Stockport Town Centre Level 2 SFRA

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Stockport Town Centre Level 2 Strategic Flood Risk Assessment

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Executive Summary

Introduction

Stockport Metropolitan Borough Council's (further referred to as SMBC) withdrawal from the Greater Manchester Spatial Framework has provided an opportunity to develop its own Local Plan. Informed by a comprehensive, proportionate, and up-to-date evidence base, the Local Plan will respond to the key challenges facing the Borough over the next 15 years.

As required under National Planning Policy Framework (NPPF) (2021) [i], a Strategic Flood Risk Assessment (SFRA) is one of the supporting documents to the Local Plan. The main purpose of this SFRA is to provide a strategic overview of flood risk within the Town Centre boundary to enable effective risk-based strategic planning for the future. It is a material consideration in allocation of development sites in the Local Plan through the application of the Sequential Test and Exception Test and the determination of subsequent planning applications. The evidence contained within this SFRA also informs other flood risk management activities and functions by SMBC, partners and stakeholders.

In 2010, a Level 2 SFRA was undertaken covering the study area of Stockport Town Centre. The SFRA identified that parts of Stockport Town Centre are at risk from various sources of flooding, specifically fluvial and surface water. However, the flood risk information used to inform the assessment is now over ten years old and potentially outdated. Therefore, SMBC have undertaken a critical review of the existing flood risk evidence relating to Stockport Town Centre and produce a revised Level 2 SFRA.

Revising the Level 2 SFRA

The overall aim of this Level 2 SFRA revision for Stockport Town Centre is to update and build upon existing evidence of flood risk including filling any gaps on mechanisms of flood risk to ensure the authority has sufficient information to satisfy the Exception Test, as required by the NPPF and to provide a robust and comprehensive evidence base to enable the Council to develop the Local Plan, sufficient to withstand scrutiny at an Examination in Public.

To achieve this, the following objectives were set:

- Undertake a critical review of the existing flood risk evidence including the Level 1 and Level 2 Stockport Town Centre SFRA.
- Summarise the plans, policies, strategies, legislation and governance around managing flood risk and development.
- Undertake a robust assessment of flood risk using available data to provide information and maps presenting flood risk from all sources within the Town Centre, including identifying areas at high risk of flooding through a detailed understanding on the probability, mechanisms, and magnitude of flood risk to the area at present and in the future.
- Provide sufficient detail to allow SMBC to apply the Sequential and Exception Test.
- Review and identify opportunities for Flood Risk Management and requirements for site-specific Flood Risk Assessments (FRA), through strategic and local issues and measures within the Town Centre.

Guide to the SFRA content

Section 1 summarises existing studies and background information.

Section 2 summarises existing development and flood risk policy and relevant guidance documents have been considered as part of this SFRA and should be considered for future flood risk assessments.

Section 3 provides an updated summary of all types of flood risk across the whole of the Town Centre boundary and defines what is considered "High" flood risk within this SFRA. This section is supported by flood risk mapping contained in the appendices to this report. The information contained in this section should be used when considering application of the Sequential Test. It is supported by a hydraulic modelling technical note and a groundwater flood risk desk study found in **Appendix E** and **Appendix F** respectively.

Section 4 includes further detailed assessments for high flood risk locations/sources. 11 Detailed Assessment Areas have been created across the Town Centre boundary as shown in Figure 1-1. The information contained in this section should be used when considering application of the Exception Test and future site-specific Flood Risk Assessments (FRAs).

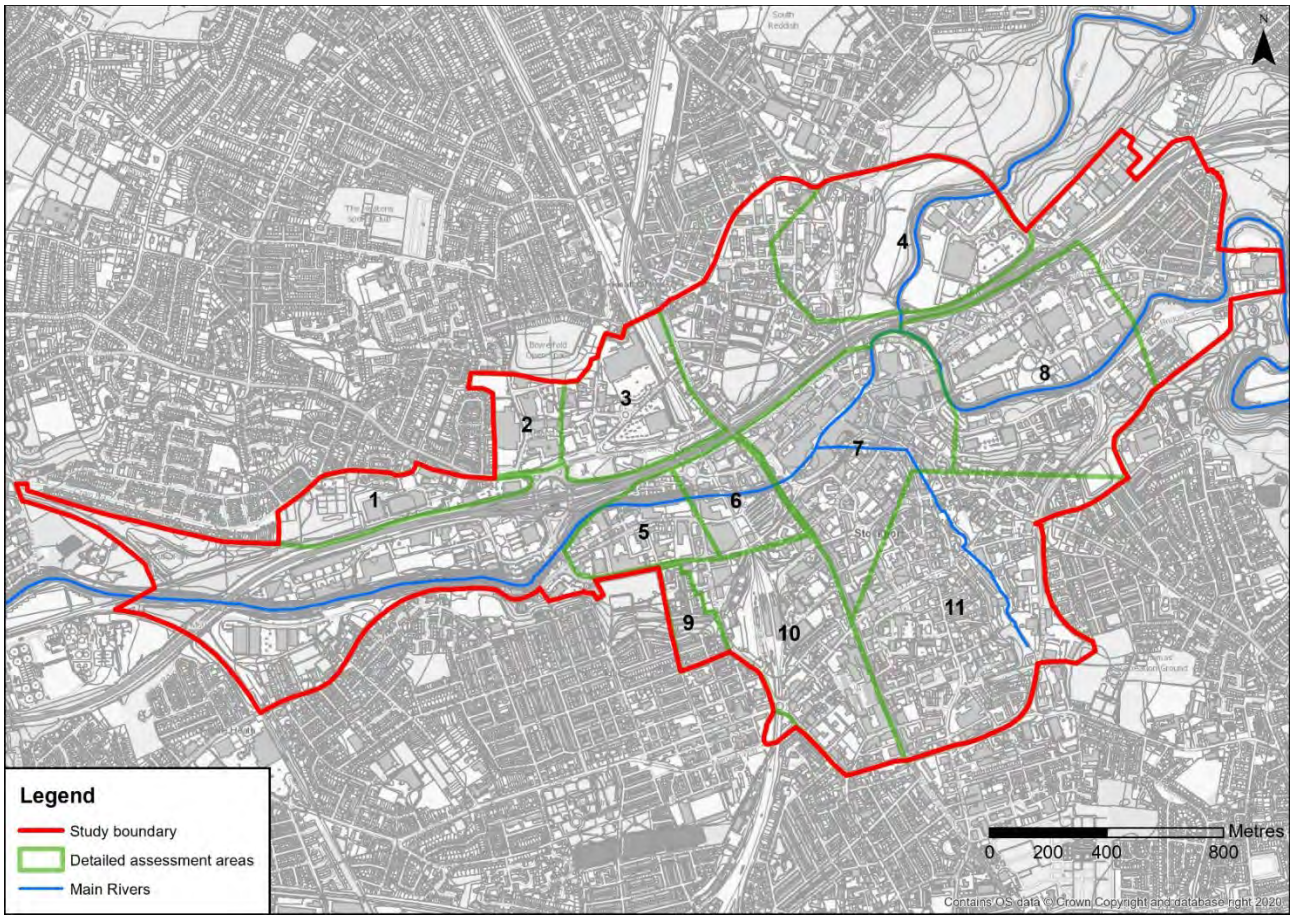

Figure 1-1. Town Centre Boundary and Detailed Assessment Areas

Section 5 provides information on potential strategic and site-specific flood risk measures that should be considered when determining if an area could be developed safely. Guidance is also provided on application of the Sequential and Exception Test.

Appendix A contains an interactive map user guide and **Appendix Appendix B** contains the interactive flood risk map showing multiple flood risk sources across the Town Centre boundary. **Appendix Appendix C** provides Flood Risk Hazard mapping for each Detailed Assessment Area identifying flood risk to people that could be

used to support application of the Sequential and Exception Test and site-specific FRAs. **Appendix Appendix D** provides new flood risk depth maps that have been produced for the SFRA.

Key flood risk findings

Fluvial sources remain a significant flood risk to the Town Centre area particularly around the confluence of the River Goyt and Tame on the River Mersey. This risk will increase when considering the impacts of climate change. New hydraulic modelling data shows there is a residual risk of flooding due to blockages around Hempshaw Brook although this is relatively well constrained.

Latest information collected suggests that most of the Town Centre boundary is within areas of low surface water and sewer flood risk. There are however pockets of high flood risk. New assessment of groundwater flood risk has been undertaken and although no groundwater areas are considered high-risk, long-term risk may be influenced by how groundwater is managed in the future.

Given the varying geographical distribution of flood risk across the Town Centre, it will be important that a sequential risk-based approach to development is implemented. This should include avoiding development in areas of high flood risk identified. How ever, it is recognised that large areas of the Town Centre will need regenerating and flood risk avoidance may not be possible. The application of the Exception Test and site-specific FRAs will be required.

The key flood risk management opportunity to support development of the Town Centre area in areas of flood risk would be to develop a potential flood storage solution upstream of the River Goyt and Tame. There are also opportunities for new development to improve flood protection and resilience by more localised partnership working. Flood Risk Management practices that could be considered include working in partnership with the Environment Agency and United Utilities to reduce the risk of fluvial, surface water and sewer flooding.

A summary of the flood risk to each Detailed Assessment Area is shown in Table 1-1.

Table 1-1. Level of flood risk against each Detailed Assessment Area

Area	Fluvial	Surface Wate	Sewers	Groundwater	Canals	Reservoirs
1	Low	High	High	Low	Low	Low
2	Low	High	High	Low	Low	Low
3	Moderate	High	Low	Moderate	Low	Low
4	High	High	High	Moderate	Low	Low
5	High	High	High	Moderate	Low	Low
6	High	High	High	Low	Low	Low
7	High	High	High	Moderate	Low	Low
8	High	High	High	Low	Low	Low
9	Low	High	Low	Low	Low	Low
10	Low	Low	High	Low	Low	Low
11	High	High	High	Low	Low	Low

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Acronyms and Abbreviations

AEP	Annual Exceedance Probability
AIMS	Asset Inventory Management System
CFMP	Catchment Flood Management Plan
CIL	Community Infrastructure Levy
CIRIA	Construction Industry Research and Information Association
CSM	Conceptual Site Models
DWMP	Drainage and Wastewater Management Plan
FRA	Flood Risk Assessment
FRMS	Flood Risk Management Strategy
GiA	Grant in Aid
GMCA	Greater Manchester Combined Authority
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
PCPA	Planning and Compulsory Purchase Act
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Policy Guidance
S19	Section 19 (FWMA) Report
SFRA	Strategic Flood Risk Assessment
SHLAA	Strategic Housing Land Availability Assessment
SMBC	Stockport Metropolitan Borough Council
SPZ	Source Protection Zone
SuDS	Sustainable Drainage Systems
WFD	Water Framework Directive

1 Introduction

1.1 Commission

Stockport Metropolitan Borough Council (SMBC) commissioned Jacobs UK Ltd in May 2022 to update the Stockport Town Centre Level 2 Strategic Flood Risk Assessment (SFRA) (2010) [ii].

For the purposes of this study, Stockport Town Centre is considered to be the area defined within the Stockport Unitary Development Plan Review (May 2006) as the "Town Centre and M60 Gateway" (i.e. those sites labelled as Development Town Centre Areas and M60 Gateway Sites[iii]). Stockport Town Centre is shown in Figure 1-1 within Section 1.3.2.

1.2 Planning Context and Background

1.2.1 Stockport Local Plan

This assessment will provide the context and be used as supporting evidence for policies and proposals within the emerging Stockport Local Plan following Stockport's withdrawal from the Greater Manchester Spatial Framework. The SFRA will act as a material consideration in the determination of planning applications, as well as being available for other uses by SMBC, partners and stakeholders. With regard to the Town Centre Level 2 SFRA (2010), this SFRA should now be considered as providing the most up to date assessment of all sources of flood risk for the Town Centre Area.

1.2.2 Development and flood risk

Paragraph 159 of the National Planning Policy Framework (NPPF) (2021)[iv] emphasises that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

The NPPF requires that strategic policies should be informed by the SFRA, and that flood risk should be managed from all sources. Plans should apply a sequential, risk-based approach to the location of development with the SFRA providing the basis for applying this test.

A level 2 SFRA should identify areas at moderate and high risk from flooding and drainage issues. It should also contain information to allow application of the Sequential and Exception Test where relevant.

1.2.3 Previous work to date

There are a number of previous SFRAs that have been undertaken encompassing Stockport and they include;

- Stockport Level 1 Update and Stockport Town Centre Level 2 SFRA (2010) [v] - provides consideration of flooding from fluvial, surface water, sewer, canals, reservoirs and groundwater at level 2 but no detailed assessment of the Town Centre Area sites.
- Greater Manchester Level 1 SFRA (2019) [vi] - provides a level 1 SFRA that assessed flood risk of the revised draft Greater Manchester Spatial Framework 2019 allocations and 2018 baseline housing.
- Level 2/ Hybrid SFRAs in Greater Manchester (2020) [vii] - a screening assessment of sites. Overall, there was only one site within the Town Centre Area identified through a screening assessment and this was at Water Street which already has planning permission.

These previous SFRAs are further described in Section 2.5.

1.3 Stockport Town Centre Level 2 SFRA

1.3.1 Why an update is needed

Town Centre Living Area contains areas of Flood Risk Zone 2 and Flood Zone 3. However, this area was not assessed as part of the Greater Manchester Level 2 Hybrid SFRA because it was not a strategic site in the Greater Manchester Strategic Framework; it will however be considered as a strategic site in the Stockport Local Plan. The flood risk information in the Level 2 SFRA for the Town Centre for the Town Centre (March 2010) is over ten years old and subsequently requires an update.

1.3.2 Aims and objectives

The overall **aim** of the Level 2 SFRA for Stockport Town Centre is to update and build upon the existing evidence of flood risk including filling any gaps to ensure the authority has sufficient information to satisfy the Exception Test, as required by the NPPF and to provide a robust and comprehensive evidence base to enable the Council to develop the Local Plan, sufficient to withstand scrutiny at an Examination in Public

The Town Centre Boundary is shown on Figure 1-1 .

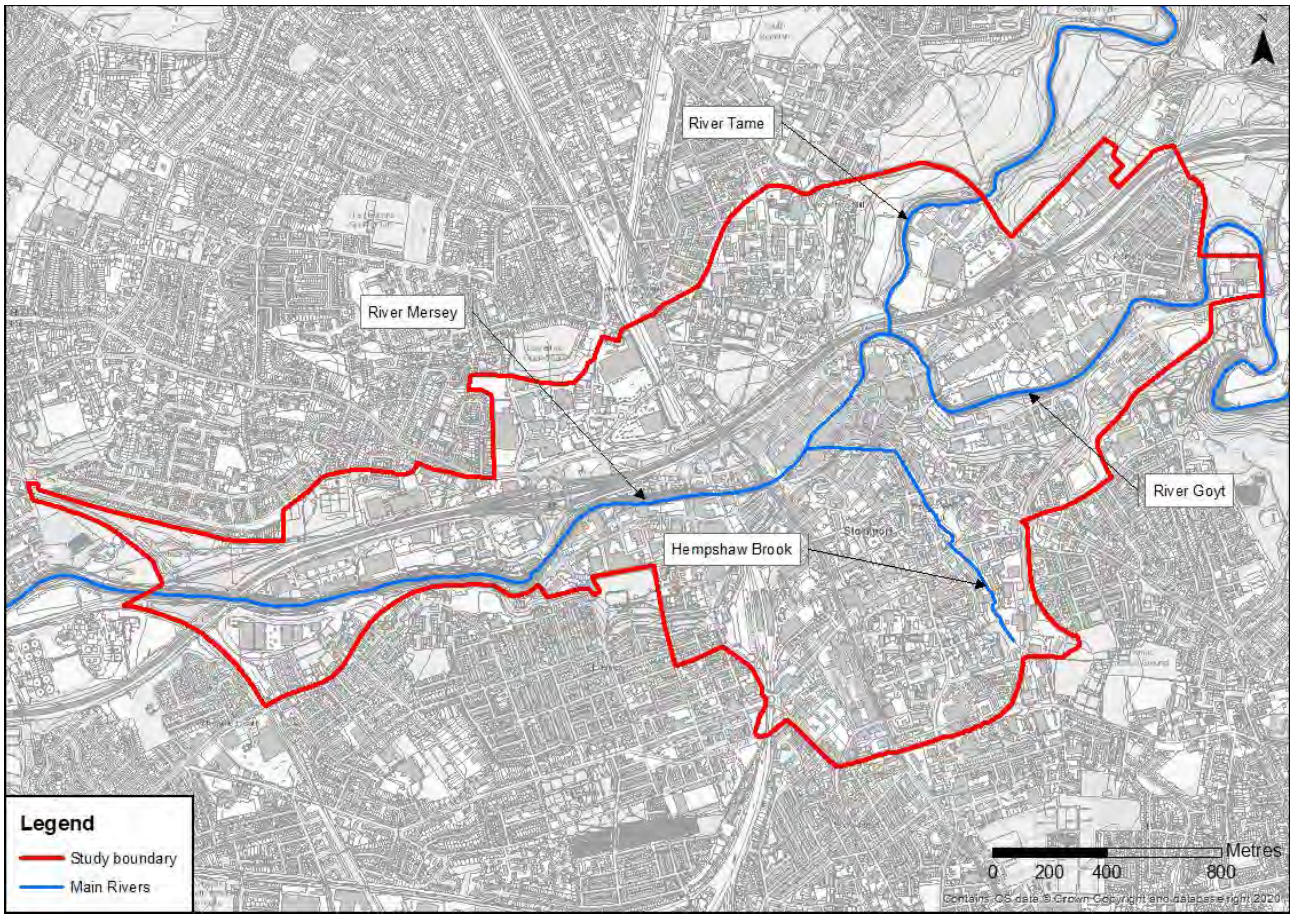

Figure 1-1: Stockport Town Centre Boundary

To achieve the aims of the study, the following **objectives** were set:

- Revise the 2010 Level 2 SFRA
- Undertake a critical review of the existing flood risk evidence.

- Using available data undertake assessment to provide information and maps presenting flood risk from all sources within the Town Centre, including a detailed understanding on the probability, mechanisms, and magnitude of flood risk to the area at present and in the future.
- Conduct appropriate hydraulic modelling to determine the fluvial flood risk in the Town Centre.
- Take into account the most recent national, regional and local policy and guidance to support the assessment of flood risk.
- Provide sufficient detail to allow the SMBC to apply the Sequential and Exception Test.
- Review the requirements for Flood Risk Management and site-specific Flood Risk Assessments (FRA), including considerations of suitable surface water management methods and opportunities to reduce flood risk to any proposed developments through localised and strategic measures.
- Identify further partnership working to address remaining information gaps and understanding of flood risk.

1.3.3 Scope

Guidance on what should be included within a Level 2 SFRA can be found on the Environment Agency's "How to prepare a Strategic Flood Risk Assessment" web page[viii]. To deliver the aim and objectives, the scope of this Level 2 SFRA includes the following key activities.

- Provide updates to fluvial flood risk in Stockport Town Centre by running and updating the Upper Mersey and Hempshaw Brook hydraulic models.
- Use the Environment Agency's Asset Inventory Management System (AIMS) to consider the Standard of Protection.
- Define the consequences of overtopping / breach of defences using two-dimensional hydraulic modelling.
- Identify surface water, drainage flood risk issues (e.g. potential ponded areas and overland flood routes where sewer system capacity is exceeded) and groundwater issues.
- Assess potential flood risk from reservoirs.
- Determine depths, velocities, rate, and onset of flooding and produce Flood Risk Hazard maps.
- Provide guidance on development and flood risk management for consideration in policy development.
- Identify any linkages to other relevant studies, such as the Greater Manchester Water Cycle Study, the Natural Capital Investment plan, and Greater Manchester Biodiversity Guidance.
- Provide guidance on the application of the Exception Test, which will assist planners in taking a sustainable and safe approach when allocating development.
- Assess locations and options for the implementation of Green Infrastructure, to help manage flood risk in key areas.
- Present mitigation options, potential delivery mechanisms including financial mechanisms for funding these interventions and delivery which promote resilience and resistance.

1.3.4 Key assumptions and limitations

This Level 2 SFRA assumes that:

- The datasets used were the most up to date when received. However, it is recognised that flood risk data is periodically updated and can become outdated.
- Sources of flooding such as groundwater has been assessed based on a conceptual understanding of flood mechanisms and impacts using a range of data sources rather than detailed hydraulic modelling.

- Hydrology of the Upper Mersey hydraulic model has not been updated from the incoming Environment Agency model other than the addition of an updated climate change allowance event. The flow estimates generated by this model are assumed to be acceptable forthis study.
- The Hempshaw Brook hydraulic model baseline scenario does not represent existing conditions of the watercourse. Therefore, it has been assumed that the baseline scenario represents clear and free flowing conditions.

Further assumptions that have been undertaken in the hydraulic models and groundwater desk study are provided in Appendix Appendix E and Appendix Appendix F.

The limitations of this assessment were:

- No detailed consultations with the Environment Agency and United Utilities have been undertaken to provide further guidance on their data provided for this assessment.
- Whilst flood risk information is shown on the produced maps in a relatively precise way, it is not possible to be completely certain from the outputs of this SFRA that any individual property, especially those near the boundaries of Flood Zones, is withina particular Flood Zone.
- Linear assets within the Town Centre along the Upper Mersey are “private” and typically high ground. Therefore, the Environment Agency did not hold any existing information on the condition of the private assetsor the location of any raised defences.
- Climate change impact on surface water, sewer and groundwater flooding has not been assessed.
- The condition of sewer/ drainage networks were not provided to confirm if leakages from water mains distribution systems and sewer / drainage networks are not contributing to groundwater flooding.
- Sewer depth and velocity datasets where not provided by the United Utilities. Therefore, the assessment of sewer flooding is based on the United Utilities asset datasets and 2D sewer flood extents.
- No groundwater monitoring data was available for the Town Centre to confirm the relationship between river level and groundwater changes.
- No reservoir modelling was undertaken as part of the assessment to understand the implications of a breach to the Town Centre.
- The identification of Critical Drainage Areashas not been undertaken.

2 Development and Flood Risk Policy

2.1 Introduction

National, regional, and local development policies inform strategic flood risk assessment and planning context. This section of the SFRA provides a high-level overview of plans, policies, and strategies relevant to this assessment including consideration of previous SFRA's

2.2 National Policy

2.2.1 National Planning Policy Framework

In England, the NPPF guides the recommend sequential, risk-based approach to the location of development. This framework is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk, but where development is necessary, making it safe without increasing flood risk elsewhere. This is achieved through the identification and assessment of flood risk through the preparation of SFRAs and site-specific FRAs, and the successful application of the Sequential and Exception Tests at all stages of the planning process, which considers flood probability, land use, development vulnerability, and long-term sustainability.

