effectiveness.

5.5.3 SuDS hierarchy

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 waterbody;
3. To surface water sewer; and
4. To combined sewer.

Effects on water quality should be investigated when considering runoff destination in terms of the potential hazards arising from development and the sensitivity of the runoff destination.

The EA may also look at the potential impact of an outfall structure through the planning consultation and Environmental Permitting Regulation[35] process. It should be noted that detailed modelling will not be available for all outfalls therefore developers should carry out

35 Environmental permits: detailed information | Environment Agency

their own investigations whilst referring to the non-statutory technical standards for sustainable drainage systems (March 2015)[36].

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

- Flood risk outside the development;
- Peak flow control;
- Volume control;
- Flood risk within the development;
- Structural integrity;
- Designing for maintenance considerations; and
- Construction

Many different SuDS techniques can be implemented. As a result, there is no one standard correct drainage solution for a site. In most cases, using the Management Train principle (see Figure 5-4), will be required, where source control is the primary aim. Source control includes interception of the first 5mm of rainfall and water quality treatment should be as near to source as possible.

In February 2021, Defra published its research project to review and provide recommendations to update the current non-statutory technical standards for sustainable drainage systems[37]. Based on the research findings, recommendations have been made to replace the current standards with a new suite of standards to cover the following:

- Runoff destinations
- Everyday rainfall
- Extreme rainfall
- Water quality
- Amenity
- Biodiversity

36 Sustainable drainage systems: non-statutory technical standards | GOV.UK | 2015

37 Defra (2021) Recommendations to Update Non-Statutory Technical Standards for Sustainable Drainage Systems (SuDS) - WT15122

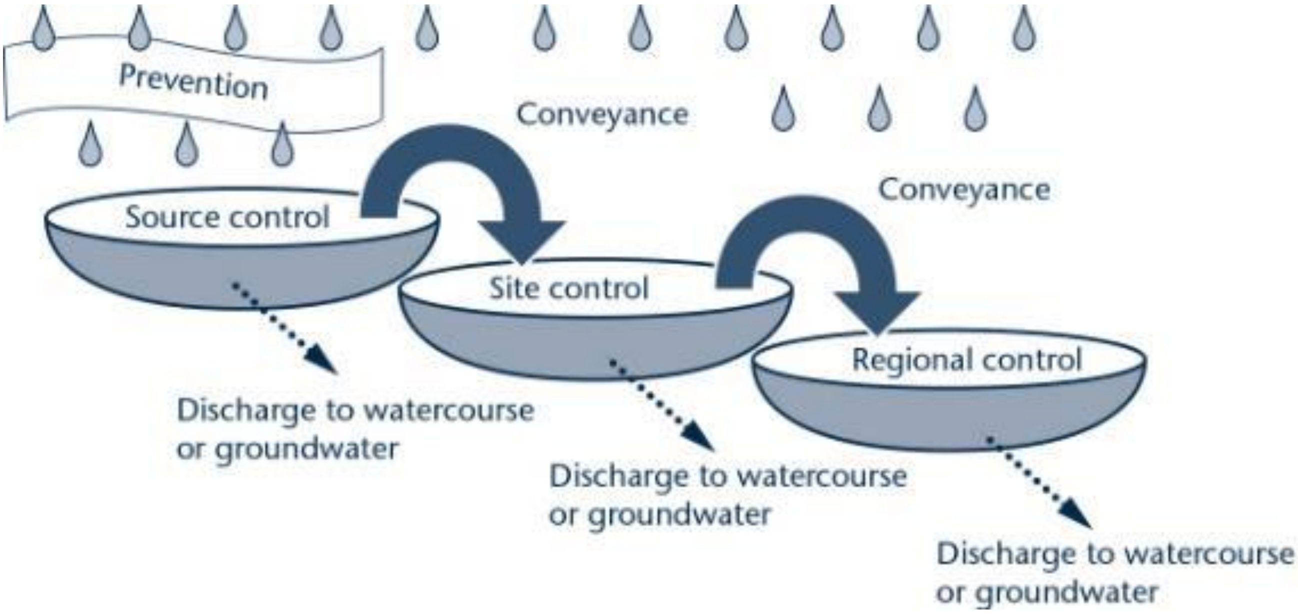

Figure 5-4 SuDS management train principle[38]

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.

In addition to the national standards, the LLFA and / or LPA may set local requirements for planning permission that include more rigorous obligations than the 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. The LLFA and LPA should always be contacted with regards to any local requirements at the earliest opportunity in development planning.

The CIRIA SuDS Manual[39] 2015 should also be consulted by developers. The SuDS manual (C753) is highly regarded and incorporates the latest research, industry practice, technical advice, and adaptable processes to assist in the planning, design, construction, management, and maintenance of good SuDS. The SuDS Manual complements the non-statutory technical standards and goes further to support the cost-effective delivery of multiple benefits.

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

39 CIRIA (2008), CIRIA SuDS Manual

5.5.4 Overland flow paths

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

Masterplanning should make sure that existing overland flow paths are retained within the development. As a minimum, the developer should investigate, as part of a site-specific FRA, the likely extents, depths, and associated hazards of surface water flooding on a development site. This is considered to be an appropriate approach to reduce the risk of flooding to new developments. Green/blue infrastructure should be used wherever possible to accommodate such flow paths. EA standing advice states that floor levels should always be set a minimum of 300 mm above ground level (or 300 mm freeboard above the design flood level) to reduce the consequences of any localised flooding unless local guidance states otherwise.

5.6 Mitigation measures

Whilst the sequential approach to development and flood risk should always be followed, there are certain instances where development must occur in areas of flood risk. This section details the generic mitigation measures that are available for new development and for existing developments at flood risk.

5.6.1 Site layout and design

Flood risk should be considered at the first stage in planning the layout and design of a site to provide an opportunity to reduce flood risk within the development.

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from areas of flood risk for example to higher ground, while more less vulnerable development (e.g., vehicular parking, recreational space) can be in higher risk areas that may be on lower ground. Whether parking in floodplains is appropriate will be based on the likely flood depths and hazard, evacuation procedures and availability of flood warning.

Waterside areas, or areas along known flow routes, can be designed and maintained as blue / green infrastructure, being used for recreation, amenity, and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas and avoid the creation of isolated islands as water levels rise during a flood event.

5.6.2 Sustainable Drainage Systems

SuDS provide a means of dealing with the quantity and quality of surface water and can also provide amenity and biodiversity benefits. Given the flexible nature of SuDS they can be used in most situations within new developments as well as being retrofitted into existing developments. SuDS can also be designed to fit into most spaces. For example, permeable paving could be used in parking spaces or rainwater gardens as part of traffic calming measures.

The developer is responsible for ensuring the design, construction and future/ongoing maintenance of any SuDS scheme is carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and current drainage arrangements is essential.

5.6.3 Modification of ground levels

Any proposal for modification of ground levels will need to be assessed as part of a detailed FRA.

Modifying ground levels to raise land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for floodwaters. However, care must be taken as raising land above the floodplain could reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land. Raising ground levels can also deflect flood flows, so analyses through modelling should be performed to demonstrate that there are no adverse effects on third party land or property.

Compensatory flood storage should be provided and would normally be on a level-for-level, volume-for-volume basis on land that does not currently flood but is adjacent to the floodplain (for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated). Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624[40].

Where proposed development results in a change in building footprint, the developer should make sure that it does not impact upon the ability of the floodplain to store or convey water and seek opportunities to provide floodplain betterment.

Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested through appropriate modelling to make sure that it would not cause increased ponding or build-up of surface runoff on third party land.

5.6.4 Raised floor levels

If raised floor levels are proposed, these should be agreed with the LPA and the EA. The minimum Finished Floor Level (FFL) may change dependent upon the vulnerability and flood risk to the development.

The EA advises that minimum FFLs should be set to a minimum of whichever is higher of 300mm above the average ground level of the site, the adjacent road level to the building or

40 CIRIA January 2004, CIRIA Report 624: Development and Flood Risk - Guidance for the Construction Industry

the 100-year plus climate change peak flood level, where the latest climate change allowances have been used (see Section 4.7.1 for the climate change allowances). An additional allowance may be required due to residual risks relating to blockages to the channel, culvert or bridge structures and should be considered as part of an FRA.

Allocating the ground floor of a building for less vulnerable, non-residential use is an effective way of raising living space above flood levels. Single storey buildings such as ground floor flats or bungalows are especially vulnerable to the rapid rise of floodwater (such as that experienced during a breach). This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route from the development to safe areas.

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 and areas at high or medium risk of surface water flooding should not be permitted, whilst basement dwellings in Flood Zone 2 will be required to pass the exception test. Access should be situated 300mm above the design flood level and waterproof construction techniques used.

5.6.5 Property Flood Resilience

Para 173 of the NPPF explains that development must only be allowed in areas at flood risk where, following the sequential and exception tests and supported by an FRA, the development is appropriately flood resistant and resilient.

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

The 'Code of practice for property flood resilience', published by CIRIA in 2021[41], defines active PFR measures as "*…measures which are not permanently installed into the property and will require deployment before a flood event (e.g. a door guard)*'. Passive PFR measures are defined as '…*measures which are installed into the property and do not require further deployment or activation before a flood event (e.g. a flood door or automatic airbrick cover)*".

Research[42] carried out by the then DCLG (now DLUHC) and the EA recommended that the use of PFR measures should generally be limited to a nominal protection height of 600 mm above ground level, the lowest point of ground abutting the external property walls. This is because the structural integrity of the property may be compromised above this level. The EA recommends that advice from a structural engineer should be sought for any measures to resist a depth of 600 mm or more.

It should be noted that it is not possible to completely prevent flooding to all communities and businesses. Also, PFR measures would not be expected to cause an increase in flood

41 CIRIA (2021) Code of practice for property flood resilience (C790F)

42 DCLG & EA (2007) Improving the Flood Performance of New Buildings - Flood Resilient Construction

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

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

5.6.5.1 Definitions

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

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

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

5.6.5.2 Property mitigation surveys

To define the scale and type of resistance or resilience measures required, a survey will need to be undertaken to pick up property threshold levels, air brick levels, doorways, historic flood levels and several ground spot levels required to better understand the flood mechanisms for floodwater arriving at the property (e.g., along roads and pavements). The depth of flooding recorded at a property will help guide the selection of the most appropriate PFR measures. Surveys will need to include:

- Detailed property information i.e. structure, presence of air bricks, cellars, outlet pipes, floor levels, door and window levels, manhole and grid locations;
- An assessment of flood risk, including property (cross) threshold levels;
- Routes of water ingress (fluvial, groundwater and surface water flooding);

- An assessment of the impact of floodwaters;
- A schedule of recommended measures to help to reduce risk;
- Details of recommendations (including indicative costs);
- Advice on future maintenance of measures; and
- Advice on flood preparedness and emergency planning.

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

5.7 Emergency planning

The provisions for emergency planning for local authorities as Category 1 responders are set out by the Civil Contingencies Act, 2004[43] and the National Flood Emergency Framework for England, December 2014[44]. This framework is a resource for all involved in emergency planning and response to flooding from rivers, surface water, groundwater, and reservoirs. The framework sets out Government's strategic approach to:

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

Along with the EA flood warning systems, there are a range of flood plans at a local level, outlining the major risks from flooding and the strategic and tactical response framework for key responders. The EA and the Association of Directors of Environment, Economy, Planning and Transport (ADEPT) have produced guidance on flood risk emergency plans for new development (September 2019)[45]. It would however be for the LPA to review and approve flood risk emergency plans with their emergency planners or through the Local Resilience Forum (see Section 5.7.1.1).