The NPPF recommends the use of the Environment Agency's National Flood Map, also called the Flood Map for Planning, as a primary dataset to help steer development to areas at lowest risk of flooding. These maps only consider flooding from Main Rivers (fluvial) and the Sea (coastal). This map has three main zones of risk, the third of which is subdivided into two categories:

- Zone 1 "Low probability of flooding" – This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).
- Zone 2 "Medium probability of flooding" – This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.
- Zone 3 "High probability of flooding" – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

As well as fluvial and coastal flooding, it is also necessary to consider flood risk from all other sources, including surface water, groundwater, non-main watercourses, artificial drainage systems and infrastructure failure. Once appropriate information has been used to identify areas at risk of flooding, the NPPF recommends the application of the Sequential Test, and where applicable, the Exception Test.

2.2.1.1 Sequential Test

As set out in the NPPF, the aim of the Sequential Test is steering new development to areas with the lowest probability of flooding, with the Flood Zones listed above as a starting point. The Local Planning Authority should not permit development if there are reasonably available sites appropriate for that development in areas of lower probability of flood risk. If following the application of the Sequential Test, it is not possible to locate the proposed development in areas at low risk of flooding (Flood Zone 1), the NPPF states that the vulnerability of the development to flooding should be considered in relation to the Flood Zone it lies within.

Table 2-1 provides a matrix illustrating the different development vulnerability classification and their respective Flood Zone compatibility. The matrix also illustrates where the application of the Exception Test is required.

Table 2-1: Flood risk vulnerability and Flood Zone 'compatibility'

Flood risk vulnerability classification	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerab	Less vulnerab
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test required	✓	✓
Zone 3a	Exception Test required	✓	×	Exception Test required	✓
Zone 3b	Exception Test required	✓	×	×	×

2.2.1.2 Exception Test

Where application of the Sequential Test shows that it isn't possible to allocate a site in a lower flood risk location, the Exception Test may have to be applied. This is focused on the Exception Test. In order to pass the Exception Test, the following must be satisfied:

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

The SFRA will assess the spatial distribution of current and future flood risk across the Stockport Town Centre boundary. This level 2 SFRA provides an update on local flood risk within the Town Centre boundary identified within this document and provides further flood risk assessment to support preparation of the Local Plan and future development. The SFRA can be used to inform the application of the Sequential and Exception Tests during the process of allocating development within the Town Centre boundary.

2.2.2 Flood and Water Management Act

The Flood and Water Management Act (2010)[ix] aims to help improve flood risk management, and provides guidance on designating roles and responsibilities for different Risk Management Authorities. SMBC is designated as Lead Local Flood Authority (LLFA) with duties and responsibilities for managing local flood risk (defined as flooding from surface water, groundwater, and Ordinary Watercourses) as well as being a statutory consultee for determination of any planning approvals.

2.2.3 Flood Risk and Coastal ChangePlanning Policy Guidance

An updated version of the Planning Policy Guidance (PPG) was published in August 2022. This advises on 'how to take account of and address the risks associated with flooding and coastal change in the planning process'. The guidance outlines the steps required when preparing strategic policies and includes guidance on application of the Sequential and Exception Tests identifying that other flood risks should be assessed in line with fluvial flood risk and that climate change should be considered.

The Sequential Test will need to be applied for all new development within the Town Centre Area in all areas of high risk and considering climate change.

2.3 Regional Policy

Regional strategies have been produced by the Environment Agency and United Utilities to support assessment of Flood Risk.

2.3.1 Upper Mersey Catchment Flood Management Plan

Produced by the Environment Agency, the role of Catchment Flood Management Plans (CFMPs)[x] is to establish flood risk management policies that will deliver sustainable flood risk management for the long term. Stockport is identified as having over 150 properties at risk of 1% AEP flooding. The established flood risk management policies for Stockport are as follows:

- Implement a programme of Asset Maintenance and Repair in line with the Mersey Maintenance Strategy. This should include looking at options for environmentally sensitive management of the existing defences.
- Implementation of new flood warning areas including Stockport.
- Investigate the potential for reducing flood risk in the Mersey catchment by use of strategic storage areas upstream.

2.3.2 Upper Mersey Drainage and Wastewater Management Plan

The Upper Mersey Drainage and Wastewater Management Plan (DWMP) is a 25-year plan produced by United Utilities to manage drainage and wastewater systems[xi] and includes recommendations for improvements to flood risk prevention in Stockport with a key recommendation being improvements in surface water control.

2.3.3 The Greater Manchester Natural Capital Investment Plan

The Greater Manchester Natural Capital Investment Plan (2019)[xii] aims to provide the methodology to collect and administer funds for environmental schemes across Greater Manchester. The plan is based on the following:

- A pipeline of potential schemes that require investment.
- To assist in the role and investment to the private sector, financial models are provided and;
- Recommendations to construct a roadmap over the next 5 years for the plan.

One of the key focuses that the plan prioritises is building resilience through addressing climate change and flood risks within Greater Manchester. Key themes were to minimise flood damage costs, reduce flood volumes by increasing investment into flood risk management projects. To maximise the benefits of this plan, it discusses potential delivery of investment for multiple benefits Sustainable Drainage Systems (SuDS) that maximise social and environmental benefits from air quality, health benefits, reduction to carbon and flood risk management.

2.4 Local Policy

Stockport Local Plan is presently under development. However, other local policy documents have been referred to in this section of the SFRA and contribute to management of flood risk.

2.4.1 Stockport Core Strategy Policy 2011

The Stockport Core Strategy (2011)[xiii] supersedes the Stockport Unitary Development Plan. As part of the Local Development Framework, the strategy aims to identify land use and address development issues that pose a challenge to Stockport. This includes achieving housing targets that are set out in the Regional Spatial Strategy. Additional points that look to be addressed include the increase in economic growth through commercial development and safeguarding and improving the environment. For flood risk it looks at supporting

development that is environmentally and economically sustainable . This includes measures to ensure developments are safe. The key core and development policies within the Stockport Unitary Development Plan and Stockport Core Strategy have been identified below inTable 2-2.

Table 2-2: Core/Development policies in Stockport Unitary Development Plan and Stockport Core Strategy

Core/Developme Policy	Description
Stockport Unitary Development Plan	
EP1.7	Development and flood risk
Stockport Core Strategy	
CS1	Addressing climate change across the borough
SD6	Sustainable design and construction requirements for development sites to adc and consequences of climate change
CS8	Enhancing developments flood risk management through green infrastructures
SIE-8	Part C: Development requirements to manage flood risk
TG1	SMBC's plan to try and accommodate development uses by addressing flood r

2.4.2 Strategic Housing Land Availability Assessment

The Strategic Housing Land Availability Assessment (SHLAA) 2021[xiv] aims to assess the land availability within Stockport that have development potential for housing. This includes reviewing the suitability, availability, and achievability of potential development areas in order to determine if the development is economically viable and should be allocated for development. Flood risk is considered within this assessment to indicate which areas are at risk of fluvial flooding in Flood Zones 2 and 3. It also gives an indication that potential development areas may be at risk from other sources of flooding such as groundwater, surface water, or other artificial risks.

2.4.3 Central Stockport Infrastructure Delivery Plan Prospectus

The Central Stockport Infrastructure Delivery Plan Prospectus (2020)[xv] document sets out Stockport's approach to delivering long term investment in the Town Centre. In relation to flood risk, the document sets out what they would like new developments to incorporate. This includes SuDS to manage surface water and to reduce the amount of flow that enter the sewer system.

2.4.4 Open Space Provision and Commuted Payments

The Recreational Open Space Provision and Commuted Payments (2019)[xvi] document aims to advise developers on implementing open space provisions in new housing developments. For flood risk one of the aims is to safeguard and improve Stockport's environment. This includes information on how developers can address climate change through the integration of SuDS and other drainage techniques through open spaces.

2.4.5 Extension and alterations to Dwellings

The Extension and alterations to Dwellings (2011)[xvii] document aims to provide guidance on the design of extensions to residential properties and what the council will consider when looking at householder applications. Regarding flood risk, information can be found on the loss of front gardens to car parking due to impermeable surfaces and provides advice on mitigating the impacts. It also provides guidelines on whether developments require an FRA for applicants to consider.

2.4.6 The Design of Residential Development 2007

The Design of Residential Development (2007)[xviii] document aims to ensure developers make appropriate decisions in terms of the design of residential developments and make good use of land and buildings. This includes helping to reduce the impact of flooding through the incorporation of SuDS and recommendations such as submitting FRAs early in the planning process if there is a flood risk to the development.

2.5 Previous SFRAs

2.5.1 Greater Manchester Level 1 SFRA

Greater Manchester Combined Authority (GMCA) commissioned JBA Consulting to undertake an update to the Level 1 SFRA (2019)[xix]. This covers ten Greater Manchester councils that form GMCA in which they agreed to form a joint development plan to set out the approach to housing for the next 20 years. The SFRA was required to:

- Carry out the Sequential Test for the allocation of land and development.
- Identify whether the Exception Test is necessary.

The key flood risk findings were that four residential areas were shown to have notable areas of Flood Zone 3 within the Stockport Borough. However, areas identified are not within the SFRA Town Centre boundary. Surface water, sewer and groundwater flooding has been identified as an issue across all Greater Manchester. However, it is likely the sources assessed would also affect the Stockport Town Centre although the significance of impacts is not defined within this document. The relevant recommendation for further works is included in Table 2-3.

Table 2-3: Greater Manchester Level 1 SFRA (2019) recommendations

Study	Explanation	Timeframe
Level 1, Level 2 SFR update	As when new development sites become available. More detail assessment of flood risk to high risk sites. More specific to the i district authorities	Short- medium term
Modelling of climate change for Level 1, Level 2 SFRA updat	Modelling of climate change using the Environment Agency's la allowances for watercourses not covered in existing detailed hy modelling	Short term
Site specific FRA's	Review of Flood Zones in those areas not covered by existing c hydraulic models	Short term
SWMP/drainage strategy	Update of the 2013 SWMP for high risk sites. To be more speci individual district authorities	Short term
Groundwater investigation	Retrieval of Groundwater information used to inform SuDS	Short term
SuDS	Identification of SuDS opportunities within the Greater Manches	Short term

2.5.2 Stockport Level 1 and Level 2 SFRAs

The aim of the Level 1 SFRA Update and Level 2 SFRA (2010) [xx] was to provide information on flood risk that will inform the Sequential Test across the district and identify whether an Exception Test is required. Key flood risk findings show that:

- The fluvial flood risk to Stockport is generally low. However, areas of Flood Zone 2 and 3 spread beyond the river banks, although flows are generally restricted by narrow passes along the Main Rivers. Areas upstream of the Goyt and Tame are at greatest risk from fluvial flooding.
- Surface water flooding is also evident in low lying areas across Stockport Town Centre, especially along areas of Hempshaw Brook.
- Groundwater flood risk was considered to be low across the Town Centre Area.
- Artificial infrastructure sources and sewer flooding was not assessed within this SFRA as reported drainage hotspots and historical records of flooding were the only data sources available at the time.

The key recommendations from this report are shown in Table 2-4.

Table 2-4: Stockport Level 1 and Level 2 SFRA (2010) recommendations

Recommendation	Explanation
Ensure flooding is taken into accou all stages of the planning process	Ensure developments is safe throughout its lifetime and does flood risk elsewhere
Investigate flood risk management options	SMBC should work with the Environment Agency to investigat management options to reduce flood risk upstream of the Rive Tame confluence
Site specific FRA's	Review of Flood Zones in those areas not covered by existing hydraulic models
SWMP/drainage strategy	Identify the need for a SWMP for to ensure surface water floo been adequately assessed
Level 2 SFRA update	An update of the Level 2 SFRA is recommended when more f data becomes available

3 Level 2 SFRA Update

3.1 Introduction

This section provides a strategic summary of potential flood risk sources and mechanisms across the Stockport Town Centre boundary. The definitions of each flood source are provided below.

- Fluvial flooding has been identified as high risk in Flood Zone 3 (1% AEP event or greater) and 1% AEP + climate change events. Moderate risk is classified as Flood Zone 2 (between a 1% and 0.1% AEP event) with Flood Zone 1 (less than 0.1% AEP) identified as low risk.
- Surface water flooding is classified as low risk (less than 1% AEP event), moderate risk (1% AEP event), high risk (3.3% AEP event).
- Sewer flooding is classified as high risk during a 2% AEP event or greater. Any datasets less than 2% AEP were not provided and is therefore assumed as low risk.
- Groundwater flooding has not been assessed with probabilities. Therefore, the level of risk has been determined from supporting datasets and professional judgement to comment on potential groundwater flooding sources and mechanisms.

3.2 Historical Flooding

Datasets and reports have been collected and reviewed to gain and understand historical flooding incidents across the Town Centre since 2010. A summary of notable incidents include:

- The Environment Agency Recorded Flood Outlines[xxi], Historic Flood Map[xxii] and SMBC historical flood records show historical fluvial flooding along Hempshaw Brook in September 2016. Here flooding has been noted as occurring because of blockages at a trash screen on the culvert entrance at Waterloo Road and at the culvert entrance at Great Underbank, causing damage to several commercial properties.
- The Preliminary Flood Risk Assessment (PFRA) 2017[xxiii] and Stockport Section 19 (S19) reports (2017[xxiv] and 2017[xxv]) have recorded significant surface water flood events in June 2016 and September 2016. However, these incidents tend to be recorded across the wider Borough, and there is no specific reference to the Town Centre. It is likely that these rainfall events would have also affected the Town Centre, although significant impacts may not have occurred or been recorded.
- The United Utilities DG5 register identifies a sewer flooding incident in 2010 occurred east of the Tame confluence, with the cellar of a residential property along Greenhalgh Street flooding from foul water.
- There are recorded incidents of cellar/basement flooding in Stockport Town Centre recorded by SMBC that may suggest groundwater flooding.

No further historical flooding incidents have been recorded within the Town Centre. This data, along with the those recorded within the 2010 SFRA, suggest that the main sources of historical flooding have been fluvial (from the River Mersey and Hempshaw Brook) along with surface water and sewer flooding.

3.3 Fluvial Flood Risk

The Main Rivers within the Town Centre boundary include the River Goyt and River Tame which joins the River Mersey. The rivers generally flow in a westerly direction until the River Mersey discharges into the Manchester Ship Canal at Urmston located outside of the Borough. The River Mersey itself is located in an area of moderate to flat relief. The Rivers Tame and Goyt are the steepest of the main watercourses within the catchment, rising in the Pennines". At Great Underbank, the River Mersey is joined by a tributary and fourth Main River (Hempshaw Brook). The Brook flows northerly draining the southern area of the Town centre near Lower and Middle Hillgate. A large proportion of Hempshaw Brook is culverted through the south eastern part of the Town Centre boundary, including its confluence with the River Mersey.

Data

To assess the risk of fluvial flooding, the following datasets have been reviewed:

- Environment Agency's Flood Map for Planning Rivers and Sea[xxvi]
- Environment Agency Hempshaw Brook hydraulic model (2023)
- Environment Agency Upper Mersey hydraulic model (2020)
- Environment Agency's Flood Warning Area's[xxvii]
- Environment Agency's AIMS database[xxviii]

The review of river modelling is included in full in Appendix Appendix E.

A high-level review of both the Upper Mersey and Hempshaw Brook hydraulic models was carried out at the onset of the study. This revealed that the 2020 Upper Mersey model and associated results are detailed enough to support the production of this Level 2 SFRA. However, the Hempshaw Brook model, which was built in 2009, was considered outdated with inaccuracies present in both the one-dimensional (1D) and two-dimensional (2D) model components.

The review suggested that to gain a better understanding of the flood mechanisms and definition of the areas at risk of flooding from the watercourse, improvements were to be made to the schematisation of the hydraulic model. This includes implementation of a 2D representation of the Hempshaw Brook floodplain coupled with a 1D representation of the watercourse channel. Regarding the hydrology, an updated climate change uplift of 53% was applied to the 1% Annual Exceedance Probability (AEP) event flows as the higher estimate at the 2080s horizon in accordance with Environment Agency guidance for climate change.[xxix] The 5%, 1%, 0.1% and 1%+53% climate change AEP events were run for the Hempshaw Brook model.

The following three scenarios were modelled for Hempshaw Brook:

- A "baseline" scenario that represents clear and free flowing conditions of the watercourse.
- An "upstream blockage" scenario where the culvert entrance at Waterloo Road is blocked to 90%.
- A "downstream blockage" scenario where the culvert entrance at Wellington Street is blocked to 90%.

In accordance with the Environment Agency's Flood Hazard Ratings for Development guidance[xxx], hazard datasets were produced to understand the dangers to people during each event. Depth and velocity datasets were also produced to understand water levels and speed. The flood outlines from the updated models are shown on the interactive flood risk map Appendix Appendix B, with the Flood Risk Hazard Maps provided in Appendix Appendix C. These are later referred to in the Detailed Area Assessments.

The production of the maps was to estimate the probability of people seriously harmed and fatalities during the event of a flood. Using the Environment Agency's Flood Hazard Ratings for Development guidance, hazard ratings were given a hazard to people classification. This is shown in Table 3-1.

Table 3-1: Hazard to People Classification using Hazard Rating

Flood Hazard Rating	Hazard to People Classification
Less than 0.75	Very low hazard
0.75 to 1.25	Danger for some
1.25 to 2.0	Danger for most
More than 2.0	Danger for all

Summary of fluvial flood risk

This assessment identifies that the Town Centre area at risk of flooding includes locations of previously designated Flood Zone 2 and 3 associated with the River Goyt, Tame, and Mersey.

It is identified that Flood Zone 3 is generally confined within the Main Rivers Goyt, Tame and Mersey. However, Flood Zone 2 areas extend out of bank more frequently, spreading across areas of the Town Centre which generally consist of commercial properties. Locations with the highest risk are upstream of the Tame which shows commercial properties within the Meadow Industrial Estate at risk of flooding within areas of Flood Zone 3. Along the River Mersey, associated Flood Zone 3 extents are shown to extend out of bank upstream of the A5145 Bridge along areas of Ford Street. This could result in the flooding of commercial properties during a high risk event. There are flood warning services provided by the Environment Agency in place for those properties at risk of fluvial flooding. This is approximately mirroring the Flood Zone 2 extent, along River Goyt, Tame, and Mersey for the length of the Town Centre boundary.

The modelling update undertaken for Hempshaw Brook has included scenarios of culvert blockage, which have historically caused flooding. The baseline scenario shows that under clear and free flowing conditions, upstream locations are shown to be at risk from a 5% AEP event onwards. Extreme events up to 0.1% AEP are identified to impact commercial properties along Gorsey Mount Street (Pennine Industrial Estate). During the upstream blockage scenario, the same properties are impacted under the same AEP events. However, the extent of flooding during the 0.1% AEP event extends further to commercial properties along Joules Court. The downstream blockage scenario is generally more confined due to the topography. The scenario shows flooding to very few properties during the 5% AEP event. This is identified to impact commercial properties along Hopes Carr, and residential flats along Manchester Road.

The Upper Mersey and Hempshaw Brook hydraulic models account for climate change that is shown to impact various locations in the Town Centre boundary. For the Upper Mersey model, the 1% AEP 35% climate change event is shown to impact Meadow Industrial Estate and Water Street along the Tame. Floods during the event extend out of bank along the Mersey, impacting properties adjacent to Ford Street and Chestergate Road. Upstream along the Goyt, properties that are impacted during this event include the Peel Centre and Richard Street Industrial Estate. The 1% AEP + 70% climate change event increase extents of flooding in all locations highlighted, extending out of bank, and spreading across the Town Centre. The Hempshaw Brook model shows that flooding along the Brook during the 1% AEP + 53% climate change event almost mirrors the 0.1% AEP event defined above.

Flood defence asset information

The Stockport Level 2 SFRA (2010) was noted to have data gaps on the existing asset condition of linear fluvial defences within the Town Centre. As part of this assessment consultation was undertaken with the Environment Agency regarding any available information on their AIMS database. It was identified that all the linear assets within the study are along the Upper Mersey were “private” and typically high ground. As such, the EA did not hold any existing information on the condition of the private assets.

Based on the understanding that all assets were in “private” ownership and that defences were classified as “high ground” it was agreed that there would be minimum benefit in collecting new data to fill this data gap such as undertaking a full T98 assessment throughout the Town Centre Area. A site visit undertaken on October 25th, 2022, did identify however that there are some locations where walls may form part of a flood defence in addition to private high ground.

Since the condition grade of these assets remain unknown, there is an unknown residual risk at the local level and it is possible that the expected life of defences could be lower than anticipated and therefore the likelihood of failure could be high. The risk of failure has not been considered within the hydraulic models.

The sensitivity of future development to this risk will depend on local factors such as the type and location of development within the floodplain adjacent to these structures. It would therefore be recommended that site -

specific T98 inspections should be undertaken for any development in Flood Zone 2 or 3 in these areas (see Table 5-3).

3.4 Surface Water Flood Risk

Surface water (pluvial) flooding results from rainfall-generated overland flow before the runoff enters any watercourse, drainage system or sewer or when the infiltration capacity of the ground surface is exceeded during extreme rainfall events. Excessive surface water runoff could pose a flood hazard especially if flowing at high velocity. Localised depressions in the ground topography could result in the ponding of water, sometimes to a significant depth.

The antecedent conditions, permeability of the soil type or geology can affect the volume of runoff, whilst the capacity and condition of the drainage network can affect how much water remains on the surface. The topography of the land and location of urban features such as road networks also influence surface water flood risk.

The 2010 SFRA included reference to Areas Susceptible to Surface Water Flooding maps. These surface water flood risk maps have now been superseded by the Risk of Flooding from Surface Water map in 2019 which now includes consideration of flood depth, velocity, and hazard.

Data

To assess the risk of surface water flooding, the following datasets have been reviewed:

- Environment Agency's Risk of Flooding from Surface Water[xxxi]
- Environment Agency's LIDAR Composite 2020- 1m[xxxii]

Summary of surface water flood risk

A review of the Risk of Flooding from Surface Water map identifies that most of the Town Centre boundary is within areas of low surface water flood risk (less than the 0.1% AEP rainfall event). There are however areas of medium (1% AEP) (referred to in this assessment within a moderate risk band) and high (3.33% AEP) probability of surface water flooding with resulting flow paths and ponding shown in the interactive map in Appendix Appendix B. Areas at risk are naturally located in areas where there is localised depressions or steep topography as shown in the Environment Agency's LIDAR Composite dataset. The more notable areas of surface water flood risk are identified around areas near Swaine Street, Great Underbank, Wellington Road (A6) and Brighton Road Industrial Estate.

Several surface water flow paths and areas of ponding along Hempshaw Brook are present. This could result in several commercial properties flooding in areas of the Pennine Industrial Estate, Jules Court, Upper Brook Street, and Hopes Carr. Additionally, significant surface water flow paths and ponding areas have been identified upstream of the Tame. This shows commercial properties within the Meadow Industrial Estate to be at risk of surface water flooding. Further areas of surface water flooding are provided in Section 4.

Climate change predictive modelling for surface water has not been provided for this SFRA. Therefore, it is important to note that the Environment Agency's climate change allowances[xxxiii] show that peak rainfall intensity could potentially increase by 20-30% over the next 100 years. Therefore, the mentioned flood events could have more severe consequences in the future.