43 Civil Contingencies Act | GOV.UK | 2004
44 The national flood emergency framework for England | GOV.UK | 2014
45 Flood Risk Emergency Plans for New Development | ADEPT/EA | 2019

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 interactive GeoPDF maps in Appendix A and accompanying GIS layers should be made available to emergency planners to help prepare for any flood event and throughout the planning process of the IAMP.

5.7.1 Civil Contingencies Act

Under the Civil Contingencies Act (CCA, 2004)[46], LLFAs and the LPAs are classified as Category 1 responders and thus have duties to assess the risk of emergencies occurring, and use this to:

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

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

5.7.1.1 Northumbria Local Resilience Forum (LRF)[47]

The aim of the LRF is to legally deliver the duties stated in the Civil Contingencies Act 2004 within a multi-agency environment. The Northumbria LRF is a group of multi-agency organisations that work together to prepare and respond to emergencies within the Tyne and Wear area. The LRF involves local authorities, emergency services, health agencies, EA and local businesses.

The LRF's common objectives are to:

- Prevent the situation from getting worse;
- Save lives;
- Relieve suffering;
- Protect property;
- Recover to normality as soon as possible; and
- Facilitate criminal investigation and judicial process as necessary.

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46 The Civil Contingencies Act | GOV.UK | 2013
47 Northumbria Local Resilience Forum

The LRF's main roles include:

- Assessing the impacts of the risk and providing this information to the public in a Community Risk Register;
- Creating emergency plans;
- Responding together in a coordinated way;
- Training and testing for preparedness; and
- Learning the lessons from incidents and exercises.

5.7.1.2 Community Risk Register[48]

The LRF produces the Community Risk Register (CRR) which lists the possible risks the probability of an emergency event occurring and the potential impact. The CRR provides information on the biggest emergencies that may happen across Northumbria, together with an assessment of how likely they are to happen and the potential impacts to people, houses, the environment and local businesses. Each identified risk is then analysed and given a rating according to how likely the risk is to lead to an emergency and their potential impact on safety and security, health, economy, environment and society.

5.7.1.3 Community Emergency Plan

Communities may need to rely on their own resources to minimise the impact of an emergency, including a flood, before the emergency services arrive. Many communities already help each other in times of need, but experience shows that those who are prepared cope better during an emergency. Communities with local knowledge, enthusiasm and information are a great asset and a Community Emergency Plan can help. Details on how to produce a community emergency plan, including a toolkit and template, are available from the Government's website[49].

5.7.1.4 Local Flood Plans

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

This SFRA can help to:

- Update these flood plans if appropriate;
- Inform emergency planners in understanding the possibility, likelihood and spatial distribution of all sources of flooding;
- Identify safe evacuation routes and access routes for emergency services;

48 Northumbria Community Risk Register
49 Resilience in society: infrastructure, communities and business | GOV.UK | 2014

- Identify key strategic locations to be protected in flooding emergencies, and the locations of refuge areas that are capable of remaining operational during flood events;
- Provide information on risks in relation to key infrastructure, and any risk management activities, plans or business continuity arrangements;
- Raise awareness and engage local communities;
- Support emergency responders in planning for and delivering a proportionate, scalable and flexible response to the level of risk; and
- Provide flood risk evidence for further studies.

The guidance written by the EA and ADEPT[50] is aimed at LPAs to help assist in setting up their own guidelines on what should be included in flood risk emergency plans.

The appropriate guidance for each LLFA, summarised below, should be followed for development falling within the respective local authority area.

Sunderland City Council Local Flood Risk Management Strategy (LFRMS)[51]

Sunderland City Council, as LLFA, have produced their LFRMS which summarises how the FWMA will be implemented within Sunderland and who will be responsible for ensuring the requirements are fulfilled. It aims to act as a tool to help deliver the benefits of well-managed and hence reduced flood risk to people, property, and the wider environment. The purpose of the LFRMS is to act as a robust guidance tool for Risk Management Authorities in delivering all flood risk management activities. It also summarises the known flood risks from all sources within the Sunderland local planning authority area.

South Tyneside Council Flood and Coastal Risk Management Strategy[52]

The South Tyneside Flood and Coastal Risk Management Strategy sets out the approach to flood risk and coastal management, ensuring consistent working relationship between organisations and partnerships to protect the public and economy from flood risk. The strategy sets out the intended response to flooding incidents and promotes awareness within the local community.

5.8 Flood warning and evacuation plans

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

50 Flood Risk Emergency Plans for New Development | ADEPT/Environment Agency | 2019

51 Sunderland City Council LFRMS | SCC | April 2016

52 South Tyneside FCRM Strategy | STC | 2017

In relation to a new development, it is up to the LPA to determine whether the flood warning and evacuation plans, or equivalent procedures, are sufficient or not. If the LPA is not satisfied, considering all relevant considerations, that a development can be considered safe without the provision of safe access and escape routes, then planning permission should be refused.

Whilst there is no statutory requirement on the EA or the emergency services to approve evacuation plans, LPAs are accountable under their Civil Contingencies duties, via planning condition or agreement, to make sure that plans are suitable. This should be done in consultation with development management officers and emergency planners. Given the cross-cutting nature of flooding, it is recommended that further discussions are held internally to the LPA between emergency planners and policy planners/development management officers, the LLFA, drainage engineers and to external stakeholders such as the emergency services, the EA, and NW.

It could be useful for the LLFAs and spatial planners to consider whether, as a condition of planning approval, flood evacuation plans should be provided by the developer that aim to safely evacuate people out of flood risk areas, using as few emergency service resources as possible. Given the assessed risk to the AAP sites, flood evacuation plans may not be required as safe access and escape routes during times of flood should be achievable.

At the time of writing, there are no EA Flood Warning Areas in place within the IAMP. There is, however, an EA Flood Alert Area in place along the River Don, namely FAA 121WAF912 - Rivers Derwent, Team, Don and estuarine tributaries. The Flood Alert Area covers a similar area to Flood Zone 2 within the IAMP, covering the northern boundary of the Expansion Land Site 2 AAP site and the south western corner of the Southern Employment Area AAP site. The Flood Alert Area is displayed on the interactive GeoPDF maps in Appendix A.

5.8.1 What should a flood warning and evacuation plan include?

Flood warning and evacuation plans should include the information stated in Table 5-1. Advice and guidance on plans are accessible from the EA website and plan templates are available for businesses and local communities.

Table 5-1 Flood warning and evacuation plans

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.

Consideration	Purpose
How flood warning is given and the occupant's awareness of the likely frequency and duration of flood events	Everyone eligible to receive flood warning should be signed up to the EA flood warning service. Where applicable, the display of flood warning signs should be considered. Particularly sites that will be visited by members of the public daily, 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 site staff, occupants, or 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 source, 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 i.e. elderly, less able, children are more vulnerable.
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.
Mental health	Exposure to a flood event i.e. having your home flooded can have severe effects on the mental health of those affected. There should be guidance on how to get help with mental issues.

6 Conclusions

6.1 Conclusions

This Level 1 SFRA provides a single repository planning tool relating to flood risk and development within the IAMP. Key flood risk stakeholders namely the EA, LLFAs and NW were consulted to collate all available and relevant flood risk information on all sources into one comprehensive high-level assessment. Together with this report, this SFRA also provides a suite of interactive GeoPDF maps (Appendix A) illustrating the level of risk to the IAMP and its individual site parcels. Appendices B and C present a flood risk screening assessment of the AAP sites to identify flood risk from multiple sources to each site. Appendix D summarises the methodology behind the delineation of the functional floodplain extent used to inform risk to development as part of this SFRA. The SFRA User Guide in Appendix E provides guidance on the flood risk datasets available to inform on flood risk to the study area.

The data and information used throughout the SFRA process is the most up-to-date data available at the time of writing. Once new, updated, or further information becomes available for the IAMP, the councils should look to update this SFRA. The Level 1 SFRA should be maintained as a 'live' entity that is updated as and when required (when new modelling or flood risk information becomes available or national changes in policy). The LPAs can decide to update the SFRA and the EA and LLFAs as statutory consultees on can also advise on when an update is required.

The assessed flood risk to each AAP site is summarised in Table 6-1.

Table 6-1 Flood risk summary for each AAP site

Site	Risk summary
Northern employment area	Surface water flood risk is confined to flow paths through the site and within scattered topographic low spots. There is a flow path along West Pastures that runs through the centre of the site, and also along the course of the drainage ditch within the south of the site
Expansion land site 1	The site is modelled to be at risk during the 1000-year plus climate change event, however this is only modelled to impact a small area within the north east of the site. Surface water flood risk within the site is confined to scattered topographic low spots, with risk to the site increasing with climate change.
Expansion land site 2	The northern boundary of the site is within the functional floodplain, in the area adjacent to the River Don. Flood Zone 3a and Flood Zone 2 are also present within the north of the site. Ideally, development would be directed towards the south of the site to avoid the area within the flood zones. Modelled fluvial climate change risk remains confined to the northern boundary of the site.

Site	Risk summary
	Surface water flood risk within the site is confined to scattered topographic low spots. Surface water flood risk to the site increases with climate change, with a flow path emerging along the eastern boundary of the site in the 100-year plus climate change event
Southern employment area	The site is within Flood Zone 2, impacting the south western corner of the site. Modelled fluvial climate change increases risk to the site in the 1000-year plus climate change event, however this remains confined to the south western corner. Surface water flood risk within the site is confined to scattered topographic low spots, with a flow path through the centre of the site during the 1000-year event. Surface water flood risk to the site increases with climate change, with some significantly large areas of ponding within the 100-year plus climate change surface water flood event.

A Appendix A - Interactive GeoPDF maps and GIS data

The SFRA Maps consist of all flood risk information used within the SFRA, by way of interactive GeoPDF maps. The Index Map includes a set of grid squares; clicking on one of these squares will open up one of the Detailed Maps of the IAMP area.

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.

A zipped folder containing the relevant GIS datasets has also been provided as part of Appendix A allowing the SCC to replicate the GeoPDF mapping using their own software or upload the data to an online mapping portal if desired.

B Appendix B - Development site assessment spreadsheet

Excel spreadsheet containing an assessment of flood risk to the AAP sites based on Flood Zones 2, 3a and 3b, as delineated through this SFRA and accounting for climate change, and the Risk of Flooding from Surface Water (RoFSW), also accounting for climate change. A summary of recommended next steps is included for each site.

C Appendix C - Site screening summary

Summarises the outcomes of the site screening recorded in Appendix B.

D Appendix D - Functional floodplain delineation

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

E Appendix E - IAMP AAP SFRA User Guide

A support document to provide guidance on the use of the data within the Level 1 SFRA to developers, spatial planners, development management, flood risk management and emergency planners.