3.5 Sewer Flood Risk

Sewer flooding occurs when there is a failure, collapse and/or blockage of the network, considered to be a residual risk. The probability of sewer flooding is dependent on the combined effect of several factors such as their condition, existing maintenance regimes and other outside influences. However, failure could potentially result in a release of large volumes of water.

Data

To assess the risk of sewer flooding, the following datasets have been reviewed:

- United Utilities asset datasets showing gravity sewers and manhole locations
- United Utilities 2D sewer flood extents 2020
- United Utilities DG5 register
- United Utilities Drainage and Wastewater Management Plan (DWMP) 2023

Summary of sewer flood risk

The overall risk of sewer flooding was not assessed in the Stockport Town Centre SFRA Level 2 (2010). Although it referenced the DG5 register, reported drainage hotspots, and historical records of flooding.

In addition, to recollecting the data from 2010, this assessment includes consideration of United Utilities predictive sewer network modelling. The outputs of which was provided by United Utilities in the form of model results contained within GIS layers showing the location of gravity sewers and manholes and 2D flood extents. Climate change events have not been modelled and has therefore not been considered in the assessment of sewer flooding.

The 2010 SFRA states *"sewers tend to have a design standard of up to the 3.3% AEP (1 in 30 year storm event, which equates approximately to a 1 in 5 year flood flow), although in many cases for existing networks it is thought that the design standard is lower, especially in privately owned systems."* A review of the 2D sewer flood extents, shows that most of the Town Centre boundary is within areas of low risk. However, multiple locations across the Town Centre boundary are at risk from sewer flooding during a 10% AEP event. The most significant risk of sewer flooding in the Town Centre boundary is identified along Green Lane with flood extents spreading to commercial properties within the area. Nearby Craig Close, there are areas at risk of sewer flooding that predominantly impact a car park, and several commercial and residential properties. Other notable areas of sewer flooding extents are identified in areas along Hempshaw Brook near Hopes Carr, which could result in flooding to commercial properties.

The latest DG5 records show historical flooding within the Town Centre boundary. To the east of the Tame confluence, a sewer flooding incident in 2010 occurred within a residential property along Greenhalgh Street. The event caused foul flooding of cellars . Within this network, large areas of sewer flood risk are identified in areas along Lancashire Hill, Nicholson Street and Gordon Street. This could result in sewer flooding to residential and commercial properties in the location.

The United Utilities DWMP[xxxiv] notes that significant investment of additional storm storage is required in Stockport. This is to ensure United Utilities meet legal obligations identified within the Water Framework Directive (WFD) 2017[xxxv]. The DWMP also shows the general risk of sewer flooding within Stockport as shown in Table 3-2.

Table 3-2: United Utilities Brava results for Stockport

Internal Flooding Risk			External Flooding Risk			Sewer Collapse Risk	Risk of Flooding in a Storm (2% AEP)		Flooding of Open Spaces	Blockage Assessm		
2020	2030	2050	2020	2030	2050	2020	2020	2050	2020	2030	2050	2020
1	1	1	1	1	1	1	2	1	3	3	3	1

Area of focus = 1 Potential area of focus = 2 No concern = 3

3.6 Groundwater Flood Risk

Groundwater flooding occurs where water levels, beneath the ground, rise above the ground surface. In some instances, groundwater can emerge at surface level following heavy rainfall events and contribute to existing flooding from other sources. Alternativ ely, a greater risk can be presented if construction works or long-term, large-scale developments, such as road schemes, intersect areas with shallow groundwater levels or create pathways for deeper confined artesian pressures, which can be released at gro und level and cause widespread flooding.

Data

To assess the risk of groundwater flooding, the following datasets have been requested and reviewed:

- GeoSmart GW5 groundwater flood risk dataset[xxxvi]
- British Geological Survey borehole dataset
- British Geological Survey SuDS dataset

Summary of groundwater flood risk

Since the 2010 Level 2 SFRA for SMBC was published there have been no records that directly attribute groundwater flooding within SMBC, as was the case in the 2010 report. However, in some cases groundwater flooding can be masked by other sources of flooding or can contribute to other flooding sources hence the recording of groundwater flooding incidents is difficult to isolate and identify on their own. Table 3-3 summarises the potential groundwater flooding mechanisms within the Town Centre boundary.

A high-level assessment of potential groundwater flooding mechanisms has been carried out for the Town Centre boundary. The full report is contained within Appendix Appendix F. The assessment considers shallow groundwater levels as a direct source, as well as the indirect effects that a shallow water table may have on other flooding mechanisms present.

In the 2010 SFRA it is mentioned that where more permeable bedrock units, such as sandstones, sub-crop underneath the superficial deposits there is potential for groundwater flooding.

GeoSmart GW5 groundwater flood risk dataset shows that the opposite is the case where groundwater flood risk is shown to be higher in areas where low permeable bedrocks such as the Manchester Marls Formation is present. This is due to the low permeability bedrock holding groundwater in the overlying superficial deposits hence preventing downwards movement. Therefore, groundwater could be closer to the surface in areas underlain by the Manchester Marls. On the other hand, sandstone bedrock units can have more storage potential for groundwater, hence reducing the risk of groundwater flooding during high rainfall events by allowing downwards movement of groundwater.

Along the course of the Rivers Tame, Goyt and Mersey groundwater flood risk is shown to be slightly elevated on groundwater flood risk maps. Baseflow index measured for the River Mersey is recorded as 0.55 indicating that 55% of the channel flow is derived from groundwaters. This indicates that there are moderate interactions between groundwater and surface water within the Town Centre boundary, which was suggested in the 2010 SFRA. Therefore, it would be expected to see shallower levels along the watercourses where these interactions occur.

A groundwater assessment, including all groundwater characteristics and flooding mechanisms within the Stockport area, is presented in Appendix Appendix F. Within the groundwater assessment it should be noted that 3 new conceptual site models (CSMs) have been provided that allow a more informed assessment of flood risk from groundwater. The location of these CSMs can be identified within Appendix Appendix F. There is currently no permanent monitoring of groundwater levels undertaken by the Environment Agency in Stockport Town Centre. It should also be noted that if existing large abstractions are reduced the groundwater levels are likely to rise in the Town Centre Area.

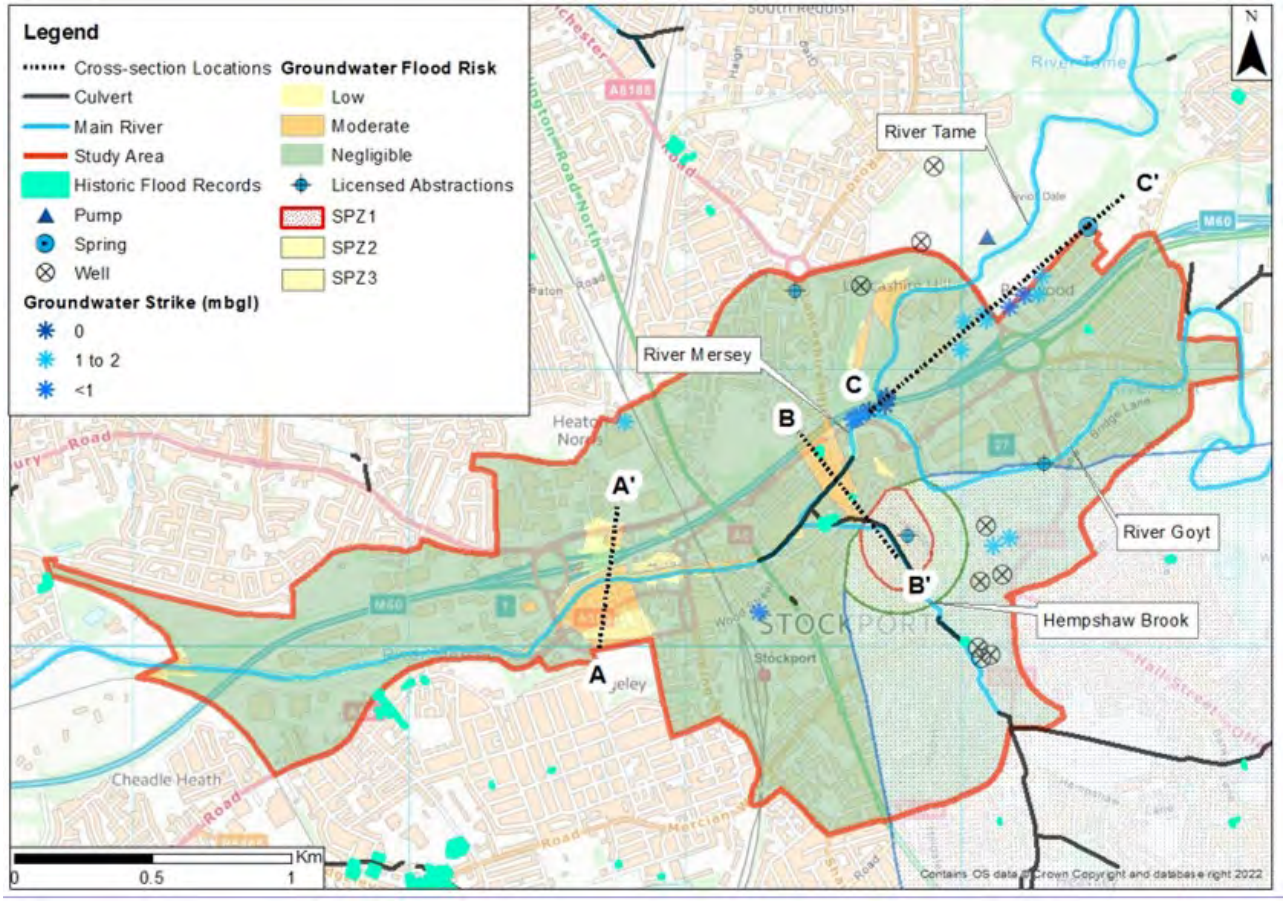

Figure 3-1: Location of new groundwater conceptual site model transects

Table 3-3 Summary of Potential Groundwater Flooding Mechanisms in the Town Centre boundary

Primary Flood Source	Flooding Mechanism(s)	Risk in Study Area	Comments
Groundwater	Naturally shallow groundwater levels in superficial and / or bedrock aquifers	✓	Likely due to evidence of shallow groundwater levels obtained from historical borehole records
	Groundwater rebound / mine water rebound from ceasing abstraction(s)	✓	Likely that the licensed groundwater abstractions within the SPZ 1 control existing groundwater levels and localised groundwater flood risk. Potential impact to future baseline flood risk if abstraction regime changes
	Sub-surface barriers to groundwater flowe.g., building foundations / basements, sheet piles, linear flood defences etc.	✓	Likely throughout the Town Centre boundary due to the degree of urbanisation and number of buildings present
	Tidal locking which drives groundwater heads in adjacent aquifers and causes groundwater levels to rise	✘	Unlikely as not in a tidal setting and fluvial network is expected to be free flowing

Primary Flood Source	Flooding Mechanism(s)	Risk in Study Area	Comments
	(even if the watercourse remains in bank)		
	Artificially elevated groundwater levels caused leaking assets (water transmission infrastructure, drainage / sewerage infrastructure, canals etc.)	✓	Likely given the degree of urbanisation within th Centre boundary and variety of historical and pr day land uses, including canalised Main Rivers, races, mill ponds, reservoirs, storage tanks, sew mains etc. Leakages of assets in Town Centre boundary if not lined or if lining is degraded coul elevate groundwater levels locally
Fluvial	Shallow groundwater levels which increases baseflow i to watercourses	~	Possible in areas with shallow groundwater levels. Further assessment on groundwater contributio baseflow to the main rivers needed
Surface wate	Shallow groundwater levels which limits infiltration and enhances runoff response	✓	Likely in areas with shallow groundwater levels v superficial deposits and / or bedrock units have permeabilities
Drainage / sewerage infrastructure	Groundwater ingress into drainage and sewerage sys which could reduce their efficiency and cause them t surcharge at an earlier ons	✓	Likely in areas with shallow groundwater levels the degree of urbanisation throughout the Town boundary

3.7 Reservoir Flood Risk

Reservoir flooding can occur as a result of the failure of artificially created ponds / lakes and is detailed in the Planning Practice Guidance[xxxvii] to be residual risk[xxxviii]. The failure of reservoirs could result in a large volume of water escaping and flooding land within its flow path.

Data

- Environment Agency's Risk of Flooding from Reservoirs[xxxix]

Summary of reservoir flood risk

The 2010 SFRA did not include for any Reservoir Flood Risk Mapping. The Environment Agency Risk of Flooding from Reservoirs map has been included within this assessment. This map indicates that the flood extent associated with a reservoir breach is anticipated to be greater than the fluvial flood extent given by the Environment Agency Flood Map for Planning for Rivers and Sea. As shown in the interactive map in Appendix Appendix B, reservoir failure is likely to cause flooding to commercial and residential properties along the floodplain within the Town Centre boundary.

There are no reservoirs that come under the Reservoirs Act 1975[xl] (volume greater than 10,000 m^3) within the Town Centre area. However, the Stockport Level 2 SFRA (2010) states *"there are many reservoirs located outside of the Town Centre boundary which may pose a potential residual flood risk to Stockport. These reservoirs are located within the headwaters of many of the watercourses which flow through Stockport. The flood mecha nism is from additional flows discharging to the rivers thereby increasing the risk of flooding downstream."*

To supplement this, Table 3-4 has been provided and lists all reservoirs which may pose a potential residual flood risk to Stockport. As no additional reservoir modelling has been undertaken, it is assumed that all reservoirs listed contribute to the reservoir flood risk identified within the Town Centre boundary.

The risk of failure from reservoirs identified in Table 3-4 is considered to have a low probability to occur . It is assumed the maintenance and planned improvements for these reservoirs are regulated under the Reservoirs Act 1975. This legislation, which is enforced by the Environment Agency, requires reservoirs to be routinely inspected and maintained to an appropriate standard. Therefore, with the application of good practic e to the design of any proposed development, the residual flood risk associated with reservoir flooding is considered to be low.

Table 3-4: Assumed reservoirs which may pose a potential residual flood risk to Stockport Town Centre

Reservoir name	Location
Audenshaw Reservoir	Manchester, M34 3QJ
Gorton Upper Reservoir	Manchester, M18 7LH
Gorton Lower Reservoir	Manchester, M18 7LH
Walkerwood Reservoir	Stalybridge, SK15 3QP
Swineshaw Reservoir	Stalybridge, SK15 3ET
Godley Reservoir	Hyde, SK14 3BU
Arnfield Reservoir	Longdendale, SK13 1HP
Valehouse Reservoir	Glossop, SK13 1HT
Rhodeswood Reservoir	Glossop, SK13 1HU
Torside Reservoir	Glossop, SK13 1JB
Kinder Reservoir	High Peak, SK22 2LJ
Combs Reservoir	High Peak, SK23 9UN
Toddbrook Reservoir	High Peak, SK23, 7BL
Errwood Reservoir	Buxton, SK17 6GJ

3.8 Flood Risk Summary

This section has updated the assessment of flood risk from the initial SFRA in 2010. The assessment has used the latest datasets available to identify key sources and mechanisms of flood risk. Table 3-5 has been created to identify notable areas of moderate to high flood risk from each source that will be taken forward into the Detailed Area Assessments in Section 4.

Table 3-5: Summary of flood sources taken forward to the Detailed Area Assessments

Area	Fluvial	Surface Water	Sewers	Groundwater	Canals	Reservoirs
1	×	✓	✓	×	×	×
2	×	✓	✓	×	×	×
3	✓	✓	×	✓	×	×
4	✓	✓	✓	✓	×	×
5	✓	✓	✓	✓	×	×
6	✓	✓	✓	×	×	×

Area	Fluvial	Surface Wate	Sewers	Groundwater	Canals	Reservoirs
7	✓	✓	✓	✓	×	×
8	✓	✓	×	✓	×	×
9	×	✓	×	×	×	×
10	×	×	✓	×	×	×
11	✓	✓	✓	✓	×	×

4 Detailed Town Centre Area Assessments

4.1 Introduction

This section of the SFRA aims to provide a more detailed understanding of flood frequencies (probability) and mechanics for all moderate to high-risk sources of flooding for each Town Centre Area identified in Chapter 3 and shown in Figure 4-1. The Sequential Test will need to be applied within the Town Centre Area in all areas of high risk and considering climate change. Areas or sources of flooding with a low risk of flooding are not considered further in this Chapter.

This section aims to support a range of development and flood risk planning activities, including:

- Supporting strategic planners and the allocation of proposed development sites in the Local Plan e.g. the likelihood that proposed sites within each area could pass the Exception Test i.e. the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, reduce flood risk overall.
- Support developers (inc. architects and engineering consultants) during site master planning, design, and planning e.g. by describing key flood risk issues, appropriate mitigation, and requirements for site-specific FRAs.
- Supporting Development Control officers and other statutory consultees make appropriate decisions on planning applications an appropriateness of site-specific FRAs submitted.

The completion of this detailed assessment does not replace any requirements for a site-specific FRA or for a sustainable drainage strategy and should only be used to inform further assessments.

The location of all the Detailed Area Assessments can be seen in Figure 4-1 and in the Interactive Flood Risk Map (Appendix Appendix B).

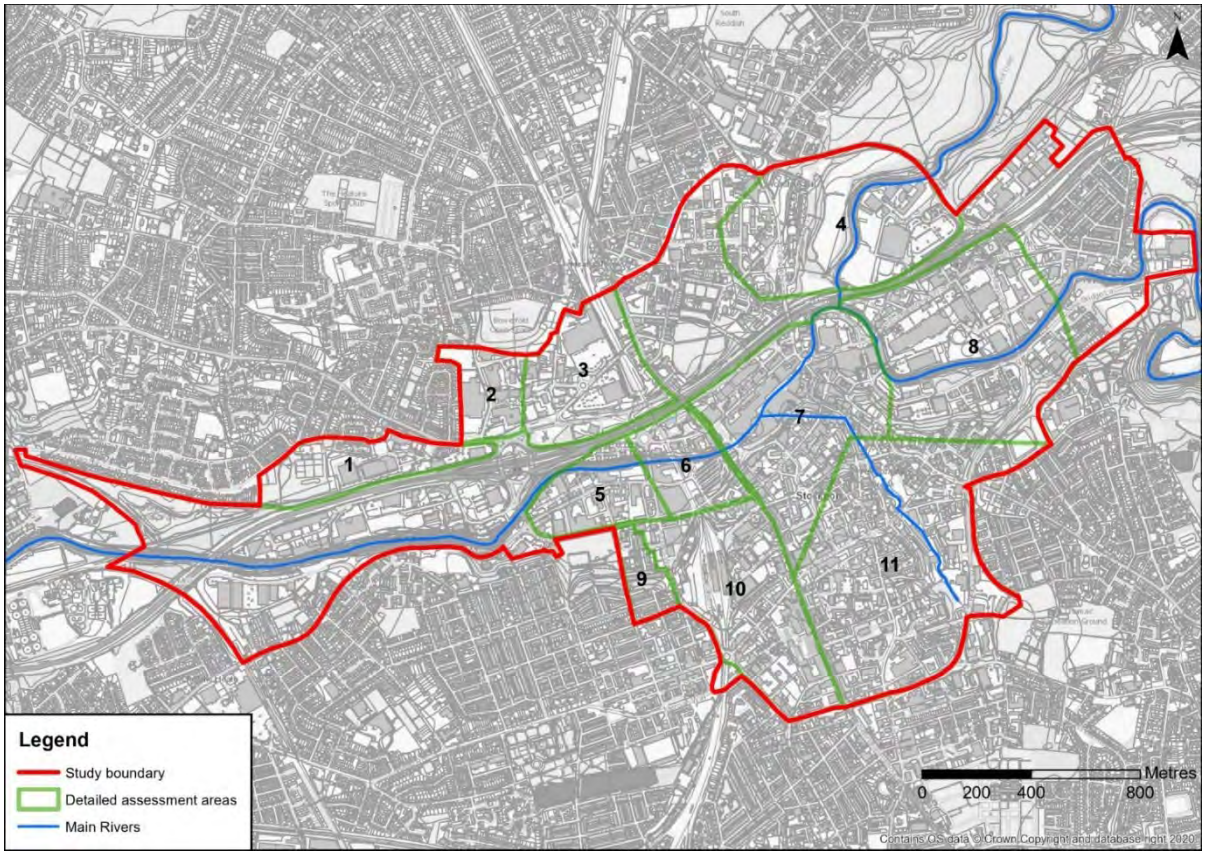

Figure 4-1. Town Centre Boundary and Detailed Assessment Areas

4.2 Area 1

4.2.1 Description

Area 1 is shown in Figure 4-2. The topography generally slopes significantly from north east to south west. The northern and eastern extent is bounded by high ground from Craigs Road and Didsbury Road with the southern extents bounded by the M60. Mersey Vale Country Park is located to the west of Area 1 which forms localised high ground.

The area is mostly comprised of commercial properties within Brighton Roads Industrial Estate of which its use is predominantly for car parking. Directly north of the industrial estate, there are several residential properties that fall within the area along Craig Close. The River Mersey flows approximately 200m south of Area 1.

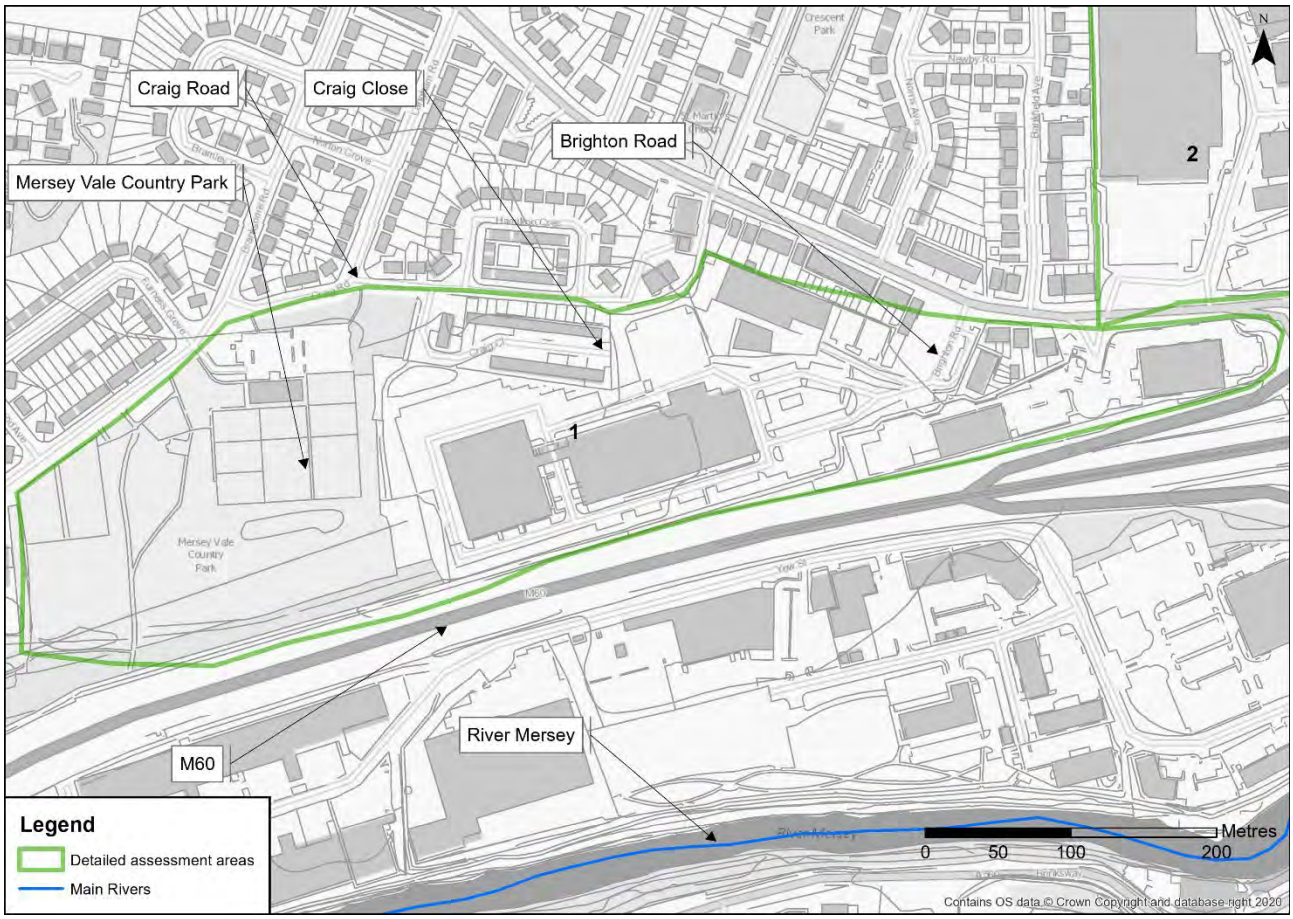

Figure 4-2: Area 1 assessment area

Based on the findings of this assessment in Section 3, this section focuses on notable sources of flooding within Area 1 as shown in Table 4-1. Flood Risk Hazard Maps for Area 1 are shown in Appendix A Appendix C.