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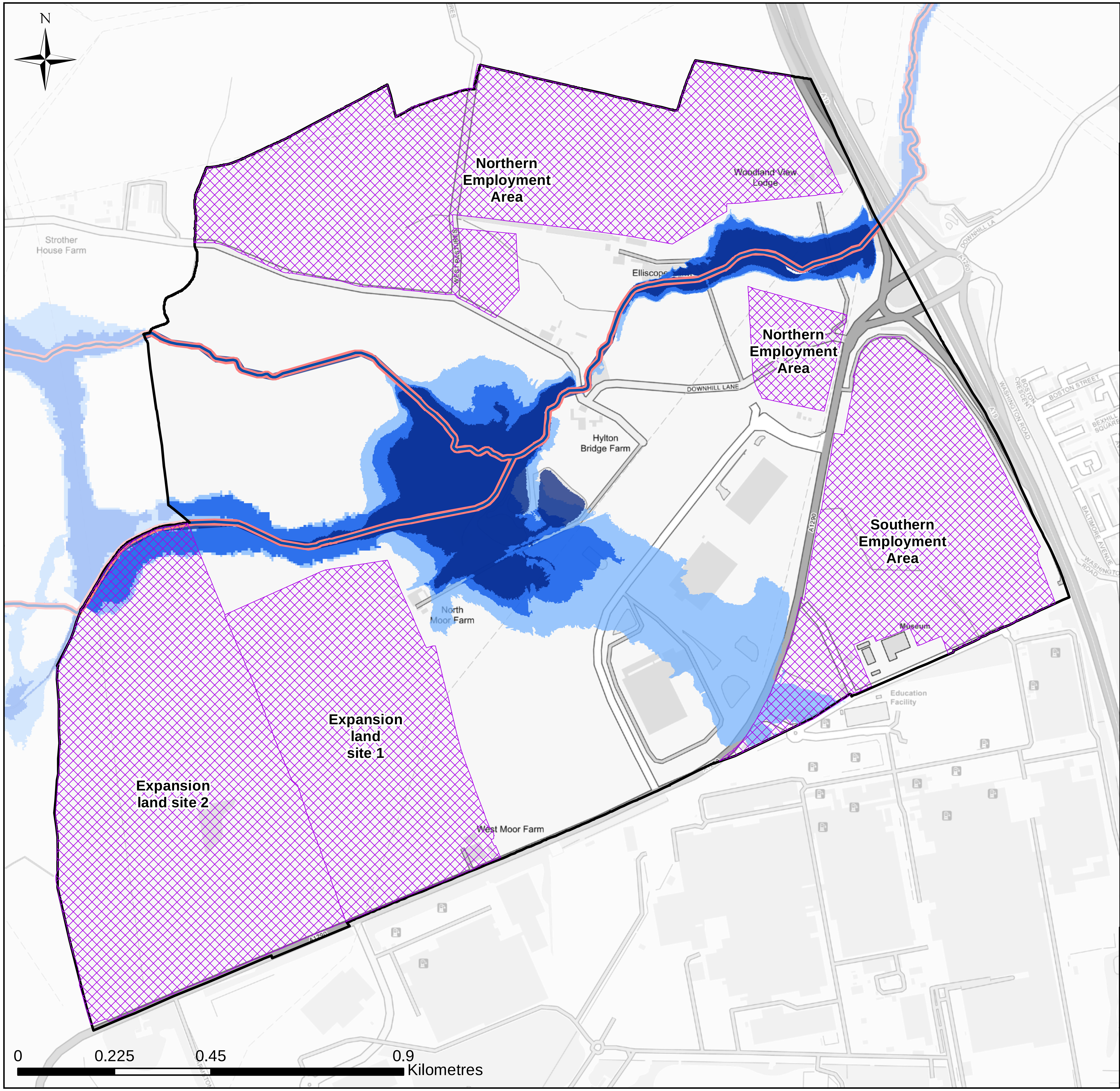

IAMP AAP SFRA
for
Sunderland City Council and
South Tyneside Council

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Detailed Map

Turn Map Labels On/Off:

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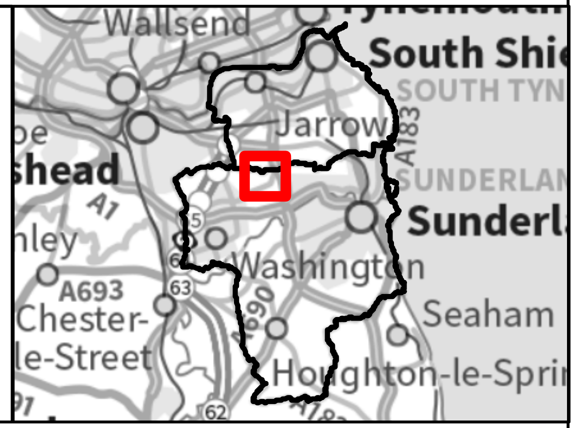

Map Data

- IAMP boundary
- Main rivers
- Area Action Plan Sites
- 8m main river buffer

Flood Zones

Flood Zones

- Flood Zone 3b (functional floodplain)
- Flood Zone 3a (EA)
- Flood Zone 2 (EA)

Sunderland City Council

South Tyneside Council

International Advanced Manufacturing Park Area Action Plan Level 1 SFRA - Appendix C

Sites Screening Summary

May 2024

Prepared for:

Sunderland City Council

South Tyneside Council

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1 Sites Screening Assessment

This report provides a strategic assessment of the suitability, relative to flood risk, of the sites to be considered for allocation in the Area Action Plan (AAP) for the International Advanced Manufacturing Park (IAMP), summarising the outcomes of the screening assessment spreadsheet in Appendix B.

The information and guidance provided in this Appendix (also supported by the SFRA Interactive Mapping in Appendix A) can be used by the LPAs to inform the AAP and provide the basis from which to apply the Sequential Test in the development allocation and the development management process.

The LPAs must use Appendix B to record their decisions on how to take each site forward, based on the evidence and recommendations provided in this Level 1 SFRA. Recording decisions in the Sites Screening Spreadsheet demonstrates that a sequential, sustainable approach to development and flood risk has been adopted.

Sunderland City Council (SCC) provided a GIS layer containing the four AAP sites within the IAMP.

The sites screening assessment entails a high-level GIS screening exercise overlaying the proposed development sites against Flood Zones 1, 2, 3a and 3b (the functional floodplain), calculating the area of each site at risk. Flood Zones 1, 2 and 3 are sourced from the EA's Flood Map for Planning (Rivers and Sea). Flood Zone 3 is split into Flood Zone 3a and Flood Zone 3b (functional floodplain) as part of this Level 1 SFRA, as required by the National Planning Policy Framework (NPPF). The AAP sites have also been screened against the IAMP TWO modelled flood outlines along the River Don. The modelled flood outlines for the 100-year and 1000-year flood events are smaller in extent than the Flood Zone 3 and Flood Zone 2 extents respectively, indicating that the flood zones are not based on this model.

The impacts of climate change have been included in the sites screening process using the delineated Flood Zone 3b plus climate change outline and modelled 100-year and 1000-year flood events plus climate change. See Section 1.3 for details.

All flood zones and modelled flood outlines are displayed on the SFRA Interactive Mapping in Appendix A.

Surface water flood risk to the proposed sites is analysed by way of the EA's national scale Risk of Flooding from Surface Water (RoFSW) dataset. However, the EA states that this dataset is not suitable for identifying whether an individual property will flood. It is recommended that the RoFSW is not displayed on basemapping more detailed than 1:10,000 as the data is open to misinterpretation if viewed at a greater or more detailed scale. Because of the way the RoFSW has been produced and the fact it is indicative, it is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to surface water flooding at any scale without further supporting studies or evidence. Further investigative work on surface water flood risk should be carried out at the FRA stage.

The impact of climate change on surface water flood risk has also been considered within this sites screening using modelled surface water climate change outputs based on the RoFSW methodology.

It is important to consider that each individual site will require further investigation, following this assessment, as local circumstances may dictate the outcome of the recommended next steps. The outcomes of the sites screening assessment are presented in the site screening spreadsheet in Appendix B.

1.1 Screening of potential sites

This section of the report draws together the results included in the sites assessment spreadsheet. The LPAs should use the spreadsheet to identify which sites should be avoided during the Sequential Test.

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 shown to be at high or medium risk of flooding.

The sites assessment spreadsheet provides a breakdown of each site and the area (in hectares) and percentage coverage of each fluvial and surface water flood zone. Fluvial Flood Zones 3b, 3a, 2 and 1 are considered in isolation. Any area of a site within the higher risk Flood Zone 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 for the sequential assessment of risk at each site by addressing those sites at higher risk first. The effects of climate change on fluvial flood risk have been assessed additionally to existing risk. Table 1-1 shows the proposed use of the sites and the number of sites within each fluvial flood zone and Table 1-2 shows the number of sites within each surface water flood zone.

Table 1-1 Number of sites at risk from fluvial flooding

Proposed Use	Number of sites within each Flood Zone				
	Flood Zone 1*	**Flood Zone 2**	**Flood Zone 3a**	**Flood Zone 3b**	**Flood Zone 3b + climate change**
Industrial	3	2	1	1	0
TOTAL	**3**	**2**	**1**	**1**	**0**

*Sites with 100% area within Flood Zone 1
Note: sites may be in more than one flood zone. In reality, a site in Flood Zone 3a will also be within Flood Zone 2.

Table 1-2 Number of sites at risk from surface water flooding

Proposed Use	Number of sites within each surface water risk category		
	Low risk zone (1 in 1000-year)	**Medium risk zone (1 in 100-year)**	**High risk zone (1 in 30-year)**
Industrial	4	4	4
TOTAL	**4**	**4**	**4**
Note: sites may be in more than one surface water risk category. In reality, a site in the high risk category will also be in the medium and low risk categories.			

1.2 Recommended approach

The recommended approach column within the site screening spreadsheet details a summary of risk for each site, and the recommended next steps. Recommendations are detailed within Table 1-3 for each site.

Table 1-3 Site screening recommended approach

Site	Recommended approach
Northern employment area	A site-specific FRA will be required for this site given it is greater than 1 hectare. The site is not modelled to be at fluvial flood risk, including during a 1000-year plus climate change flood event. Surface water flood risk is confined to flow paths through the site and within scattered topographic low spots. There is a flow path along West Pastures that runs through the centre of the site, and also along the course of the drainage ditch within the south of the site. A drainage strategy will be required alongside the FRA to ensure there is no increase in surface water flood risk elsewhere as a result of new development, involving surface water flood modelling based on layout plans and detailed design and full consultation with the LLFA. Safe access and escape routes should be possible via the road to the south of the site.

Site	Recommended approach
Expansion land site 1	A site-specific FRA will be required for this site given it is greater than 1 hectare. The site is not modelled to be at risk in the fluvial 100-year present day event, 100-year plus climate change events or the 1000-year present day event. The site is modelled to be at risk during the 1000-year plus climate change event, however this is only modelled to impact a small area within the north east of the site. Surface water flood risk within the site is confined to scattered topographic low spots, with risk to the site increasing with climate change. A drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development, involving surface water flood modelling based on layout plans and detailed design and full consultation with the LLFA. Safe access and escape routes should be possible via the A1290 to the south of the site.
Expansion land site 2	A site-specific FRA will be required for this site given it is greater than 1 hectare. The northern boundary of the site is within the functional floodplain of the River Don. The functional floodplain impacting the site is comprised largely of the 8 metre buffered channel, with a nominal percentage of the site within the modelled 30-year flood event of the River Don. There should be no development within 8 metres of a main river. Therefore, development should avoid the northern boundary of the site which should be left as open greenspace. Flood Zone 3a and Flood Zone 2 are also present within the north of the site. Ideally, development would be directed towards the south of the site to avoid the area within the flood zones. Any development in Flood Zone 2 must consider property flood resilience measures and must account for the safety of people within a building if it floods and also the safety of people around a building and in adjacent areas, including people who are less mobile or who have a physical impairment. Modelled fluvial climate change risk remains confined to the northern boundary of the site. Surface water flood risk within the site is confined to scattered topographic low spots. Surface water flood risk to the site increases with climate change, with a flow path emerging along the eastern boundary of the site in the 100-year plus climate change event. A drainage strategy would be required to ensure there is no increase in

Site	Recommended approach
	surface water flood risk elsewhere as a result of new development, involving surface water flood modelling based on layout plans and detailed design and full consultation with the LLFA. Safe access and escape routes should be possible via the A1290 to the south of the site.
Southern employment area	A site-specific FRA will be required for this site given it is greater than 1 hectare. The site is partially within Flood Zone 2, impacting the south western corner of the site. Development should avoid this area and be directed towards Flood Zone 1 which covers ~95% of the site. Any development in Flood Zone 2 must consider property flood resilience measures and must account for the safety of people within a building if it floods and also the safety of people around a building and in adjacent areas, including people who are less mobile or who have a physical impairment. Modelled fluvial climate change increases risk to the site in the 1000-year plus climate change event, however this remains confined to the south western corner. Surface water flood risk within the site is confined to scattered topographic low spots, with a flow path through the centre of the site during the 1000-year event. Surface water flood risk to the site increases with climate change, with some significantly large areas of ponding within the 100-year plus climate change surface water flood event. A drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development, involving surface water flood modelling based on layout plans and detailed design and full consultation with the LLFA. Safe access and escape routes should be possible via the A1290 to the west of the site.