Table 4-1: summary of Area 1 significant flood sources

Area	Fluvial	Surface Wat	Sewers	Groundwate	Canals	Reservoirs
1	×	✓	✓	×	×	×

4.2.2 Flood Risk Assessment

4.2.2.1 Surface water

The Risk of Flooding from Surface Water map shows that Area 1 is predominantly at low risk of surface water flooding. However, there is a moderate risk (1% AEP event) to high risk (3.3% AEP event) that is summarised below:

- During the 3.3% AEP event, localised depressions induce areas of ponding at the eastern end of Craig Close. During this event depths reach up to 300mm with maximum velocities of 0.25m/s. During the 1% AEP event, increases in water levels cause the enlargement of ponding extents which spread to adjacent properties. Depths of ponding during this event reach up to 600mm.
- During the 3.3% AEP event, the car park to the leisure centre within Mersey Vale Country Park contains localised areas of ponding, reaching depths up to 300mm. During the 1% AEP event, new flow paths that flow into the car park from Craig Road can exacerbate the risk. Velocities of floodwater travelling towards the car park reach up to 2m/s. The Environment Agency's Flood Risk to People (2006)[xli] document details that flood depths greater than 300mm with velocities greater than 1m/s could result in stationary vehicles being moved by the flow of the water which would be unsafe for users. Therefore, the risk to vehicles in this flood area is high.
- During the 3.3% AEP event, localised ponding is shown to impact commercial properties and car parks within the Brighton Road Industrial Estate with maximum depths of 600mm and velocities of 0.25m/s. During the 1% AEP event, increases in water levels lead to larger areas of ponding within the industrial estate.

4.2.2.2 Sewers

The United Utilities 2D sewer surcharge flood modelling show that Area 1 is predominantly at low risk of sewer flooding. However, there is a risk of sewer flooding in multiple areas from a 2% AEP to 10% AEP event. Although predictive sewer modelling shows risk from sewer flooding with this area, no historical flooding incidents have been recorded. Locations at risk are summarised below:

- During the 10% AEP event, areas within the Brighton Road Industrial Estate are at risk from sewer flooding. This includes a car park and commercial properties directly east of Mersey Vale Country Park. During the 2% AEP event, sewer flooding extends further east and impacts commercial properties and other car parks within the estate.
- Residential properties along the eastern end of Craig Close are at risk from sewer flooding during the 10% AEP event. Sewer flood extents increase during the 2% AEP event, increasing the number of properties at risk along Craig Close.
- Sewer flooding is identified to pose a risk to the car park of the leisure centre within Mersey Vale Country Park during a 2% AEP event. Further extents approximately 5m east flow southwards along a walkway adjacent to Craig Road.

4.2.3 Area Specific Guidance

4.2.3.1 Flood Risk Management

Given the level of flood risk in Area 1, the most likely suitable site Flood Risk Management approaches are as follows:

- Managing surface water run-off and overland flow paths in areas along Craig Close, Craig Road and within Brighton Road Industrial Estate. This will require site specific mitigation including SuDS.,
- Increasing capacity of storm sewer networks in areas within Brighton Road Industrial Estate, Craig Close and the car park within Mersey Vale Country Park.

Strategic Flood Risk Management that may support development in Area 1 include;

- Possible flood storage within Mersey Vale Country Park. However, this option would require excavation of the land due to elevated ground levels that would impede on flood flows travelling from at risk locations such as Brighton Road Industrial Estate. Other factors include the assessment of where stored water would be discharged. The Mersey is approximately 200m south of considered option with adjacent properties and would therefore not be viable option for discharging.

For more information on strategic flood risk management, refer to Section 5.

4.2.3.2 Site-specific Flood Risk Assessment

Given the level of flood risk in Area 1, any site-specific FRA should consider the following issues :

- Risk associated with allowances for the predicted future impacts of climate change on rainfall intensity in relation to surface water run-off.
- Site specific modelling of surface water run-off along Craig Close, Craig Road and within Brighton Road Industrial Estate where there are either flow paths or identified areas of ponding that impact of flood risk on or off site .
- In the areas of Brighton Road Industrial Estate, Craig Close and the car park within Mersey Vale Country Park consultation with the utility provider would be beneficial as to whether any improvements can be made to the sewer network to reduce risk of flooding to this area and adjacent areas.
- Consideration of emergency planning access and egress routes for specific sites within Brighton Road Industrial Estate.
- Residual risk associated with the blockage or exceedance of the sewer and drainage system.
- The presence of nearby sites that may potentially benefit from flood storage.

For more information, refer to Section 5.

4.3 Area 2

4.3.1 Description

Area 2 (shown in Figure 4-3) lies within the western extent of the Town Centre boundary, directly south of Bowerfold Open Space Gardens to which it is bounded by. The southern extent of the area is bounded by the A5145 with residential properties along Bankfield Avenue bordering the westerly extent. The nearest Main River is the River Mersey which flows approximately 220m south of Area 2. The ground levels generally slope north to south towards the Mersey. Key roads include Green Lane which runs through the centre of the site. Other key roads include Kennedy Way to the north and Brent Road to the south of the area. The Grantham Road Green Lane Industrial Estate is shown to be a key feature which predominantly comprises of commercial properties and car parks.

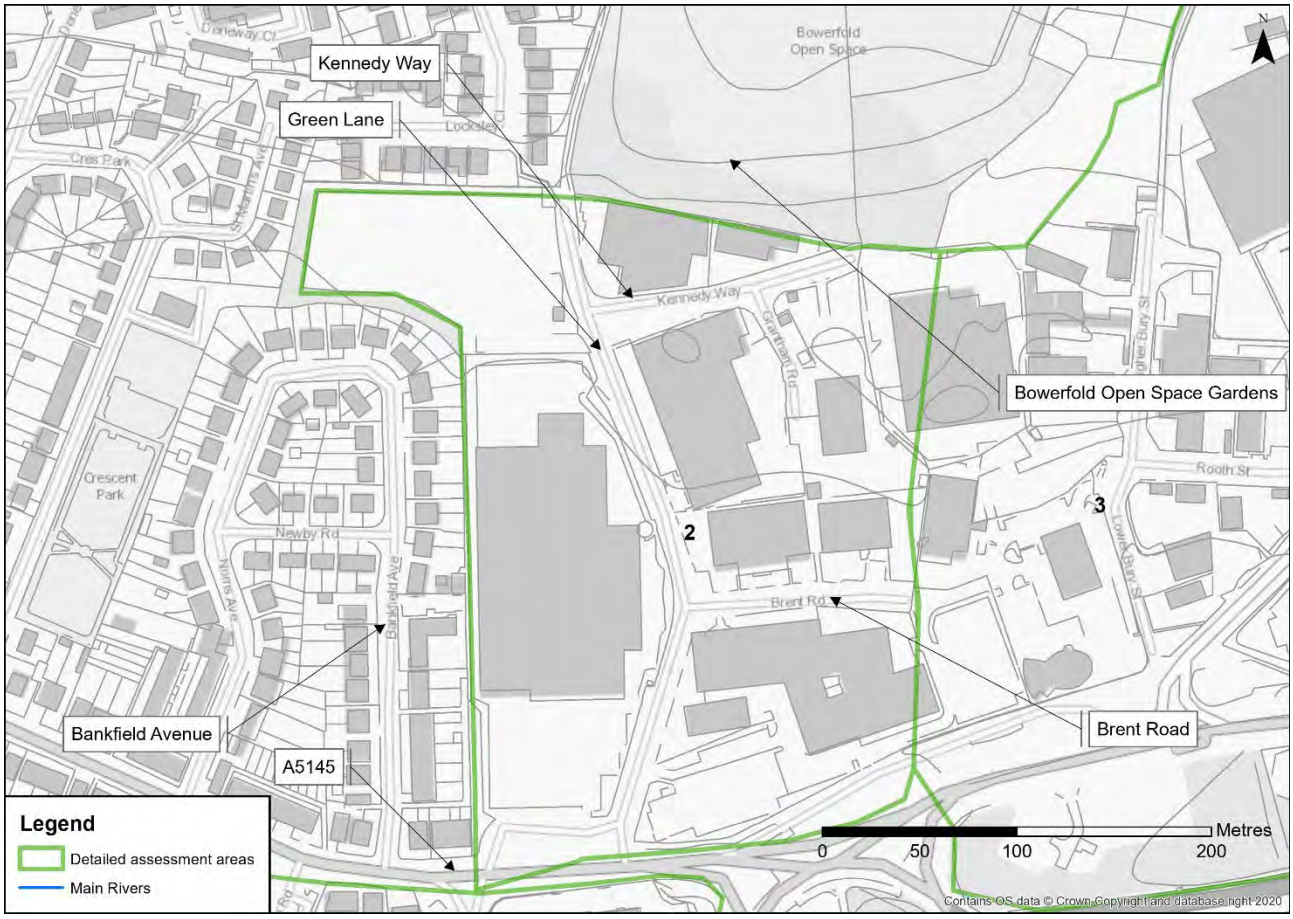

Figure 4-3: Area 2 assessment area

Based on the findings of the assessment in Section 3, this section focuses on notable sources of flooding within Area 2 as shown in Table 4-2. Flood Risk Hazard Maps for Area 2 are shown in Appendix Appendix C.

Table 4-2: Summary of Area 2 significant flood sources

Area	Fluvial	Surface Wat	Sewers	Groundwate	Canals	Reservoirs
2	×	✓	✓	×	×	×

4.3.2 Flood Risk Assessment

4.3.2.1 Surface water

Area 2 is predominantly at low risk from surface water flooding. However, various locations are moderate risk (1% AEP event) to high risk (3.3% AEP event) areas of surface water flooding. These locations are detailed below:

- During the 3.3% AEP event, surface water ponding occurs due to localised depressions in the southern extent of Area 2. Ponding within this area impacts commercial properties and a car park adjacent to the A5145. Maximum depths during the event reach up to 300mm with maximum velocities up to 0.25m/s. During the 1% AEP event, new areas of ponding form within the described car park. Additionally, all existing extents of ponding grow in size due to increased water levels. New flow paths along Brent Road travel south and flood small areas of mentioned commercial properties. The same properties are impacted by new flow paths traveling along the A5145 towards the east of commercial properties. As a result of this increase in water levels and flows, maximum depths of ponding and new flow paths during the event reach up to 600mm.
- During the 1% AEP event, surface water flow paths with maximum velocities of 2m/s are confined to Green Lane. Areas of ponding are identified to flood small areas of adjacent commercial properties with depths up to 300mm.

4.3.2.2 Sewers

Area 2 is generally at low risk from sewer flooding. However, large areas at risk from sewer flooding during the 10% AEP to 2% AEP events are discussed below:

- During the 10% AEP event, more notable extents are predominantly shown along Green Lane that impact adjacent commercial properties. The event reaches the car parks in the north west boundaries of the area. During the 2% AEP event, extents are shown to spread further south along Green Lane until Brent Road, causing further flooding to the adjacent properties.

4.3.3 Area-Specific Guidance

4.3.3.1 Flood Risk Management

Given the level of flood risk in Area 2, the most likely suitable site Flood Risk Management approaches are as follows:

- Managing surface water run-off and overland flow paths along Green Lane and adjacent areas. This will require site specific mitigation including SuDS.

Strategic Flood Risk Management approaches may support development in Area 2 include;

- Increasing capacity of storm sewer networks in areas along Green Lane. This will require consultation with the utility provider as to whether any improvements can be made to the sewer network to reduce risk of flooding to this area and adjacent areas.
- Possible flood storage within Bowerfold Open Space. However, this option would require excavation of the land due to elevated ground levels that would impede on flood flows travelling from at risk locations along Green Lane. Other factors include the assessment of where stored water would be discharged.

For more information on strategic Flood Risk Management, refer to Section 5.

4.3.3.2 Site-specific Flood Risk Assessment

Given the level of risk in Area 2, any site-specific FRA should consider the following issues:

- Risk associated with allowances for the predicted future impacts of climate change on rainfall intensity in relation to surface water run-off.
- Site specific modelling of surface water run-off along Green Lane and adjacent areas.
- Consultation with the utility provider would be beneficial as to whether any improvements can be made to the sewer network to reduce risk of flooding to this area and adjacent areas.
- Where appropriate assess the residual risk associated with the blockage or exceedance of the sewer and drainage system.
- The presence of nearby sites that may potentially benefit from flood storage .

For more information on site specific flood risk assessment, refer to Section 5.

4.4 Area 3

4.4.1 Description

Area 3 (shown in Figure 4-4) is focused within the northern reaches of the Town Centre boundary. The topography generally slopes from north to south and is bounded by Bowerfield Lane to the north, the A6 to the east, and the M60 to the south. The area is predominantly occupied by Commercial properties. Various areas of car parking is shown east and west of Higher and Lower Bury Street. Grantham Road Green Lane Industrial Estate is observed to encroach on the western boundary.

Other features within the area include George's roundabout that connects to George's Road and Rooth Street. The Manchester London Road to Cheadle Hulme railway line runs near the eastern borders within the area. The nearest Main River is the River Mersey which flows approximately 100 m south of Area 3.

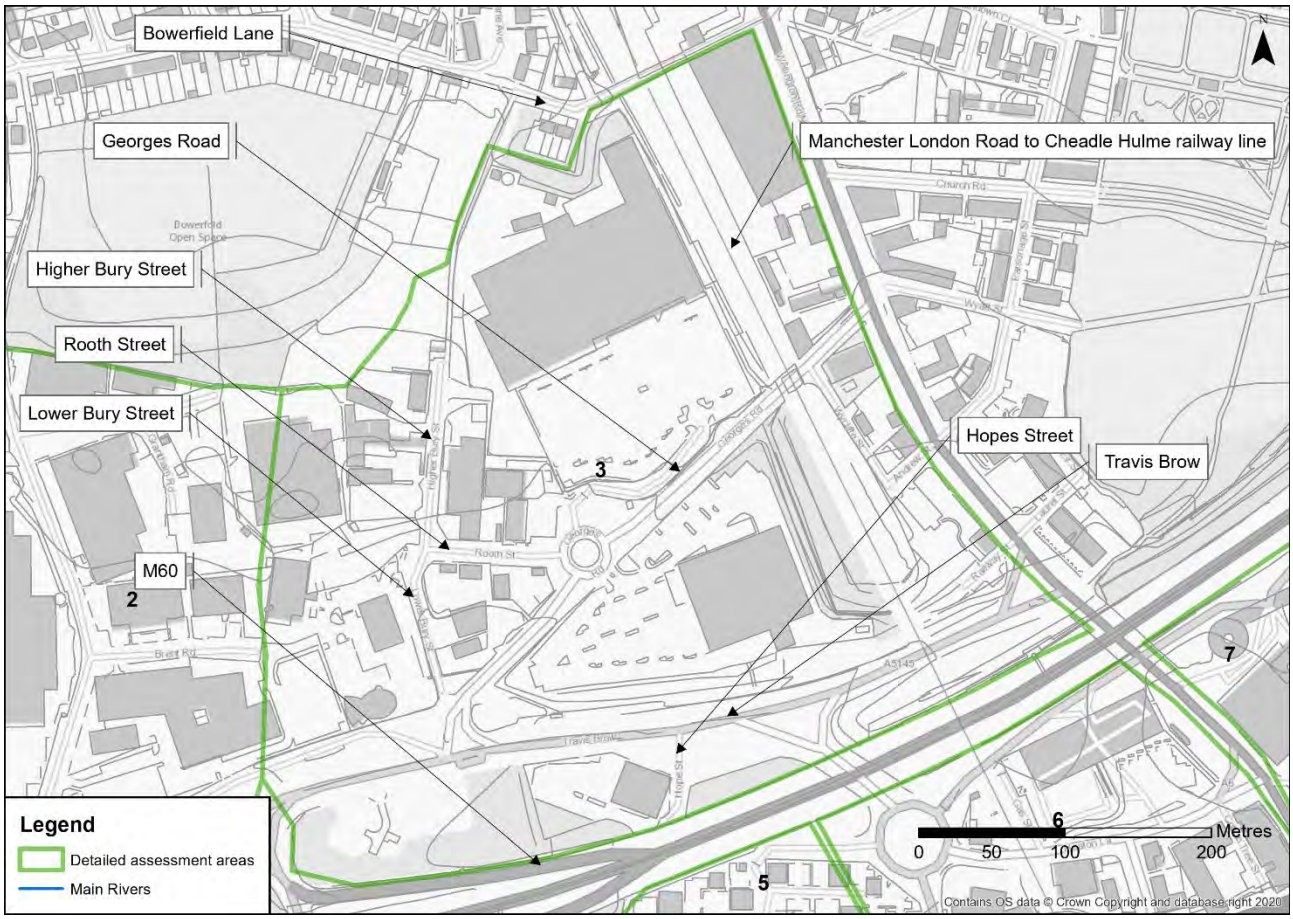

Figure 4-4: Area 3 assessment area

Based on the findings of the assessment in Section 3, this section focuses on notable sources of flooding within Area 3 as shown in Table 4-3. Flood Risk Hazard Maps for Area 3 are shown in Appendix Appendix C.

Table 4-3: Summary of Area 3 significant flood sources

Area	Fluvial	Surface Wat	Sewers	Groundwate	Canals	Reservoirs
3	✓	✓	✓	×	×	×

4.4.2 Flood Risk Assessment

4.4.2.1 Fluvial

The Upper Mersey hydraulic model shows that Area 3 is predominantly at low risk of fluvial flooding. However, areas within Flood Zone 2 (between a 1% and 0.1% AEP event) are summarised below:

- During the 0.1% AEP event, initial overtopping outside of Area 3 occurs on the right bank of the River Mersey due to a low point (39.83mAOD) downstream of the A560 River Mersey crossing. Floodwater then flows north along Travis Brow into Area 3. A separate flow path travels under the M60 towards car parking along Hope Street. Maximum flood depths reach up to 1m with maximum velocities of 0.2m/s. Overall, Flood Risk Hazard mapping generally suggests a "danger for some people" in areas along Travis Brow. Hope Street is identified to be a very low hazard.

4.4.2.2 Surface water

Area 3 is predominantly at low risk of surface water flooding. However, there areas at moderate risk (1% AEP event) to high risk (3.3% AEP event) which are summarised below:

- During the 3.3% AEP event, surface water ponding is identified across areas of Grantham Road Green Lane Industrial Estate with maximum depths of 600mm and maximum velocities of 0.25m/s. Floodwater during the event is noted to impact areas of commercial properties and car parking within the eastern locations of the estate. Areas of ponding at this location increase in size during the 1% AEP event due to new flow paths forming within the estate's car parks. Maximum velocities of new flow paths reach up to 1m/s.
- Three main surface water flow paths are visibly located along areas of Hopes Street, Travis Brow, and Georges Road during the 3.3% AEP event. Overall, maximum depths of 1.2m and maximum velocities up to 2m/s are shown along the noted roads. During the 1% AEP event, flow paths increase in size as water along Hopes Street flows north onto Travis Brow. The floodwater then travels along Georges Road towards George's Roundabout. Additional flow paths that run along a bus lane adjacent to Travis Brow further exacerbates the risk in this area. The Environment Agency's Flood Risk to People (2006)[xlii] document details that flood depths greater than 300mm with velocities greater than 1m/s could result in stationary vehicles being moved by the flow of the water. This would be unsafe for users and therefore the risk to vehicles would be high.
- To the north east of the area, surface water ponding during the 3.3% AEP event is shown to impact commercial properties adjacent to the Manchester London Road to Cheadle Hulme railway line. Maximum depths at locations of ponding reach up to 300mm, with slow moving floodwaters reaching velocities up to 0.25m/s. During the 1% AEP event, areas of ponding are enlarged due to increased water levels, reaching depths up to 900mm.

4.4.2.3 Groundwater

GeoSmart GW5 groundwater flood risk dataset[xliii] shows an area of moderate to low risk of groundwater flooding to the south of the area. Within Area 3 the presence of Manchester Marls Formation, partially underlying the site has the potential to act as a barrier to downwards groundwater flow. Therefore, within part of the Area, groundwater is likely confined to the overlying superficial deposits which could create localised perched groundwater to form above the marls. Additionally, as displayed in the CSM Section A-A' (Appendix Appendix F) the variable composition of made ground, which overlies the majority of the area, has the potential for perched groundwater above low permeability lenses.

Given the urban nature of the area, depending on the condition of local sewer and drainage networks, water egress could promote surface waters to recharge the superficial aquifers by leaking water transmission infrastructure, hence locally increasing groundwater levels, especially in areas where groundwater is perched on top of low permeability deposits. This could increase the risk of groundwater flooding within this area.

4.4.3 Area-Specific Guidance

4.4.3.1 Flood Risk Management

Given the level of flood risk in Area 3, the most likely suitable site Flood Risk Management approachesare as follows:

- Managing surface water run-off and overland flow paths along Hopes Street, Travis Brow, Georges Road, and adjacent areas. This will require site specific mitigation including SuDS,
- Groundwater collection mitigation.

Strategic Flood Risk Management approaches may support development in Area 3 include;

- Possible flood storage within green space location bounded by the M60 to the south, Travis Brow to the north, Hopes Street to the east, and the Pyramid Roundabout to the west. It is likely that any water stored could be discharged into the River Mersey approximately 80m south.

For more information on strategic Flood Risk Management, refer to Section 5.

4.4.3.2 Site-specific Flood Risk Assessment

Given the level of risk in Area 3, any site-specific FRA should consider the following issues:

- The presence of nearby sites that may potentially benefit from flood storage.
- Site specific modelling of surface water run-off along Hopes Street, Travis Brow, Georges Road, and adjacent areas.
- Risk associated with allowances for the predicted future impacts of climate change on rainfall intensity.
- Residual risk associated with the blockage or exceedance of the sewer and drainage system.
- Groundwater flood risk assessment based on ground investigation.

For more information on site specific flood risk assessment, refer to Section 5.

4.5 Area 4

4.5.1 Description

The River Tame generally flows south westerly as it runs through Area 4 (Figure 4-5). High ground encompasses the western and northern parts of Area 4 which is bounded by Penny Lane and Tiviot Way. The M60 forms the southern border of Area 4 before the Tame combines with the Goyt to form the Mersey 50m south of the boundary. Eastern extents are relatively flat and form the lowest part of Area 4, lying only 2 -3m higher than the left bank of the Tame. The ground levels generally fall towards the floodplain.

Area 4 predominantly comprises of commercial properties along Lancashire Hill, Penny Lane, Marsland Street and Water Street. A key location of commercial properties being within Meadow Industrial Estate along Water Street. It is noted that large portions of land to the east of the area is allocated car parking.

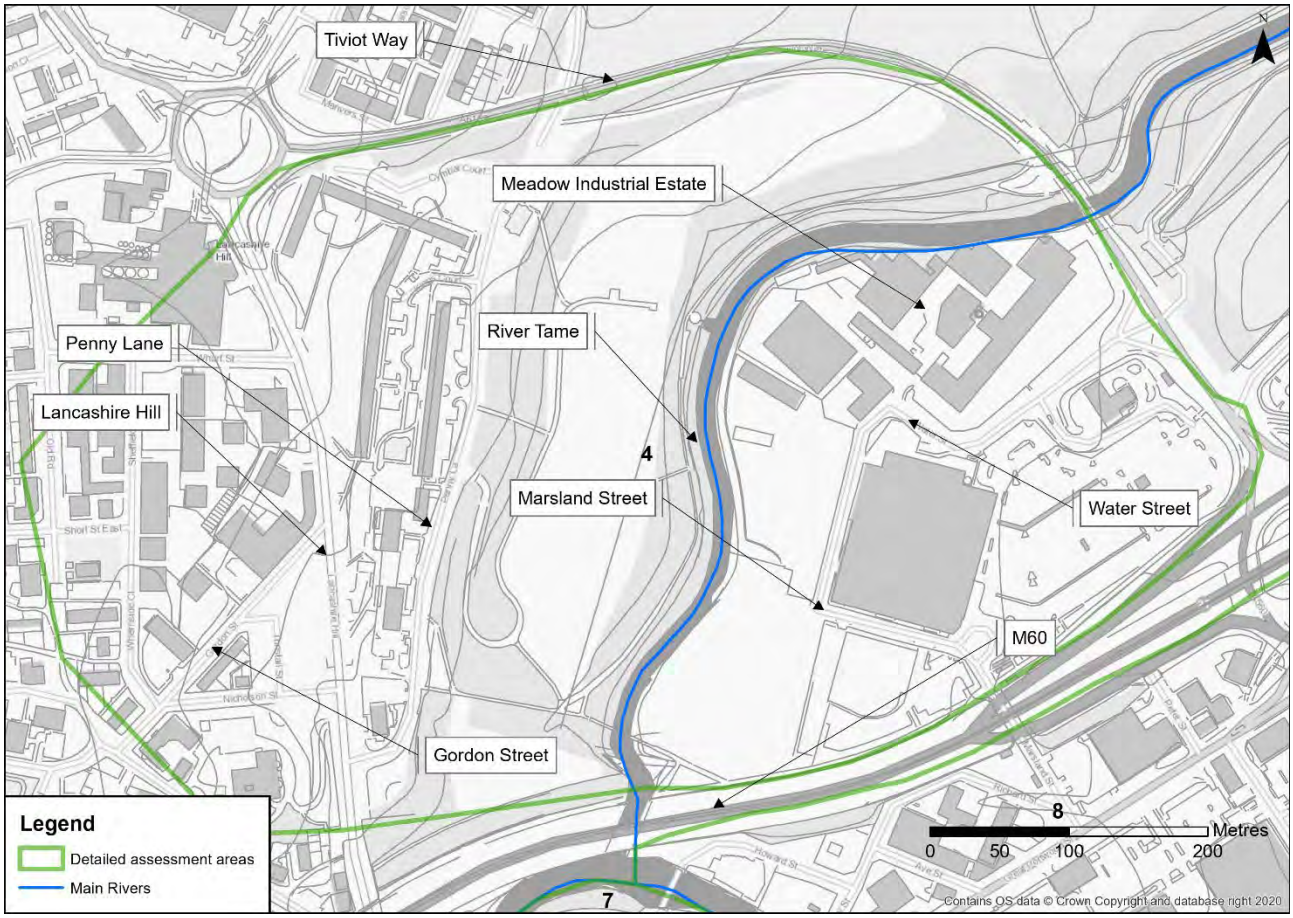

Figure 4-5: Area 4 assessment area

Based on the findings of the assessment in Section 3, this section focuses on notable sources of flooding within Area 4 as shown in Table 4-4. Flood Risk Hazard Maps for Area 4 are shown in Appendix Appendix C.

Table 4-4: Summary of Area 4 significant flood sources

Area	Fluvial	Surface Wat	Sewers	Groundwate	Canals	Reservoirs
4	✓	✓	✓	×	×	×

4.5.2 Flood Risk Assessment

4.5.2.1 Fluvial

The Upper Mersey hydraulic model shows that Area 4 is predominantly at low risk of fluvial flooding. However, areas within Flood Zone 2(between a 1% and 0.1% AEP event)to Flood Zone 3 (1% AEP event or greater)are included below:

- During the 1% AEP event, initial overtopping occurs at a low point (40.26mAOD) along the left bank of the River Tame, downstream of Tiviot Way (A6188) Bridge. The extent of floodwaters impact properties within the Meadow Industrial Estate. Maximum flood depths during the 1% AEP event reach up to 900mm, with maximum velocities of 1m/s as floodwater travels north to south through the estate. The Flood Risk Hazard mapping shows that flooding during this event has a "danger to most people" within the estate. This is regarding the general public and does not include the emergency services.
- During the 0.1% AEP event, floodwater spreads further south, with maximum flood depths of 5m. In addition to Meadow Industrial Estate, flooding during this extreme event will impact commercial properties along Water Street and Marsland Street. Flood hazard generally suggests a "danger to all people" during this event. As a result of this, there is a high likelihood there would be increased stress on emergency response times and resources.

During the 1% + 35% climate change AEP event, in addition to the flooding at Meadow Industrial Estate, extents increase further south and flood Water Street. Maximum flood depths during the event reach up to 1.6m, with maximum velocities up to 1.3m/s. During the 1% + 70% climate change AEP event, floodwater extends further south impacting the properties adjacent to Water Street and Marsland Street. Flood depths reach up to 4m within Meadow Industrial Estate. Overall, flood hazard suggests a "danger to most" during the event.

4.5.2.2 Surface water

Area 4 is predominantly at low risk of surface water flooding. However, there is a moderate risk (1% AEP event) to high risk (3.3% AEP event) to specific locations within the area that are summarised below:

- Surface water ponding occurs within the Meadow Industrial Estate during the 3.3% AEP event, with maximum flood depths of 300mm and maximum velocities of 0.25m/s. During the 1% AEP event, extents of ponding increase due to new flow paths along Water Street that flow into the estate and exacerbate the risk. Maximum velocities along Water Street can reach up to 1m/s as floodwater travels south easterly through the estates entrance. Maximum depths of 600mm occurs at low spots within the estate's car park. It is likely areas that flood depths greater than 300mm and velocities greater than 1m/s could result in stationary vehicles being moved by fast flowing water.

4.5.2.3 Sewers

Area 4 is predominantly at low risk of sewer flooding. However, the 2% AEP event is identified within the south west extents of the area. Although predictive sewer modelling shows risk from sewer flooding with this area, no historical flooding incidents have been recorded. During the 2% AEP event, sewer flood extents are shown to impact commercial properties adjacent to Whernside Close, Nicholson Street, Gordon Street and Lancashire Hill.

4.5.2.4 Groundwater

Geosmart GW5 data indicates an area of moderate to low risk of groundwater flooding to the west of the River Tame on the floodplain, east of Penny Lane. In reference to CSM Section C-C' (Appendix Appendix F), the rural nature of the floodplain around the River Tame means that the superficial aquifer is able to receive direct recharge inputs through infiltration, especially where the topography is flat. Additionally, Appendix Appendix F contains a high level review of groundwater information in the Town Centre boundary (obtained from

historical borehole records), and noted shallow groundwater strikes in the east and south of Area 4 around the confluence of the three rivers, and upgradient of this confluence. This suggests that groundwater levels are relatively shallow around this area,and likely have a moderate contribution to baseflow of the Rivers Tame and Mersey.

Shallow groundwater is generally expected to flow within the glacial till, and superficial sands and gravels, towards the Rivers Tame and Mersey. However, the moderate groundwater flood risk is associated with where these deposits are underlain by the Manc hester Marls and associated faults, which could be confining groundwater to specific areas within the bedrock and limiting downwards groundwater movement hence confining groundwater to shallower depths. This could create perched groundwater closer to the surface which in times of high rainfall could emerge at the surface, hence increasing groundwater flood risk.

4.5.3 Area-Specific Guidance

4.5.3.1 Flood Risk Management

Given the level of flood risk in Area 4, the most likely suitable site Flood Risk Management approaches are as follows:

- Raising linear defences along the River Tame to reduce risk of overtopping at low points.
- Groundwater collection mitigation.
- Managing surface water run-off and overland flow paths along Water Street and within Meadow Industrial Estate. This will require site specific mitigation including SuDS,

Strategic Flood Risk Management approaches may support development in Area 4 include;

- Possible storage upstream along the Tame within Reddish Vale Country Park could be used as a strategic option to reduce water levels downstream and within other areas (Areas 5, 6, 7 and 8). It is likely that any water stored could discharge back into the Tame once flooding has subsided.
- Increasing capacity of storm sewer networks in areas along Whernside Close, Nicholson Street, Gordon Street and Lancashire Hill. This will require hydraulic modelling of proposed sewer networks and consultation with the utility provider as to whether any improvements can be made to the sewer network to reduce risk of flooding to this area and adjacent areas.

For more information on strategic Flood Risk Management, refer to Section 5.

4.5.3.2 Site-specific Flood Risk Assessment

Given the level of risk in Area 4, any site-specific FRA should consider the following issues:

- Assess the improvement/ raising of linear defences along the River Tame, particularly in areas downstream of Tiviot Way (A6188) Bridge.
- Assess the viability of storage at Reddish Vale Country Park.
- Site specific modelling of surface water run-off along Water Street and within Meadow Industrial Estate.
- Risk associated with allowances for the predicted future impacts of climate change on rainfall intensity.
- In areas of Whernside Close, Nicholson Street, Gordon Street and Lancashire Hill consultation with the utility provider would be beneficial as to whether any improvements can be made to the sewer network to reduce risk of flooding to this area and adjacent areas.
- Residual risk associated with the blockage or exceedance of the sewer and drainage system.
- Groundwater flood risk assessment based on ground investigation.

For more information on site specific flood risk assessment, refer to Section 5.

4.6 Area 5

4.6.1 Description

Area 5 (shown in Figure 4-6) lies in the western extent of the Town Centre boundary. It is bounded by Wood Street to the south and west, and the A5145 to the east. The River Mersey flows from east to west along the northern boundaries. Area 5 is relatively flat, gradually falling north towards the River. Chestergate Road runs central through east to west of the area. Other key roads include Ford Street in the north west, West Street in the south west, and Kingston Street in the south east. The area predominantly contains commercial properties, with various portions allocated to car parking.

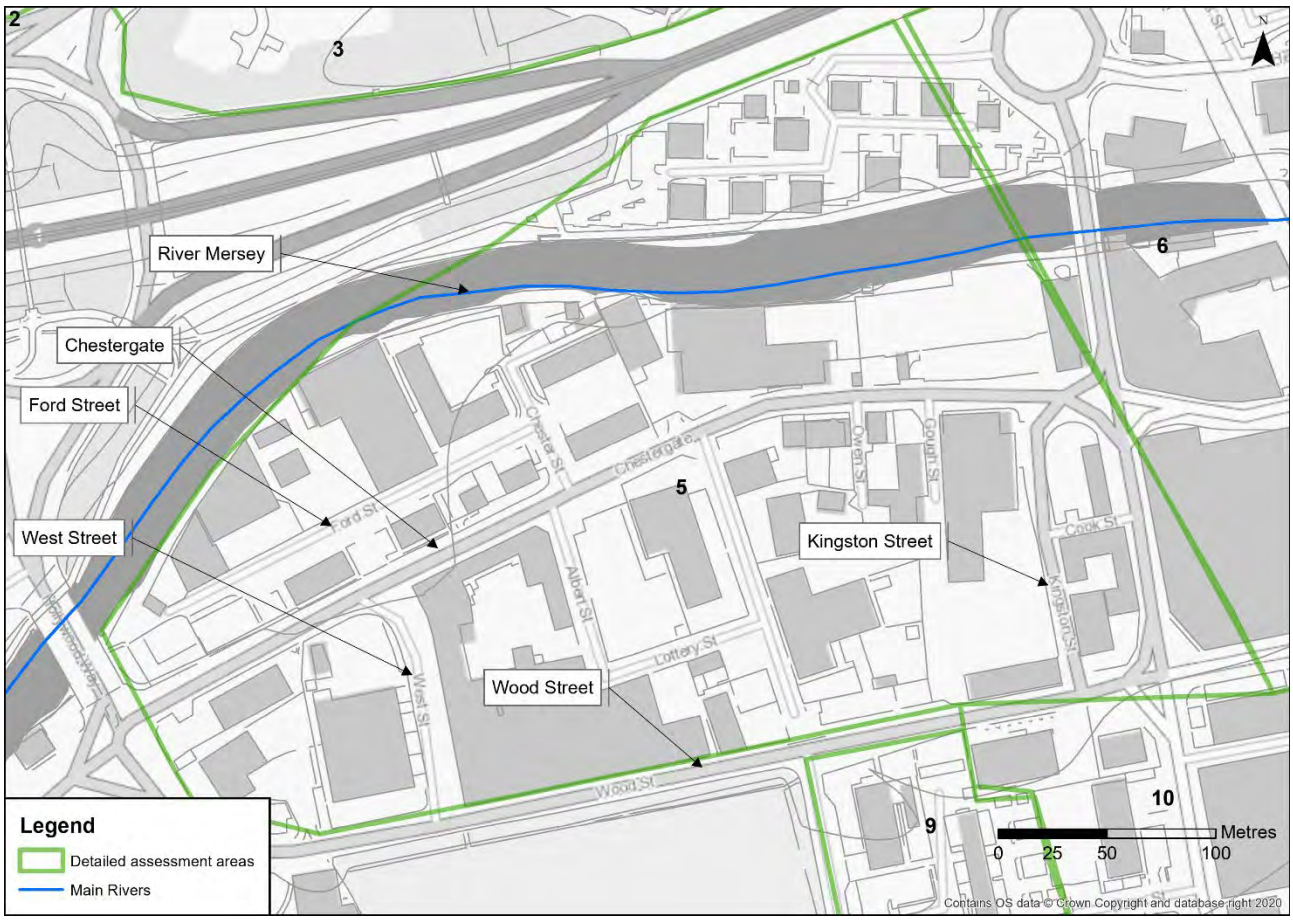

Figure 4-6: Area 5 assessment area

Based on the findings of the assessment in Section 3, this section focuses on notable sources of flooding within Area 5 as shown in Table 4-5. Flood Risk Hazard Maps for Area 5 are shown in Appendix Appendix C.

Table 4-5: Summary of Area 5 significant flood sources

Area	Fluvial	Surface Water	Sewers	Groundwater	Canals	Reservoirs
5	✓	✓	✓	×	×	×

4.6.2 Flood Risk Assessment

4.6.2.1 Fluvial

Approximately half of Area 5 is visually located within areas at low risk of fluvial flooding. The remainder lies within Flood Zone 2 (between a 1% and 0.1% AEP event) to Flood Zone 3 (1% AEP event or greater). The locations at risk are summarised below:

- Upstream of the A5145 Bridge, the River Mersey starts to overtop at a low point (37.65mAOD) along the left bank during the 1% AEP event. Immediately, commercial properties and car parks along the western area of Ford Street are impacted with maximum depths of 1.2m and velocities of 0.2m/s. Overall, Flood Risk Hazard mapping generally suggests a "danger for some people" in western areas adjacent to Ford Street.
- During the 0.1% AEP event, floodwaters spread further south east across Area 5. Flood extents during this extreme event are shown to impact properties adjacent to Ford Street, West Street, Chester Street, Chestergate Road and Albert Street. Maximum depths of flood to properties adjacent to Ford Street reach 3m with velocities reaching 0.6m. From Ford Street, Gradual decreases in depths are observed with a maximum of 1m along areas of Albert Street. Flood hazard generally suggests a "danger to all people" during this event. As a result of this, there is a high likelihood there would be increased stress on emergency response times and resources.

During the 1% + 35% climate change AEP event, extents spread south east impacting properties adjacent to Ford Street and Chestergate Road. Depths during this event reach up to 1.8m with velocities up to 0.4m/s. The extent of flooding during the 1% + 70% climate change AEP event is a similar extent to the 0.1% AEP event. However, depths during the climate change event reach up to 3.8m and velocities up to 1m/s. Overall, flood hazard suggests a "danger for most people".

4.6.2.2 Surface water

The risk of flooding from surface water within Area 5 is predominantly low risk. However, there is a moderate risk (1% AEP event) to high risk (3.3% AEP event) to specific locations within the area as summarised below:

- During the 3.3% AEP event, surface water ponding is predominantly confined at low spots along Ford Street, Chestergate Road, West Street, Gough Street, Kingston Street and the A5145. Maximum flood depths of 600mm with velocities reaching 1m/s are shown within these areas. During the 1% AEP event, extents of ponding increase due to new flow paths along Wood Street that flow along roads and exacerbate the risk. The roads impacted by new flow paths include West Street, Chestergate Road and Ford Street with maximum velocities of 2m/s. Along Gough Street and Kingston Street, extents of ponding increase due to increased water levels. New areas of ponding start to form along Owen Street. New flow paths along Daw Bank travel north along the A5145 with maximum velocities of 2m/s. The flow paths would increase extents of ponding in areas adjacent to Cook Street. Along West Street and A5145, it is likely areas with flood depths greater than 300mm and velocities greater than 1m/s could result in hazards for users.

4.6.2.3 Sewers

Area 5 is predominantly at low risk of sewer flooding. However, it is noted that during the 2% AEP event, sewer flood extents are shown to impact commercial properties adjacent to Ford Street despite no records of historical flooding incidents in the area. Site 9 lies within the specified area of flooding. The remainder of the site lies within areas of low risk.

4.6.2.4 Groundwater

Geosmart GW5 data indicates a moderate to low risk of groundwater flooding across the majority of the area, with the moderate risk located around the banks of the River Mersey, the A560, Brinksway and Ford Street. In reference to CSM Section A-A' (Appendix Appendix F), water ingress and/or egress could promote exchanges

of surface waters and groundwaters in the shallow sub-surface depending on the condition of local sewer and drainage networks, and the canalised channel bed and banks of the River Mersey. This means that the made ground deposits and/or superficial and bedrock aquifers could be recharged by leaking water transmission infrastructure, and vice versa (i.e., depending on hydraulic head gradients present). This could increase groundwater flood risk locally to the leaking infrastructure and river. Additionally, this area is located directly downstream of where the River Mersey emerges from a large culvert, hence interactions between the groundwater and surface water will be increased in this area, compared to the adjacent area 6.

The permeability of the made ground, sand and gravel dominated superficial deposits, and highly weathered sandstone and mudstone bedrock (upper horizons) is generally expected to be relatively high across Section A-A'. However, groundwater interactions across the boundaries between the sandstone and mudstone bedrock units are unknown, with the potential for the Marls to act as a barrier to downwards groundwater flow. Therefore, within the western part of the area there is potential for groundwater to be confined to the overlying superficial deposits which could create localised perched groundwater close to the surface, which could locally increase the groundwater flood risk.

4.6.3 Area-Specific Guidance

4.6.3.1 Flood Risk Management

Given the level of flood risk in Area 4, the most likely suitable site Flood Risk Management approaches are as follows:

- Raising linear defences along the River Mersey to reduce risk of overtopping at low points upstream of the A5145 Bridge.
- Managing surface water run-off and overland flow paths in areas specified in Section 4.6.2.2. This will require site specific mitigation including SuDS
- Groundwater collection mitigation

Strategic Flood Risk Management approaches that may support development in Area 4 include;

- Increasing capacity of storm sewer networks in areas along Ford Street.

For more information on strategic Flood Risk Management, refer to Section 5.

4.6.3.2 Site-specific Flood Risk Assessment

Given the level of risk in Area 5, any site-specific FRA should consider the following issues:

- If sites in areas associated with Flood Zone 3 do not pass the Exception Test, can the sites be redeveloped in an alternative location.
- Assess the improvement/raising of linear defences along the River Mersey, particularly in areas upstream of the A5145 Bridge.
- Site specific modelling of surface water run-off along areas specified in Section 4.6.2.2.
- Risk associated with allowances for the predicted future impacts of climate change on rainfall intensity.
- In areas along Ford Street consultation with the utility provider would be beneficial as to whether any improvements can be made to the sewer network to reduce risk of flooding to this area and adjacent areas.
- Residual risk associated with the blockage or exceedance of the sewer and drainage system.
- Groundwater flood risk assessment based on ground investigation.

For more information on site specific flood risk assessment, refer to Section 5.

4.7 Area 6

4.7.1 Description

The River Mersey flows easterly and drains through Area 6 (Figure 4-7). Most of the land forms a relatively flat low-lying valley that falls within the floodplain associated with the River. Key features influencing the topography are the M60 in the north and Daw Bank in the south. These roads form high ground along the north and south boundaries of Area 6.

The area predominantly comprises of commercial properties along Heaton Lane, Chestergate and Astley Street, with most comprising of allocated car parking. Other key areas include bus stands adjacent to Swaine Street and Daw Bank.