1.3 Assessment of climate change

The sites screening spreadsheet (Appendix B) highlights the additional risk to sites, where applicable, as a result of climate change. To represent the potential increase in flood risk from rivers due to climate change, peak fluvial inflows were uplifted according to the latest EA allowances. The IAMP area is within two management catchments: the Wear Management Catchment and the Tyne Management Catchment.

Table 1-4 indicates the climate change allowances applicable to the management catchments covering the study area. The central and higher central climate change allowances for each management catchment have been applied to consider the impact on fluvial flood risk, as stated in the EA's guidance for assessing climate change in SFRAs.

Table 1-4 Climate change allowances for peak river flows (2080s)

Climate change allowance	Wear Management Catchment	Tyne Management Catchment
Central	25%	34%
Higher Central	32%	42%
Upper	50%	64%

At the time of writing, the following EA guidance should be followed:

Flood risk assessments: climate change allowances

The sites screening spreadsheet highlights the **additional** risk from climate change. This has been assessed through GIS geoprocessing tools by clipping the baseline modelled flood outlines from the climate change enhanced flood outlines for each equivalent return period, resulting in outlines of the additional areas at risk. This was screened against the potential development sites to identify sites at risk from climate change. The Risk of Flooding from Fluvial Climate Change columns indicate the area of each site that intersects with each relevant modelled flood outline.

The fluvial climate change scenarios assessed were:

- 1 in 30 year + central climate change allowance (functional floodplain + climate change)
- 1 in 100 year + central climate change allowances
- 1 in 100 year + higher central climate change allowance
- 1 in 1000 year + central climate change allowance

The impact of climate change on surface water flood risk has been assessed through uplifting the events of the Risk of Flooding from Surface Water dataset using the upper end peak rainfall intensity allowance. The surface water climate change scenarios assessed were:

- 1 in 30 year + upper end climate change allowance
- 1 in 100 year + upper end climate change allowance

1.4 Summary of site assessment outcomes

Overall, risk to the AAP sites within the IAMP is nominal and can be managed. Development should be avoided in any area within the functional floodplain and should be directed towards areas at a lower risk of flooding. There is risk of flooding from surface water to all sites therefore drainage strategies will be required, alongside a site specific FRA, to manage this risk.

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International Advanced Manufacturing Park Area Action Plan Level 1 SFRA - Appendix D

Functional Floodplain Delineation Methodology

April 2024

Prepared for:

Sunderland City Council

South Tyneside Council

www.jbaconsulting.com

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1 Introduction

The Flood Risk and Coastal Change Planning Practice Guidance[1] (FRCC-PPG) states that local planning authorities (LPA) should identify in their Strategic Flood Risk Assessments (SFRA) areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency (EA). The International Advanced Manufacturing Park (IAMP) area functional floodplain (Flood Zone 3b) extent has therefore been delineated as part of this Level 1 SFRA using the most up-to-date data available. This methodology note explains the delineation process.

Note that Flood Zone 3b is not included in the Flood Map for Planning. This SFRA sub-divides Flood Zone 3 into Flood Zone 3a and Flood Zone 3b. This distinction is for the use of LPAs and developers in development planning. Flood Zone 3a can be considered to be Flood Zone 3 of the Flood Map for Planning that is not functional floodplain.

Sunderland City Council (SCC) and South Tyneside Council (STC), as both LPA and Lead Local Flood Authority (LLFA), and the EA must all agree on the extent of the functional floodplain outline and the methodology used. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. The local knowledge of the LPAs, LLFAs and EA is therefore crucial in defining the functional floodplain as robustly and realistically as possible.

1 Flood Risk and Coastal Change Planning Practice Guidance | UK Government | 2022

2 Functional floodplain definition

The EA's SFRA guidance[2] states that the Level 1 SFRA should include the functional floodplain extent on maps with a detailed explanation of how the functional floodplain was defined. This methodology note provides this definition and the interactive GeoPDF maps present the extent of the functional floodplain.

The EA's SFRA guidance states:

"In any modelling used to identify the functional floodplain, include defences and other flood risk management features and structures,

Functional floodplain may not be required in locations where evidence shows flooding would be prevented by existing:

- *Flood defences*
- *Flood risk management features or structures*
- *Solid buildings*

Water storage areas are shown on the Flood Map for Planning. The EA should confirm whether these areas are suitable to include in the functional floodplain extent."

The FRCC-PPG states the functional floodplain:

"Comprises land where water from rivers or the sea has to flow or be stored in times of flood,

Should comprise of land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively, or

Should comprise of land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding),

Should take account of local circumstances and not be defined solely on rigid probability parameters."

2 How to Prepare a Strategic Flood Risk Assessment | Environment Agency | 2022

3 Functional floodplain delineation

3.1 Datasets

Based on the above guidance, the modelled flood outline (MFO) listed in Table 3-1 below was used to assist in the delineation of the functional floodplain within the IAMP area. Direct modelling of the present and future 3.33% AEP event has been used to delineate Flood Zone 3b and the future Flood Zone 3b.