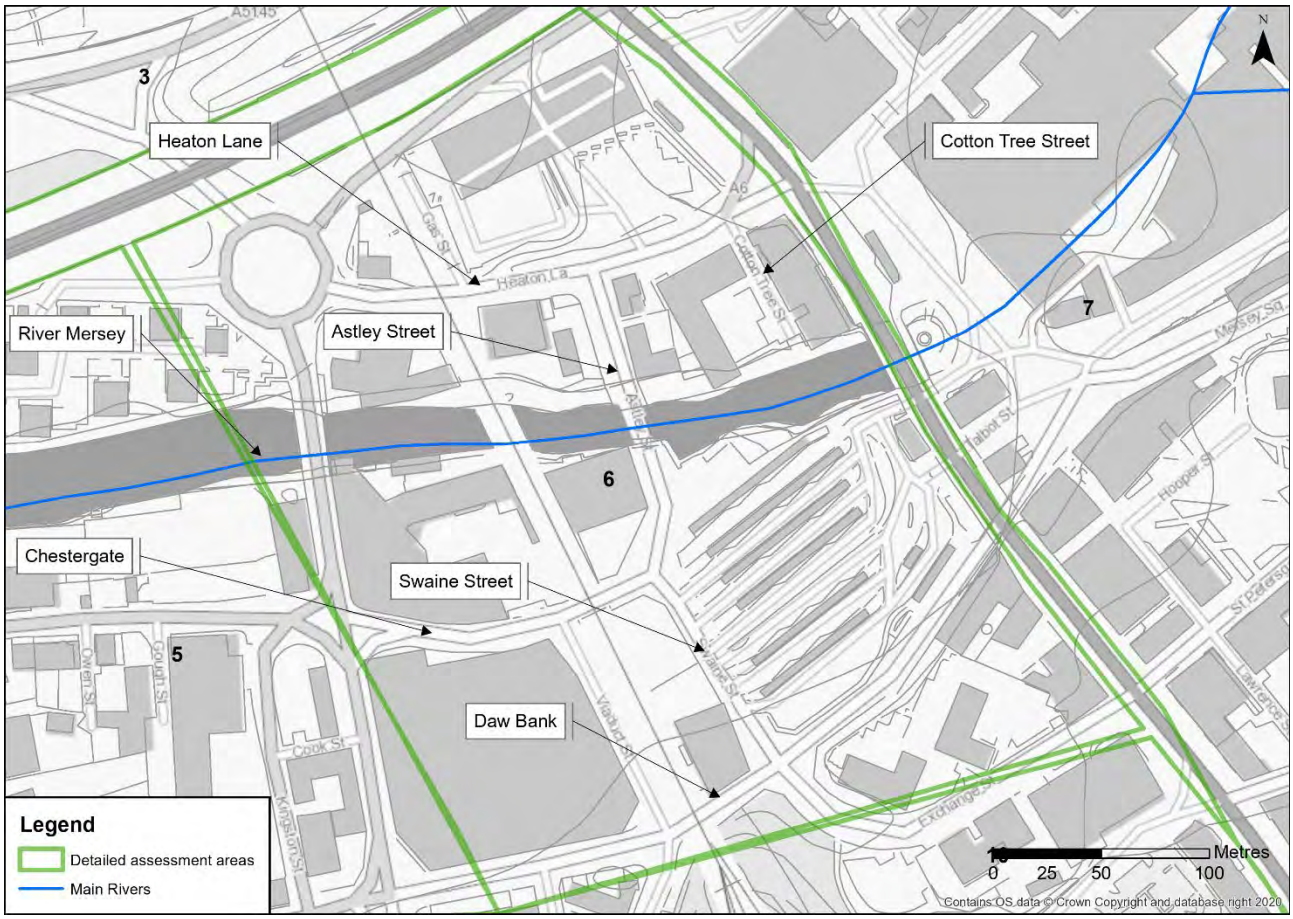

Figure 4-7: Area 6 assessment area

Based on the findings of the assessment in Section 3, this section focuses on notable sources of flooding within Area 6 as shown in Table 4-6. Flood Risk Hazard Maps for Area 6 are shown in Appendix Appendix C.

Table 4-6: Summary of Area 6 significant flood sources

Area	Fluvial	Surface Wat	Sewers	Groundwater	Canals	Reservoirs
6	✓	✓	✓	×	×	×

4.7.2 Flood Risk Assessment

4.7.2.1 Fluvial

Area 6 is mostly at low risk of fluvial flooding. The 1% AEP event is generally confined to the riverbanks of the Mersey within Area 6. However, during the 0.1% AEP event, occurrences of overtopping cause water to extend north and south of the river. Approximately half of the area is visibly located in areas of flood during the 0.1% AEP event. The extent of floodwaters impacts commercial properties adjacent to Heaton Lane, Astley Street, Cotton Tree Street and Chestergate. Floodwaters also impact the bus stands along Swaine Street. Maximum depths during the 0.1% AEP event reach up to 5m, with velocities reaching 1.5m/s. The Flood Risk Hazard mapping generally suggests that flooding during this event is a “danger to most people” and would therefore be a danger to the general public.

During the 1% + 70% climate change AEP event, floodwaters impact properties adjacent to Astley Street and Cotton Tree Street. Bus stands along Swaine Street are also visibly located in areas at risk with depths reaching up to 8m and velocities reaching up to 1.8m/s that is suggested to cause a “danger to all people”.

4.7.2.2 Surface water

Area 6 is predominantly at low risk of surface water flooding. However, there is a moderate risk (1% AEP event) to high risk (3.3% AEP event) to specific locations within the area as summarised below:

- Surface water ponding due to low spots occur at the bus stands adjacent to Swaine Street during a 3.3% AEP event, with maximum flood depths of 600mm and maximum velocities of 0.5m/s. During the 1% AEP event, extents of ponding increase due to new surface water flow paths travelling along Swaine Street and Talibot Street. Maximum velocities along Swaine Street and Talibot Street reach up to 2m/s as floodwater travels towards the bus stands. Other areas of surface water flooding are identified along Heaton Lane, Chestergate and Daw Bank. However, the extents are generally confined to the roads and do not pose a risk to properties within the area.

4.7.2.3 Sewers

Area 6 is predominantly at low risk of sewer flooding. During the 2% AEP event, sewer flood extents are shown to flood Chestergate and an adjacent car park. Although predictive sewer modelling shows risk from sewer flooding with this area, no historical flooding incidents have been recorded.

4.7.3 Area-Specific Guidance

4.7.3.1 Flood Risk Management

Given the level of flood risk in Area 6, the most likely suitable site Flood Risk Management approaches are as follows:

- Manage surface water run-off and overland flow paths in areas along Swaine Street and adjacent bus stands. Site specific mitigation required to manage the risk would include SuDS.

Strategic Flood Risk Management approaches that may support development in Area 6 include;

- Increasing capacity of storm sewer networks in areas along Chestergate.

For more information on strategic Flood Risk Management, refer to Section 5.

4.7.3.2 Site-specific Flood Risk Assessment

Given the level of risk in Area 6, any site-specific FRA should consider the following issues:

- Site specific modelling of surface water run-off along areas of Swaine Street.

- Risk associated with allowances for the predicted future impacts of climate change on rainfall intensity
- In areas along Chestergate consultation with the utility provider would be beneficial as to whether any improvements can be made to the sewer network to reduce risk of flooding to this area and adjacent areas.
- Residual risk associated with the blockage or exceedance of the sewer and drainage system along Chestergate and Swaine Street.

For more information on site specific flood risk assessment, refer to Section 5.

4.8 Area 7

4.8.1 Description

The River Mersey is culverted under the Town Centre and generally flows westerly, draining through Area 7 (Figure 4-8). At Great Underbank, the River Mersey is joined by the tributary and Main River Hempshaw Brook. The Brook is heavily culverted and flows northerly draining the southern locations of Area 7 near Lower Hillgate and Little Underbank before discharging into the Mersey. Area 7 is bounded by the M60 to the north, the River Goyt to the east, and the A6 to the west. The ground levels generally fall towards the M60, with northern parts forming the lowest locations.

The area predominantly comprises of commercial properties, including the Merseyway Shopping Centre and Adlington Walk Shopping Centre. It is noted that there are portions of land allocated to car parking.

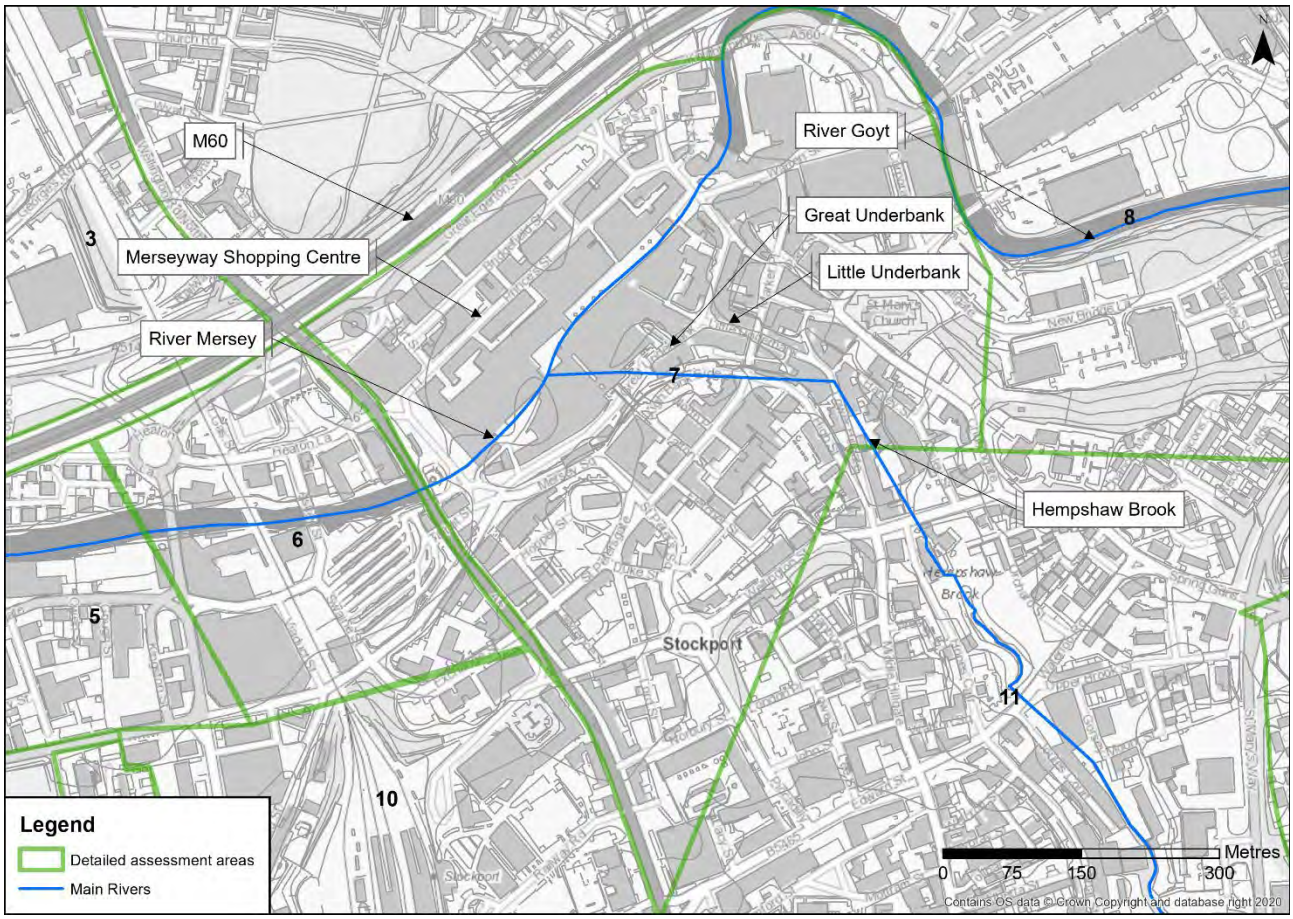

Figure 4-8: Area 7 assessment areas

Based on the findings of the assessment in Section 3, this section focuses on notable sources of flooding within Area 7 as shown in Table 4-7. Flood Risk Hazard Maps for Area 7 are shown in Appendix Appendix C.

Table 4-7: Summary of Area 7 significant flood sources

Area	Fluvial	Surface Water	Sewers	Groundwate	Canals	Reservoirs
7	✓	✓	✓	×	×	×

4.8.2 Flood Risk Assessment

4.8.2.1 Fluvial

Predictive modelling shows that approximately half of Area 7 is visibly located in Flood Zone 1 (less than a 0.1% AEP event) However, areas within Flood Zone 2 (between a 1% and 0.1% AEP event) associated with the River Merseyare summarised below:

- During the 0.1% AEP event, overtopping occurs at a low point (39.83mAOD) upstream of culverted sections of the Mersey. The floodwaters travel westerly, impacting commercial properties within Merseyway Shopping Centre and properties adjacent to Great Underbank, Bridgefield Street, and Prince's Street. Depths reach up to 2.5m with maximum velocities up to 1.5m/s. Overall, Flood Risk Hazard mapping shows that flooding during this event has a "Danger to most people". As this area is heavily urbanised, flooding during this extreme event is shown to be highly consequential causing substantial damages to property and harm to the general public. During the 1% + 70% climate change AEP event, floodwaters are predominantly confined to areas of the Merseyway Shopping Centre and Great Underbank with depths reaching up to 3m.

4.8.2.2 Surface water

Area 7 is predominantly at low risk of surface water flooding. However, areas of moderate risk (1% AEP event) to high risk (3.3% AEP event) have been noted throughout. The key locations been summarised below:

- During the 3.3% AEP event, surface water flooding is predominantly confined to the roads. However, areas of surface water ponding are shown to impact the properties adjacent to Great Underbank. Depths of ponding in the areas mentioned reach up to 1.2m with velocities up to 0.5m/s. During the 1% AEP event, extents of ponding increase due to new flow paths that exacerbate the risk. These new flow paths form along Lower Hillgate and travel northward. Flows continue north along Little Underbank, reaching velocities of 2m/s along Royal Oak Yard until floodwater reaches properties adjacent to Great Underbank. Flows along the roads would likely be unsafe for users and therefore the risk to vehicles would be high.
- Where low spots are identified, the Mersey Shopping Centre is noted to be susceptible to surface water ponding. During the 3.3% AEP event, commercial properties are impacted by surface water ponding adjacent to Prince's Street, with maximum flood depths of 600mm. During the 1% AEP event, increases in water levels lead to larger areas of ponding and maximum depths of 900mm within areas mentioned.

4.8.2.3 Sewers

The predictive sewer modelling shows that Area 7 is predominantly at low risk of sewer flooding. However, locations summarised below are at risk from sewer flooding during a 2% AEP event. Although predictive sewer modelling shows risk from sewer flooding with this area, no historical flooding incidents have been recorded.

- Commercial properties adjacent to St Petersgate, Lawrence Street and the A6 are at risk from sewer flooding. Further flood extents are shown within car parks adjacent to Norbury Street and along Deanery Way and Bridge Street. Flows along the roads and where stationary vehicles are located would likely be unsafe for users.

4.8.2.4 Groundwater

Groundwater flooding susceptibility mapping indicates moderate risk from groundwater flooding within the centre of the area at Bridge Street, Daniel's Lane and Great Underbank. Additionally, Appendix Appendix F contains a high level review of groundwater information in the Town Centre boundary (obtained from historical borehole records), and noted shallow groundwater strikes in the east of Area 7 around the confluence of the three rivers. In reference to the CSM Section B-B' in Appendix Appendix F, the presence of boulder clay across parts of the area identified through BGS historical borehole records would likely limit recharge rates through the unconsolidated strata, potentially enhancing saturated or partially saturated conditions in the made ground

or overlying sands and gravels (where present). This can allow perched groundwater to form, hence increasing groundwater flood risk. Additionally, where moderate risk from groundwater flooding prevails on Geosmart mapping (2022) the underlying bedrock is t he Manchester Marls which are generally of a lower permeability than the surrounding sandstone. Therefore, the Manchester Marls could potentially be limiting the downwards flow of groundwater into the bedrock aquifers.

Additionally, within this area to the southeast is a Source Protection Zone 1 (Inner Protection Zone) with a radius of approximately 140m in all directions around the abstractions, encompassing the area between St Petersgate and Churchgate. Additionally, a n SPZ 2 (Outer Protection Zone) extending 250m from the abstractions in a broadly south-east direction, while a Total Catchment (SPZ 3) reaches beyond the south-east of the Town Centre boundary towards Marple. These are associated with two licensed groundwater abstractions located at Robinson's Unicorn Brewery which have a maximum daily abstraction rate of 3637m3/day from the sandstone bedrock aquifers. Therefore, it is likely that the licensed groundwater abstractions control existing groundwater levels and localised groundwater flood risk. Therefore, should the abstractions cease, or partially cease, groundwater levels could rebound, increasing groundwater flood risk.

4.8.3 Area-Specific Guidance

4.8.3.1 Flood Risk Management

Given the level of flood risk in Area 7, the most likely suitable site Flood Risk Management approaches are as follows:

- Conduct T98 Inspection along the River Mersey to identify the condition of culverted sections. If required, specific mitigation may include culvert lining or replacement of culverted sections.
- Managing surface water run-off and overland flow paths in areas along Great Underbank and within the Mersey Shopping Centre. Site specific mitigation required to manage the risk would include SuDS.
- Groundwater collection mitigation

Strategic Flood Risk Management approaches that may support development in Area 7 include;

- Increasing capacity of storm sewer networks in areas detailed in Section 4.8.2.3.

For more information on strategic Flood Risk Management, refer to Section 5.

4.8.3.2 Site-specific Flood Risk Assessment

Given the level of risk in Area 7, any site-specific FRA should consider the following issues:

- Assess the condition and viability of culvert lining or replacement of culverted sections along the River Mersey.
- Site specific modelling of surface water run-off along areas of Great Underbank and within the Mersey Shopping Centre.
- Risk associated with allowances for the predicted future impacts of climate change on rainfall intensity
- In areas detailed in Section 4.8.2.3. consultation with the utility provider would be beneficial as to whether any improvements can be made to the sewer network to reduce risk of flooding to this area and adjacent areas.
- Residual risk associated with the blockage or exceedance of the culvert beneath Mersey Shopping Centre and the sewer and drainage system in Area 7.
- Groundwater flood risk assessment based on ground investigation and where appropriate and available long term groundwater level information

For more information on site specific flood risk assessment, refer to Section 5.

4.9 Area 8

4.9.1 Description

Area 8 is located in the eastern reaches of the Town Centre boundary (Figure 4-9). The River Goyt generally flows easterly through the area and bounds the west perimeter before reaching the confluence that joins to the River Mersey. Additionally, the area is bounded by the M60 to the north, with commercial properties encroaching on the area's border to the east, and residential properties to the south. High ground encompasses the southern reaches of Area 8 which is bounded by residential properties along Chancel Mews, Deacons Close and Rectory Fields. The ground levels generally fall to spaces within the floodplain associated with the River. The northern reaches are relatively flat and form the lowest parts of Area 8.

The area predominantly comprises of commercial properties, with key areas such as the Peel Centre, Vernon Industrial Estate and Richard Street Industrial Estate with large areas allocated to car parking. Main roads include St Mary's Way to the east, New Bridge Lane to the south and Great Portwood Street to the north.

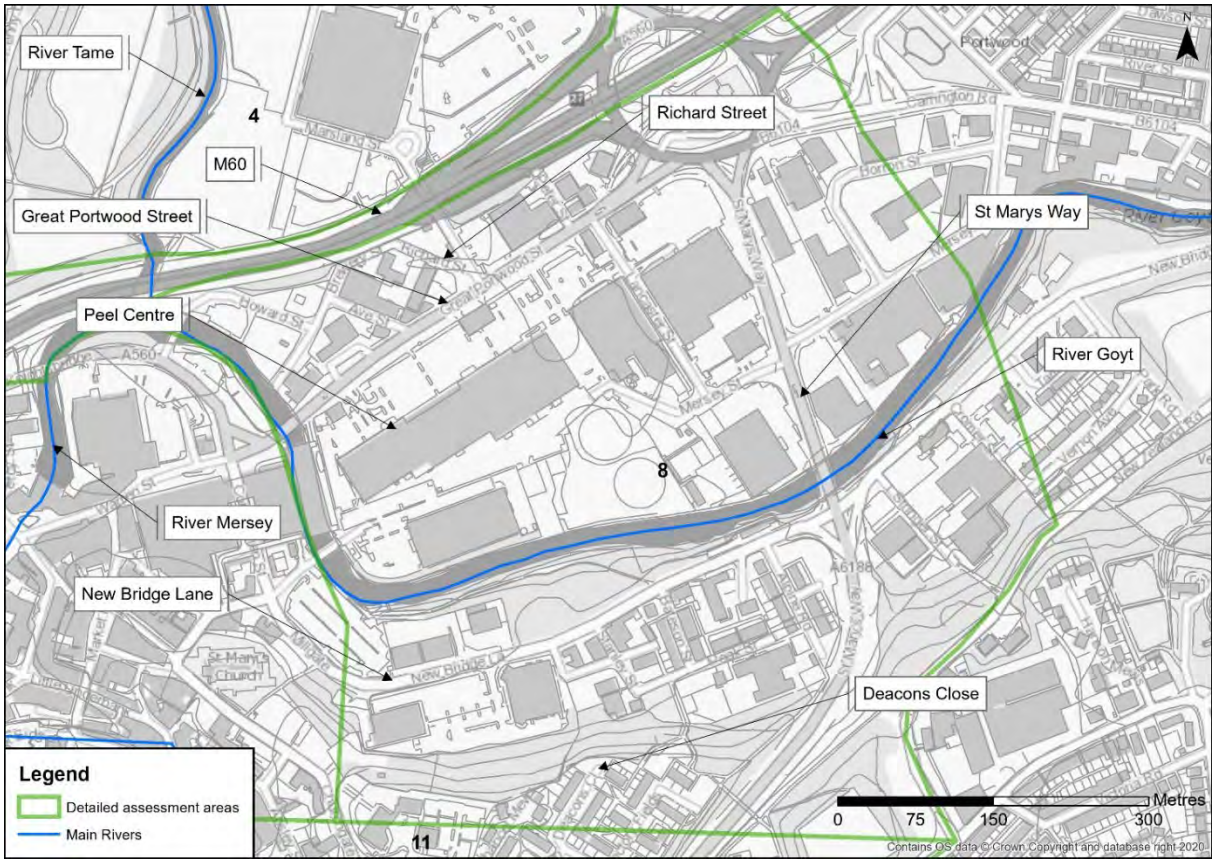

Figure 4-9: Area 8 assessment areas

Based on the findings of the assessment in Section 3, this section focuses on notable sources of flooding within Area 8 as shown in Table 4-8. Flood Risk Hazard Maps for Area 8 are shown in Appendix Appendix C.

Table 4-8: Summary of Area 8 significant flood sources

Area	Fluvial	Surface Wate	Sewers	Groundwater	Canals	Reservoirs
8	✓	✓	✓	×	×	×

4.9.2 Flood Risk Assessment

4.9.2.1 Fluvial

Predictive modelling shows that Area 8 is predominantly at low risk of fluvial flooding . However, areas within Flood Zone 2 (between a 1% and 0.1% AEP event) are summarised below:

- During the 0.1% AEP event, initial overtopping occurs due to a low point (42.42 mAOD) along the River Goyt's right bank downstream of the A6188 bridge. The extent of floodwaters impact properties predominantly along Lancaster Street, Millgate, St Marys Way, and Great Portwood Street with depths reaching up to 3.5m and velocities reaching up to 1.5m/s. Other key areas flooded during the event include the Peel Centre and Richard Street Industrial Estate. Overall, the flood hazard is a "Danger to most people" during this extreme event which includes the general public.
- Upstream of the A6188 bridge, overtopping starts to occur along the left bank of the River Goyt during the 0.1% AEP event. Water is shown to spill onto New Bridge Lane and Stringer Street which floods adjacent commercial properties and car parks. Overall, flooding during this event is considered to be a "danger to some people" with depths reaching up to 2m and maximum velocities of 0.3m/s.

During the 1% + 35% climate change AEP event, Overtopping occurs along the River Goyt's right bank downstream of the A6188 bridge. The extent of floodwaters impact properties located along Millgate with depths up to 2m and velocities up to 0.3m/s. The 1% + 35% climate change AEP event extents travel further north, impacting properties within areas such as the Peel Centre and Richard Street Industrial Estate. Velocities during this event increase with a maximum of 1.6m/s. Maximum depths reach up to 3m. Overall, the flood hazard is a "Danger to most people".

4.9.2.2 Surface water

Area 8 is predominantly at low risk of surface water flooding. However, there are locations impacted by moderate risk (1% AEP event) to high risk (3.3% AEP event) events. These are summarised below:

- Surface water ponding during the 3.3% AEP event is shown to impact commercial properties adjacent to Lancaster Street (Peel Centre) with depths reaching up to 600mm and velocities up to 0.25m/s. During the 1% AEP event, increases in water levels lead to larger areas of ponding. Although water covers a larger area in this extreme event, depths remain at a maximum of 600mm.
- During the 3.3% AEP event, surface water flow paths are identified confined along roads such as New Bridge Lane, Lancaster Street, St Marys Way, and Mersey Street. Depths along mentioned roads during the event reach up to 300mm with velocities up to 0.25m/s. Extents of flow paths extend further along the roads during the 1% AEP event due to increased water levels. The rise in water levels generate increase in depths up to 600mm. Velocities during this extreme event reach up to 1m/s along New Bridge Lane and St Marys Way.

4.9.2.3 Sewers

The predictive sewer modelling shows that Area 8 is predominantly at low risk of sewer flooding. However, locations summarised below are at risk from sewer flooding during a 2% AEP event. Although predictive sewer modelling shows risk from sewer flooding with this area, no historical flooding incidents have been recorded.

During the 2% AEP event, sewer flooding is identified along Borron Street and Mersey Street. Two extents are visibly located in areas adjacent to Portwood Roundabout, covering a small area of Brunswick Wesleyan Chapel Graveyard.

4.9.2.4 Groundwater

Groundwater flooding susceptibility mapping indicates that this area is at negligible risk from groundwater flooding. Additionally, the geology of the area is likely to allow downwards flow of groundwater into the bedrock aquifers. Therefore, the likelihood of groundwater flood risk in this area is assessed to be low.

However, it should be noted that within the southwest of the area is an SPZ 2 (Outer Protection Zone) and an SPZ 3 (Total Catchment). These are associated with two licensed groundwater abstractions located at Robinson's Unicorn Brewery which have a maximum daily abstraction rate of 3637m3/day from the sandstone bedrock aquifers. Therefore, it is likely that the licensed groundwater abstractions control existing groundwater levels and localised groundwater flood risk. Therefore, should the abstractions cease , or partially cease, groundwater levels could rebound, increasing groundwater flood risk.

4.9.3 Area-Specific Guidance

4.9.3.1 Flood Risk Management

Given the level of flood risk in Area 8, the most likely suitable site Flood Risk Management approachesare as follows:

- Managing surface water run-off and overland flow paths in areas at areas specified in Section 4.9.2.2. Site specific mitigation required to manage the risk would include SuDS.

Strategic Flood Risk Management approaches that may support development in Area 8 include;

- Increasing capacity of storm sewer networks in areas along Borron Street, Mersey Street, and Portwood Roundabout.
- Possible upstream storage along the Goyt within the green area bounded by New Bridge Lane to the north, New Zealand Road to the east and south, and W Park Road to the west. The potential storage area could be used as a strategic option to reduce water levels downstream and within other areas (Areas 5, 6, 7 and 8). It is likely that any water stored could discharge back into the Goyt once flooding has subsided.

For more information on strategic Flood Risk Management, refer to Section 5.

4.9.3.2 Site-specific Flood Risk Assessment

Given the level of risk in Area 8, any site-specific FRA should consider the following issues:

- Site specific modelling of surface water run-off along areas specified in Section 4.9.2.2.
- Risk associated with allowances for the predicted future impacts of climate change on rainfall intensity.
- Residual risk associated with the blockage or exceedance of the sewer and drainage system.
- In areas along Borron Street, Mersey Street and Portwood Roundabout consultation with the utility provider would be beneficial as to whether any improvements can be made to the sewer network to reduce risk of flooding to this area and adjacent areas.

For more information on site specific flood risk assessment, refer to Section 5.

4.10 Area 9

4.10.1 Description

Area 9 (shown in Figure 4-10) lies in the south western extent of the Town Centre boundary which comprises of residential and commercial buildings and various areas of allocated car parking. It is bounded by Wood Street in the north, Hardman Street and Aberdeen Crescent to the west, and Chatham Street to the south. The eastern boundary is partly bounded by the B6184, with the upper eastern boundary bordering commercial properties adjacent to Bann Street. Southern locations of the area consist of high ground with ground levels generally falling to the north. The area is located approximately 200m south of the River Mersey.

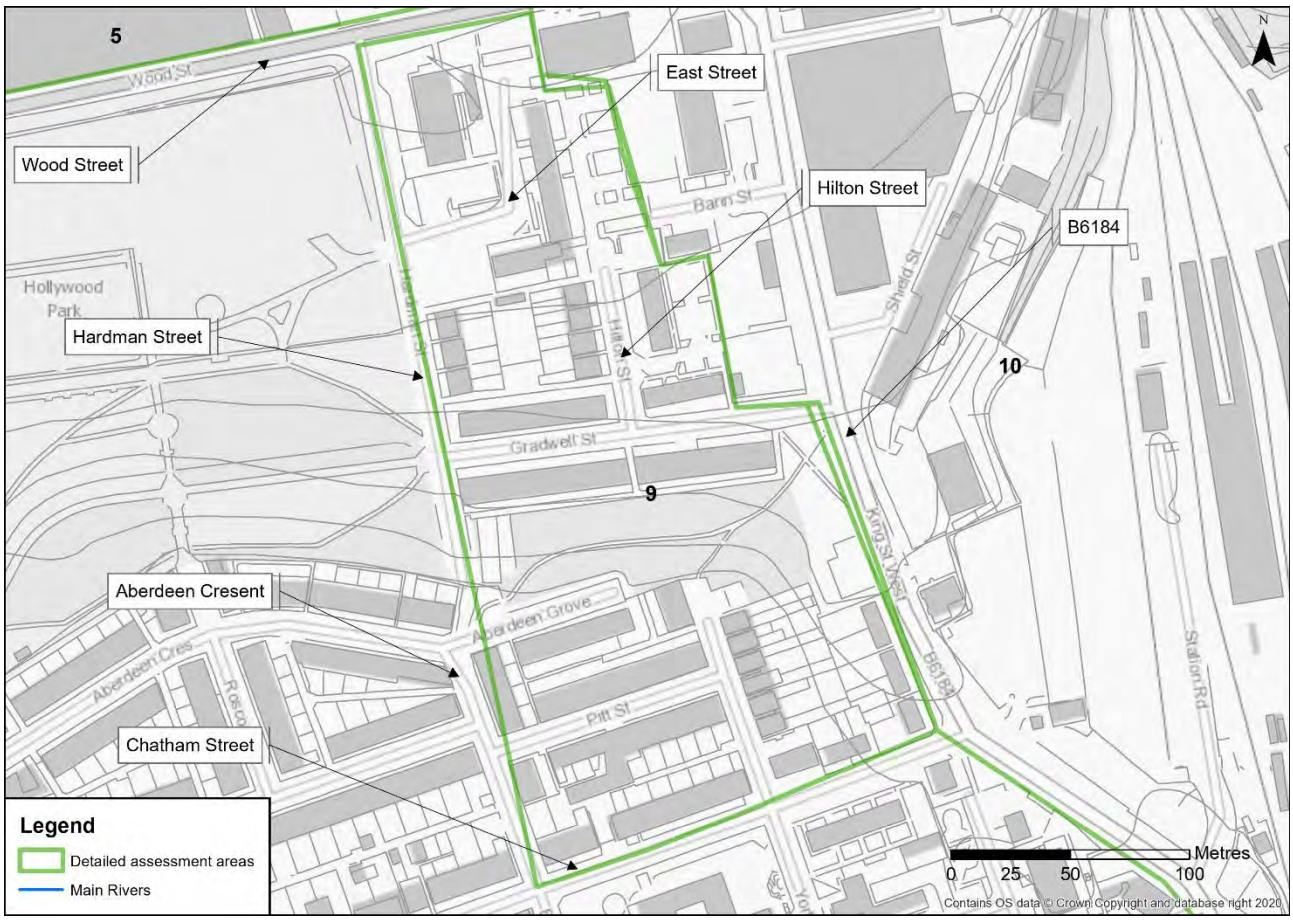

Figure 4-10: Area 9 assessment areas

Based on the findings of the assessment in Section 3, this section focuses on notable sources of flooding within Area 9 as shown in Table 4-9. Flood Risk Hazard Maps for Area 9 are shown in Appendix Appendix C.

Table 4-9: Summary of Area 9 significant flood sources

Area	Fluvial	Surface Wat	Sewers	Groundwater	Canals	Reservoirs
9	×	✓	×	×	×	×

4.10.2 Flood Risk Assessment

4.10.2.1 Surface Water

The Risk of Flooding from Surface Water map shows that Area 9 is predominantly at low risk of surface water flooding. However, there is a moderate risk (1% AEP event) to high risk (3.3% AEP event) within the northern

extents of the area. During the 3.3% AEP event, surface water ponding occurs at the dead end of East Street, with maximum flood depths of 600mm and maximum velocities of 0.25m/s. During the 1% AEP event, extents of ponding along East Street increase due to rising water levels.New areas of ponding start to format the dead end of Hilton Street. As a result, garages adjacent to East Street and Hilton Street could flood during the 1% AEP event.

4.10.3 Area-Specific Guidance

4.10.3.1 Flood Risk Management

Given the level of flood risk in Area 9, the most likely suitable site Flood Risk Management approaches are as follows:

- Managing surface water run-off and overland flow paths in areas along East Street. Site specific mitigation required to manage the risk would include SuDS.

For more information on strategic Flood Risk Management, refer to Section 5.

4.10.3.2 Site-specific Flood Risk Assessment

Given the level of risk in Area 9, any site-specific FRA should consider the following issues:

- Site specific modelling of surface water run-off along areas of East Street.
- Risk associated with allowances for the predicted future impacts of climate change on rainfall intensity.

For more information on site specific flood risk assessment, refer to Section 5.

4.11 Area 10

4.11.1 Description

Area 10 (shown in Figure 4-11) lies approximately 220m south of the River Mersey. Southern locations of the area consist of high ground with ground levels generally falling to the north. The Area is bounded by the A6 to the east and Longshut Lane West to the south, and the B6184 to th e west. The Manchester London Road to Cheadle Hulme railway line runs through the area directly east of the B6184. The area predominantly comprises of commercial properties with various areas allocated for car parking.

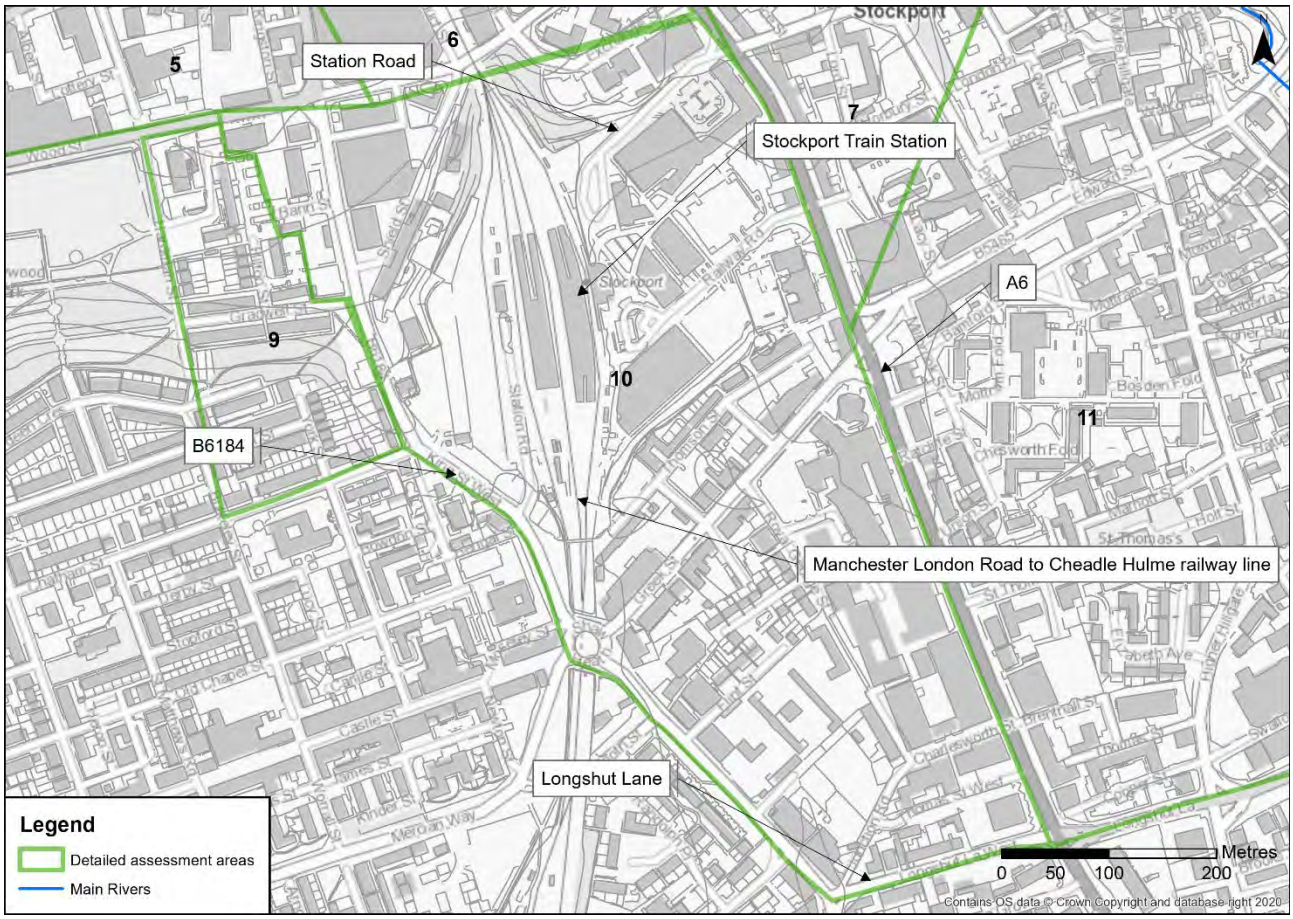

Figure 4-11: Area 10 assessment areas

Based on the findings of the assessment in Section 3, this section focuses on notable sources of flooding within Area 10 as shown in Table 4-10. Flood Risk Hazard Maps for Area 10 are shown in Appendix Appendix C.

Table 4-10: Summary of Area 10 significant flood sources

Area	Fluvial	Surface Water	Sewers	Groundwater	Canals	Reservoirs
10	×	×	✓	×	×	×

4.11.2 Flood Risk Assessment

4.11.2.1 Sewers

The United Utilities sewer surcharge flood modelling shows that Area 5 is predominantly at low risk of sewer flooding. However, there is a risk of sewer flooding at various locations between a 2% AEP event to 10% AEP event. Although predictive sewer modelling shows risk from sewer flooding with this area, no historical flooding incidents have been recorded. The area at risk of sewer flooding is summarised below

- During the 10% AEP event, sewer flooding is identified along Station Road. The extent of water increases during the 2% AEP event as flooding with more notable floods impacting commercial properties adjacent to Station Road and Exchange Street.
- Sewer flooding is shown along the B6184 during the 2% AEP event. The sewer flood extents are shown to the Stockport train station and adjacent car parks. This could lead to disruption to transport as flooding can cause a short circuit and cut the power to the train if the track has a live conductor rail.

4.11.3 Area-Specific Guidance

4.11.3.1 Flood Risk Management

Given the level of flood risk in Area 10, Strategic Flood Risk Management approaches that may support development include;

- Increasing capacity of storm sewer networks in areas along Station Road and the B6184 which is associated with sewer flooding to Stockport train station.

For more information on strategic Flood Risk Management, refer to Section 5.

4.11.3.2 Site-specific Flood Risk Assessment

Given the level of risk in Area 10, any site-specific FRA should consider the following issues:

- In areas along Station Road and the B6184 consultation with the utility provider would be beneficial as to whether any improvements can be made to the sewer network to reduce risk of flooding to this area and adjacent areas.
- Residual risk associated with the blockage or exceedance of the sewer and drainage system.

For more information on site specific flood risk assessment, refer to Section 5.

4.12 Area 11

4.12.1 Description

Hempshaw Brook flows northerly through Area 11 (shown in Figure 4-12). The Brook drains the southern parts of the Town centre near Middle Hillgate. The area contains high ground that generally falls to spaces within the floodplain associated with the Brook. It is bounded by St Marys Way to the east, Hempshaw Lane to the south, and the A6 to the west. The majority of land comprises of commercial properties and car parks. Various areas include residential properties along roads such as Orchard Street, Banbury Street and Shawcross Street. Other key areas include the Pennine Industrial Estate, Hillgate Business Centre, Crown Royal Industrial Estate and Brookside Industrial Estate.

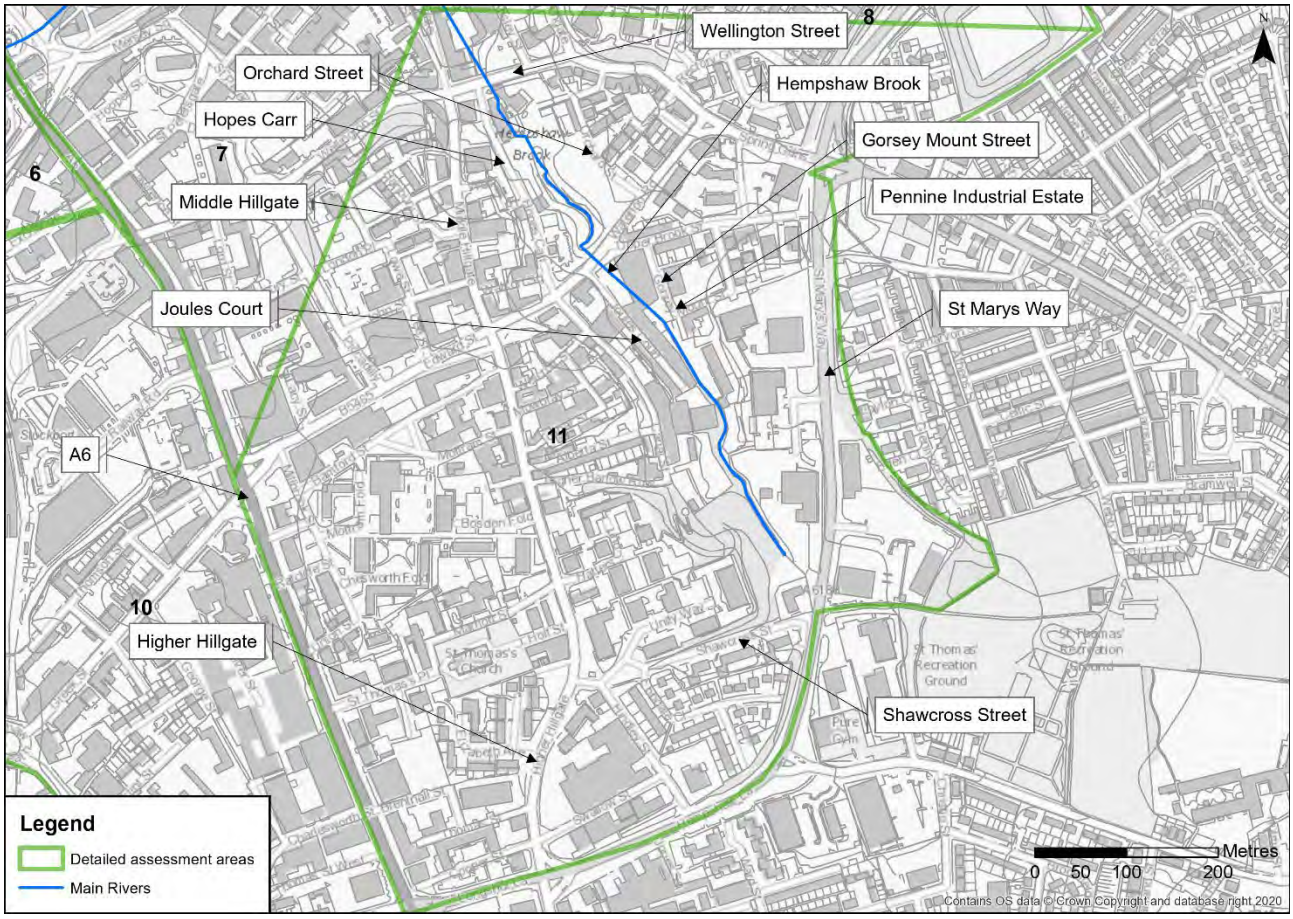

Figure 4-12: Area 11 assessment area

Based on the findings of the assessment in Section 3, this section focuses on notable sources of flooding within Area 11 as shown in Table 4-11. Flood Risk Hazard Maps for Area 11 are shown in Appendix Appendix C.

Table 4-11: Summary of Area 11 significant flood sources

Area	Fluvial	Surface Water	Sewers	Groundwater	Canals	Reservoirs
11	✓	✓	✓	✓	×	×

4.12.2 Flood Risk Assessment

4.12.2.1 Fluvial

The Hempshaw Brook hydraulic model shows that Area 11 is predominantly at low risk of fluvial flooding. However, areas within Flood Zone 2 (between a 1% and 0.1% AEP event) to Flood Zone 3 (1% AEP event or greater) are included below:

- During the 5% AEP event, blockage on the upstream culvert entrance is shown to backup water and spill out of bank. Water then starts to flood properties within Pennine Industrial Estate at depths up to 1.2m and velocities up to 1.5m/s. The extent of flooding increases during the 1% AEP event as floodwater spreads further to commercial properties along Joules Court. Flood extents in the 0.1% AEP event is shown to cause more severe consequences to the mentioned properties with depths up to 2m. The overall flood hazard suggests a "danger to most people".
- Blockages on the downstream culvert entrance causes water to backup and spill out of bank during the 5% AEP event. Extents of floodwaters are constricted by the field bounded by Hopes Carr to the west and Orchard Street to the east. Depths along the field reach up to 700mm with velocities up to 0.3m/s during the event. However, flood extents grow during the 0.1% AEP event due to additional out of bank flows that are shown to impact commercial properties adjacent to Wellington Street. Depth during this event reach up to 2m. Flood hazard suggests a "danger to most people" in the location.