The hierarchy of methods used to define Flood Zone 3b is outlined below:

1. Use of detailed model outputs.
2. Use of the buffered watercourse, 8 metres either side of the channel.

Table 3-1: Modelled flood outline

Model	Year	Annual Exceedance Probability (AEP)	Defended?
River Don IAMP	2018	3.33%	Yes

Along with the modelled flood outline listed in Table 3-1, the watercourse dataset in Table 3-2 was also used to assist with the delineation.

Table 3-2: Additional datasets

Dataset	Purpose
Watercourse link - OS Open Rivers	To create river channel areas within Flood Zone 3b as requested by EA SFRA guidance. This dataset includes watercourses only and does not include closed waterbodies such as ponds, lakes. The dataset has been buffered by 8m either side of the watercourse polyline to broadly represent the width of the Don and Usworth Burn watercourse across the area. It is recognised that this is an approximation. Policy relating to Flood Zone 3b applies to the watercourse and not the mapping where they are different.

4 GIS methodology

The draft functional floodplain outline should be assessed and agreed upon by the LPAs, LLFAs and the EA. The extent of the functional floodplain outline produced from this Level 1 SFRA should always be assessed in greater detail where any more detailed study such as a Level 2 SFRA or site-specific FRA are undertaken.

The below steps summarise the methodology used to delineate the functional floodplain:

- The 2019 Flood Zone 3b outline was used as a starting point and updated with the MFO listed in Table 3-1.
- All river channel sections were added to the Flood Zone 3b outline, as required by the EA's guidance. It is noted that the river channel dataset used (OS Open Rivers Dataset, Watercourse Link Shapefile) is a high level dataset that may not be spatially correct in many areas. At a local scale, this could lead to inaccuracies, especially in hydrologically complex areas where there are man-made interactions or interactions with other bodies of water such as reservoirs or canals. Recognising this, Flood Zone 3b policy relates to the watercourse including an 8m buffer either side of the channel and not the mapping where they are different.
- The EA's Flood Storage Area (FSA) dataset has been reviewed, and it was found that there were no FSAs within the IAMP area.
- It has been assumed that any small 'dry islands', or holes, within the Flood Zone 3b outline should be considered as functional floodplain, and therefore manual edits have been made to include these 'dry islands', or holes, within the outline.
- Each polygon within the Flood Zone 3b outline has been attributed with the source MFO or dataset, so it is possible to ascertain which model or dataset each polygon within the outline came from.
- Checks on the geometry of the Flood Zone 3b outline were carried out to ensure geometric correctness in GIS.

5 Future functional floodplain dataset

In addition to the present day Flood Zone 3b extent, a future Flood Zone 3b extent has also been produced using the present day updated Flood Zone 3b as a starting point, as recommended in the EA's SFRA guidance. This has been updated using climate change enhanced flood modelling for the modelled extent listed in Table 3-1. Within this modelling, an uplift in peak river flow estimates has been applied to make allowance for the future impacts of climate change on peak river flows in accordance with EA guidance. Table 5-1 outlines the climate change uplift applied to the present day modelled functional floodplain.

Table 5-1: Future function floodplain modelling

Model	Annual Exceedance Probability (AEP)	Higher central uplift (%)	Defended?
River Don IAMP	3.33%	34	Yes

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Source of Flooding	High Risk	Medium Risk	Low Risk	Present Day	Future
Fluvial	Greater than 1% AEP (1 in 100 year) – Flood Zone 3	Between 1% and 0.1% AEP (1 in 100 and 1 in 1000 year) – Flood Zone 2	Less than 0.1% AEP (1 in 1000 year) – Flood Zone 1	Environment Agency's Flood Zones 1, 2 and 3 use a risk-based approach. Functional floodplain (Flood Zone 3b) has been delineated using the best available model data. See Appendix D for details of the model used.	Environment Agency's Flood Zones 1, 2 and 3 use a risk-based approach. Climate change uplifts should be assessed as part of the screening process. Where significant parts of a sites area are shown to be at risk in the 1000 year (0.1% AEP), a review of whether the site is sequentially appropriate may be required following a Level 2 assessment. This may result in slightly larger numbers of sites requiring assessment at Level 2.
Coastal	Greater than 0.5% AEP (1 in 200 year) – Flood Zone 3	Between 0.5% and 0.1% AEP (1 in 200 year and 1 in 1000 year) – Flood Zone 2	Less than 0.1% AEP (1 in 1000 year) – Flood Zone 1	No coastal flood risk to the IAMP.	
Surface Water	Greater than 3.3% AEP (1 in 30 year)	Between 3.3% and 1% AEP (1 in 30 and 1 in 100 year)	Between 1% and 0.1% AEP (1 in 100 and 1 in 1000 year)	Different assumptions are used to derive surface water risk than is the case for fluvial flood zones. The RoFSW dataset does not provide the confidence or certainty required to define areas of high, medium and low flood risk that are comparable with the risk zones for river flooding. Therefore, a precautionary approach should be taken so development is located in areas of lower flood risk. This approach will require that sites where proposed development is located in a higher risk surface water zone,	As present day. The impact of climate change on surface water has been modelled for the following events and scenarios: - 3.3% AEP CC+40% - 1% AEP CC+45%. Surface water flood risk into the future should be sequentially assessed using the both the 3.3% AEP extent including 40% uplift for climate change

				and do not clearly show that development can be achieved away from the flood risk, are assessed in more detail in the Level 2 SFRA.	and the 1% AEP extent including 45% uplift for climate change.
Groundwater	Groundwater flood risk should be assessed on a case-by-case basis using best available data.			Datasets do not have the confidence or certainty required to provide mapping that enables a comparative assessment to be made of the risk of flooding of land from groundwater as with fluvial and surface water flood risk. Therefore, a precautionary approach should be taken and sites where groundwater flooding is predicted to impact potential development sites will be assessed in a Level 2 SFRA and the implications for sequential selection of alternative locations considered at that stage.	