During the 1% + 53% climate change AEP event, it is noted that both blockage scenarios generally mirror the 0.1% AEP event with similar depths and velocities. Flood hazard during the climate change event is suggested to be a "danger to most people" in the locations specified in present day scenarios.

4.12.2.2 Surface Water

Area 7 is predominantly at low risk of surface water flooding. However, areas of moderate risk (1% AEP event) to high risk (3.3% AEP event) have been identified and summarised below:

- During the 3.3% AEP event, several flow paths and areas of ponding are identified with a 100m proximity of Hempshaw Brook with depths reaching up to 600mm and velocities up to 0.5m/s. Commercial properties impacted during the event can be observed along Gorsey Mount Street, Upper Brook Street, Shawcross Street, Hopes Carr, and Wellington Street. During the 1% AEP event, surface water flood extents along Gorsey Mount Street, Upper Brook Street and Shawcross Street increase due to new flow paths exacerbating the risk. Flooding to properties adjacent to Hopes Carr and the A6 is increased due to additional water volume.

4.12.2.3 Sewers

The United Utilities sewer surcharge flood modelling shows that Area 5 is predominantly at low risk of sewer flooding. However, there is a risk of sewer flooding at various locations during a 2% AEP event which is summarised below:

- Sewer flooding is shown along Hempshaw Brook during the 2% AEP event. The identified flood extent extends approximately 100m west. Commercial properties and car parks are impacted along Hopes Carr, Wesley Street, Middle Hillgate and Waterloo Road.

4.12.2.4 Groundwater

Groundwater flooding susceptibility mapping indicates that this area is at negligible risk from groundwater flooding. Additionally, the geology of the area is likely to allow downwards flow of groundwater into the bedrock aquifers. Therefore, the likelihood of groundwater flood risk in this area is assessed to be low.

However, it should be noted that within this area is an SPZ 1 (Inner Protection Zone) with a radius of approximately 140m in all directions around the abstractions, encompassing the area between St Petersgate and Churchgate. An SPZ 2 (Outer Protection Zone) extending 250m from the abstractions in a broadly south-east direction, while a Total Catchment (SPZ 3) reaches beyond the south-east of the Town Centre boundary towards Marple. These are associated with two licensed groundwater abstractions located at Robinson's Unicorn Brewery which have a maximum daily abstraction rate of 3637m3/day from the sandstone bedrock aquifers. Therefore, it is likely that the licensed groundwater abstractions control existing groundwater levels and localised groundwater flood risk. Therefore, should the abstractions cease, or partially cease, groundwater levels could rebound, increasing groundwater flood risk.

4.12.3 Area-Specific Guidance

4.12.3.1 Flood Risk Management

Given the level of flood risk in Area 11, the most likely suitable site Flood Risk Management approaches are as follows:

- Managing surface water run-off and overland flow paths in areas specified in Section 4.12.2.2. Site specific mitigation required to manage the risk would include SuDS
- Conduct T98 Inspection along Hempshaw Brook to identify the condition of culverted sections. If required, specific mitigation may include culvert lining or replacement of culverted sections.
- Groundwater collection mitigation

Strategic Flood Risk Management approaches that may support development in Area 11 include;

- Increasing capacity of storm sewer networks in areas of Hopes Carr, Wesley Street, Middle Hillgate and Waterloo Road. This will require hydraulic modelling of proposed sewer networks and consultation with the utility provider as to whether any improvements can be made to the sewer network to reduce risk of flooding to this area and adjacent areas.

For more information on strategic Flood Risk Management, refer to Section 5.

4.12.3.2 Site-specific Flood Risk Assessment

Given the level of risk in Area 11, any site-specific FRA should consider the following issues:

- Risk associated with allowances for the predicted future impacts of climate change on rainfall intensity.
- Site specific modelling of surface water run-off along areas specified in Section 4.12.2.2.
- In areas along Hopes Carr, Wesley Street, Middle Hillgate and Waterloo Road consultation with the utility provider would be beneficial as to whether any improvements can be made to the sewer network to reduce risk of flooding to this area and adjacent areas.
- Residual risk associated with the blockage or exceedance of the sewer and drainage system.
- Assess the condition and viability of culvert lining or replacement of culverted sections along Hempshaw Brook
- Groundwater flood risk assessment based on ground investigation and where appropriate and available long term groundwater level information.

For more information on site specific flood risk assessment, refer to Section 5.

4.13 Area Flood Risk Summary

As a result of the detailed assessment provided above,Table 4-12 includes the level of risk that is posed against each area.

Table 4-12: Level of flood risk against each Detailed Area Assessment

Area	Fluvial	Surface Wate	Sewers	Groundwater	Canals	Reservoirs
1	Low	High	High	Low	Low	Low
2	Low	High	High	Low	Low	Low
3	Moderate	High	Low	Moderate	Low	Low
4	High	High	High	Moderate	Low	Low
5	High	High	High	Moderate	Low	Low
6	High	High	High	Low	Low	Low
7	High	High	High	Moderate	Low	Low
8	High	High	High	Low	Low	Low
9	Low	High	Low	Low	Low	Low
10	Low	Low	High	Low	Low	Low
11	High	High	High	Low	Low	Low

5 Flood Risk Management

5.1 Introduction

Flood Risk Management guided by this Level 2 SFRA includes approaches to Development Policy (Section 5.2), identifying Strategic Flood Risk Management measures (Section 5.3) and guidance on Site Specific Flood Risk Assessment (Section 5.4).

The principles of Flood Risk Management and related policies for SMBC are outlined in Section 7 of the Town Centre Level 2 SFRA (2010) and considered in Section 5 of the Flood Risk Management Strategy (2016). Where appropriate, the sections of this SFRA supersede the requirements of the 2010 SFRA.

5.2 Development Policy

Development policies should aim to provide flood risk management and make development safe without increasing flood risk elsewhere and, where possible, reducing flood risk overall.

5.2.1 Flood risk avoidance

It is recommended that any new development or redevelopment is moved away from areas of high flood risk through application of the Sequential Test..

In particular within Detailed Area Assessment 4 and 5 in Section 4 there would be significant cost required to meet the Exception test where development may be in areas at risk of flooding in Zone 3a and 3b. Development should be preferred outside of these areas. Detailed evidence is required to provided from a developer to prove the Sequential Test is met. Other areas of high flood risk are identified in Section 4.

5.2.2 The impact of climate change

This SFRA has provided updated assessment in Chapter 4 and Appendices B to F) on the negative impact of climate change on flood risk in Stockton Town Centre. The impact of climate change should be considered when determining if development is located in an area of lower risk and also used to determine what flood risk measures should be applied.

5.2.3 Flood compensation and storage

For any new development or redevelopment (both major and minor) that by exception are located in Flood Zone 3 and are above existing ground levels mitigation shall be required for loss in floodplain storage volume. Flood storage compensation should be on a level for level and volume by volume basis. Any variation to this approach would be as a result of detailed technical discussions with either the Environment Agency or the LLFA.

For developments in Area 4 (River Tame), Area 5 (Upper Mersey) and Area 11 (Hempshaw Brook) it may not be possible to provide adequate level for level flood compensation within development sites due to site area constraints.

With reference to Section 7.4.4 of the 2010 SFRA and the CFMP options were identified that showed the benefit of upstream storage on the River Goyt (although land required for the mitigation is outside of Town Centre area and SMBC Boundaries).

5.2.4 Safeguarding of land

It is recommended that land at Reddish Vale Country Park and Woodbank park is safeguarded to allow for potential schemes to reduce the risk of fluvial flooding on the River Tame, River Goyt and Upper Mersey and land around Hope Street is safeguarded for management of surface water overland flows.

5.3 Strategic Flood Risk Management Measures

Within the Town Centre Area strategic measures for managing flood risk can be addressed by developers and Risk Management Authorities working in partnership. Some strategic flood risk measures may only be possible by working at a more localised site level over a number of development sites. Partnership working is also aligned with policies and plans from Risk Management Authorities that include the SMBC Green Infrastructure Enhancement Strategy, the Environment Agency's Catchment Flood Management Plan, United Utilities Drainage and Wastewater Management Plan and Greater Manchester Natural Capital Investment Plan.

Specific strategic flood risk management measures for the Town Centre Area are outlined in Sections 5.3.1 to Section 5.3.5. and potential funding mechanisms are identified in Section 5.3.6

5.3.1 On site flood risk compensation

For any new development or redevelopment (both major and minor) that by exception are located in Flood Zone 3, and that are built above the existing ground level, mitigation shall be required for loss in floodplain storage volume. Flood storage compensation should be on a level for level and volume by volume basis. Any variation to this approach would be as a result of detailed technical discussions with either the Environment Agency or the LLFA. In existing High flood risk areas and where appropriate development should look to reduce existing flood risk.

For developments in Area 4 (River Tame), Area 5 (Upper Mersey) and Area 11 (Hempshaw Brook) it may not be possible to provide adequate level for level flood compensation within development sites.

5.3.2 Off-site flood risk compensation

It is recommended that land at Reddish Vale Country Park and Woodbank park is safeguarded to allow for potential schemes to reduce the risk of fluvial flooding on the River Tame, River Goyt and Upper Mersey and land around Hope Street is safeguarded for management of surface water overland flows.

Further investigation including hydraulic modelling, detailed design and construction would be required.

With reference to Section 7.4.4 of the 2010 SFRA and the Catchment Flood Management Plan options were identified that showed the benefit of upstream storage on the River Goyt (although land required for the mitigation is outside of Town Centre area and SMBC Boundaries).

The Upper Mersey Catchment Flood Management Plan[xliv] looks at the strategic improvements that could/ will be taken along the Tame, Goyt and Mersey. All areas look to Identify the maintenance/ capital works associated with flood risk management assets that will be required over the next 100 years. Areas along the Tame plan to address the following:

- Put in place policies which seem to remove and relocate critical infrastructure from Flood Zones 3 to improve the area's ability to respond to and deal with flood incidents in the future.

Regarding the Mersey, the Environment Agency plan to address the following:

- Implementation of flood alleviation schemes on the Mersey where economically and environmentally feasible. This includes reducing flood risk in the Mersey catchment by use of strategic storage areas upstream and the implementation of SuDS and improvements to the urban sewerage and drainage network.
- Implement a programme of Asset Maintenance and Repair in line with the Mersey Maintenance Strategy.
- Implement new flood warning areas in Stockport.

The CRMP do not propose any relevant interventions on the River Goyt.

5.3.3 Linear defences

This assessment has highlighted that the linear defences through the Town Centre Area are in private ownership and consist of high ground. No strategic approach to increasing the defended area of land by raising linear defences has been assessed.

Any proposals to provide an increased Standard of Protection to linear defences in areas with existing Flood Zone 3 would require a detailed FRA noted in Section 5.4.

Any strategic programme to improve the Standard of Protection of Town Centre areas is likely to include multiple development sites.

5.3.4 Surface Water Management

Within Section 4 of this report guidance on surface water management has been provided for Detailed Assessment Areas. There is the potential to combine surface water management with Green Infrastructure.

SMBC have undertaken an urban Green Infrastructure Enhancement Strategy (2015). This has identified that the Town Centre is underperforming in terms of meeting green infrastructure needs.

SMBC have also undertaken an assessment of parks and green spaces that may be suitable for mitigation within the Town Centre area. No specific areas were identified within the Town Centre boundary. However, just crossing the eastern boundary of the Town Centre Area Penny Lane Meadows offers an opportunity for the collection of surface water combined with potential for compensatory storage areas.

With regards to management of surface water and groundwater the Green Infrastructure Enhancement Strategy suggests collaborative work with United Utilities to implement pilot schemes to prove proof of concept. These could be in the form of co-delivering SuDS in Areas 1 and 2, where sewer and surface water flooding have been identified and could be in the form of multiple local mitigation measures such as SuDS. No specific areas have been identified for multiple location SuDS.

The local authority should work with the Mayoral Development Corporation, United Utilities, the Environment Agency, and other developers to consider the possibility for strategic SuDS to serve development sites in Detailed Assessment Areas 5-11.

The Greater Manchester Natural Capital Investment Plan describes sustainable drainage and habitat creation as being strategic measure that could incorporate flood risk management and are currently most investible with the best returns.

United Utilities DWMP identifies that there are requirements in Stockport where significant investment of additional storm storage is required. This is to meet legal obligations identified within the WFD 2017[xlv]. If sustainable drainage is implemented, this could relieve pressures on the wider system.

The DWMP mentions that if United Utilities were to invest in Stockport over the next 25 years, around 29% of the investment could be to address flooding issues. Potential investment could include the following:

- Surface water source control measures such as SuDS. These form a key part of the strategy to manage rainwater from entering the sewer system in Stockport, and
- Repair and rehabilitation programmes to replace or update the existing intelligent network monitoring system.

5.3.5 Groundwater management

Within Section 4 Detailed Area Assessments have identified groundwater flood risk mitigation for Detailed Assessment Areas 3-8 and Area 11.

The proposed strategic options for managing groundwater flood risk including locating new development away from known areas of groundwater flooding (in Areas 5 and Area 7 in particular).

Should the existing groundwater abstraction within Detailed Assessment Area 11 be stopped, consideration of longer-term flood risk management , including a suitable pumping strategy may be required for existing and proposed development.

5.3.6 Partnership funding mechanisms

There is a wide range of available funding to part support strategic measures for flood risk mitigation. These include;

- Developer agreements (S106 agreements and CIL) agreed with developers to provide appropriate flood risk mitigation.
- Partnership Funding (GiA) is recommended as a process by which the LLFA, Utilities Companies, Environment Agency and developers can work together to provide strategic flood risk mechanisms. It is recommended that early consultation is undertaken with the LPA to explore the possibility of developing a funding bid.
- The Greater Manchester Natural Capital Investment Plan, and
- Other funding opportunities for the delivery of Green Infrastructure are identified in Section 8 of the Stockport Town Centre Urban Green Infrastructure Enhancement Project.

5.4 Standard Site-Specific Guidance

This level 2 SFRA does not assess any specific allocated or future development site. However, based the Detailed Assessment Areas that have high flood risk outlined in Section 4 there are some potential flood risk measures and requirements of site-specific FRAs that can be identified. Table 5-2 and Table 5-3 provides a summary of the approaches to flood risk management at sites at risk within each Detailed Assessment Area and guidance as to specific inputs that may be required for site-specific Flood Risk Assessments within each Detailed Assessment Area.

Standard flood risk management measures and standard details required for site-specific FRAs are outlined below.

Flood Risk Hazard Maps are included within Appendix Appendix C and should be considered when undertaking Flood Risk Assessment.

5.4.1 Flood risk management measures

Standard flood risk management measures for extensions, basement development and other types of development are summarised in Table 5-1.

5.4.2 site-specific Flood Risk Assessments

All site-specific Flood Risk Assessments should include:

- Flood Risk Assessment as required by government guidance,
- Consideration of all sources of flood risk,
- Consideration of historic flood risk,
- Consideration of sustainable drainage techniques (CIRIA c697);
- Mitigation of flood risk to include interception as defined in the code of practice for surface water management BS8582:2013 and CIRIA C697 to ensure that water is either reused or retained on site, and,

- Consideration of climate change, and
- Consultations with the LLFA.

Table 5-1: Standard approaches to Flood Risk Measures

	Zone 3	Zone 2	Zone 1	Surface Water and Sewer flooding	Groundwater
Extensions, Outbuildings, Permitted Development & Property Subdivision (see Environment Agency guidance on permitted development)	There should be a presumption against building extensions (including out buildings)	Building extensions (including out buildings) should be discouraged to avoid raising flood levels elsewhere.	No restrictions	Building extensions and outbuildings should not obstruct overland flow paths and should be designed carefully to avoid raising the potential risk of flooding to adjoining properties.	Consideration should be given to the impact of foundations on groundwater and the potential for emergence of groundwater.
Flood Resilience & Resistance, including Floor Levels and Below Ground Services	Generally, floor levels must be a minimum of 300mm above the 1% (1 in 100) annual chance event river flood level, including climate change, but varies according to Flood Zone and nature of development - see Environment Agency (fluvial flood risk from Main Rivers)	Generally, floor levels must be a minimum of 300mm above the 1% (1 in 100) annual chance event river flood level, including climate change, but varies according to Flood Zone and nature of development - see Environment Agency (fluvial flood risk from Main Rivers)	n/a	Generally, floor levels must be a minimum of 300mm above the 1% (1 in 100) annual chance event flood level, including climate change,	Groundwater collection should be applied as required. Maximum groundwater levels should be considered when determining the finished floor levels of a development. The design of below ground services should consider maximum groundwater levels within the site to minimise risk of groundwater infiltration into the sewer network and/or pollution of groundwater.
Site Access & Escape, including Flood Evacuation	A Flood Evacuation Plan must be in place, suitable to the type of development, where there is no safe dry access to/from the site (i.e. access through Zone 1) for 1% AEP event plus climate change allowance.		n/a	A Flood Evacuation Plan must be in place, suitable to the type of development, where there is no safe dry access to/from the site (i.e. access through Zone 1) for 1% AEP event plus climate change allowance.	For redevelopment of existing developments unimpeded access/egress should be provided.
Basements	Not permitted for new development	Design out where possible. Basements required to have unimpeded access.	Basements allowed.	Not permitted for new development in areas of high flood.risk	No basements in areas of high flood risk
Areas of hardstanding >5m2	Minimum 8m buffer zone must be provided to ‘top of bank’ within sites immediately adjoining a Main River (and culverted waterways and culverted waterway corridors). Any structures within 8m of ‘top of bank’ will require Environment Agency consent. Reference should be made to Environment Agency’s “Living on the Edge” guide (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/454562/LIT_7114.pdf) that discusses development situated in, over, under or adjacent to rivers and/or streams and the responsibilities of the riparian landowner.				
Buffer Zones and Environment Agency Consent	Minimum 8m buffer zone must be provided to ‘top of bank’ within sites immediately adjoining a Main River (and culverted waterways and culverted waterway corridors). Any structures within 8m of ‘top of bank’ will require Environment Agency consent. Reference should be made to Environment Agency’s “Living on the Edge” guide (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/454562/LIT_7114.pdf) that discusses development situated in, over, under or adjacent to rivers and/or streams and the responsibilities of the riparian				
Other	As an integral part of the government’s “Making Space for Water” agenda, the Environment Agency is actively seeking the de-culverting of culverted watercourses as part of any future development. Realistic opportunities to reinstate the natural open river/stream within existing culverted reaches of the river(s) should be promoted.				

Table 5-2: Flood Risk Management Measures for high flood risk areas

	Zone 3	Zone 2	Zone 1	Surface Water Flooding	Groundwater	Sewer flooding (5% AEP)
Area 1	N/A	N/A	Consider use management techniques to reduce flood where possible. (i.e. SuDS)	Increased on site storage o safe flood conveyance to convey water through the s	N/A	Provide on-site measures to improve or increase local sewe capacity where appropriate and possible
Area 2	N/A	N/A	Consider use management techniques to reduce flood where possible. (i.e. SuDS)	Increased on site storage o safe flood conveyance to convey water through the s	N/A	Provide on-site measures to improve or increase local sewe capacity where appropriate and possible
Area 3	X	Where development is appropriat consideration of compensatory fl plain	Consider use management techniques to reduce flood where possible. (i.e. SuDS)	Increased on site storage o safe flood conveyance to convey water through the s	Design to consider inclusio groundwater management measures	N/A
Area 4	Where development is appropriate consideration of compensatory flo plain Consider improving Standard of Protection	Where development is appropriat consideration of compensatory fl plain	Consider use management techniques to reduce flood where possible. (i.e. SuDS)	Increased on site storage o safe flood conveyance to convey water through the s	Design to consider inclusio groundwater management measures	Consider if it is possible to provide on-site measures to improve increase local sewer capacity where appropriate and pos
Area 5	Where development is appropriate consideration of compensatory flo plain Consider improving Standard of Protection	Where development is appropriat consideration of compensatory fl plain	Consider use management techniques to reduce flood where possible. (i.e. SuDS)	Increased on site storage o safe flood conveyance to convey water through the s	Design to include groundwa management measures	Consider if it is possible to provide on-site measures to improve increase local sewer capacity where appropriate and pos
Area 6	Where development is appropriate consideration of compensatory flo plain	Where development is appropriate consideration of compensatory fl plain	Consider use management techniques to reduce flood where possible. (i.e. SuDS)	Increased on site storage o safe flood conveyance to convey water through the s	Design to consider inclusio groundwater management measures	Consider if it is possible to provide on-site measures to improve increase local sewer capacity where appropriate and pos
Area 7	Where development is appropriate consideration of compensatory flo plain	Where development is appropriat consideration of compensatory fl plain	Consider use management techniques to reduce flood where possible. (i.e. SuDS)	Increased on site storage o safe flood conveyance to convey water through the s	Design to include groundwa management measures	Consider if it is possible to provide on-site measures to improve increase local sewer capacity where appropriate and pos
Area 8	Where development is appropriate consideration of compensatory flo plain Consider improving Standard of Protection	Where development is appropriat consideration of compensatory fl plain	Consider use management techniques to reduce flood where possible. (i.e. SuDS)	Increased on site storage o safe flood conveyance to convey water through the s	Design to consider inclusio groundwater management measures	N/A
Area 9	N/A	N/A	Consider use management techniques to reduce flood where possible. (i.e. SuDS)	N/A	N/A	N/A
Area 10	N/A	N/A	Consider use management techniques to reduce flood where possible. (i.e. SuDS)	N/A	N/A	Provide on-site measures to improve or increase local sewe capacity where appropriate and possible
Area 11	Where development is appropriate consideration of compensatory flo plain Improvement to Hempshaw Brook Culvert Screen operation	Where development is appropriat consideration of compensatory fl plain	Consider use management techniques to reduce flood where possible. (i.e. SuDS)	Increased on site storage o safe flood conveyance to convey water through the s	Design to include groundwa management measures	Consider if it is possible to provide on-site measures to improve increase local sewer capacity where appropriate and pos

**No specific high flood risk areas were identified for canals and reservoirs.*

Table 5-3: Additional inputs to Site-Specific Flood Risk Assessments for high flood risk areas

	Zone 3	Zone 2	Zone 1	Surface Water Flooding	Groundwater	Sewer flooding	Defences adjacent to main river
Area 1	N/A	N/A	See standard flood risk measures (Section 5.3)	Hydraulic modelling to include surface flow modelling as appropriate	N/A	Hydraulic modelling to include surface flow modelling as appropriate Discuss improvements with United Utilities	N/A
Area 2	N/A	N/A	See standard flood risk measures (Section 5.3)	Hydraulic modelling to included surface flow modelling as appropriate	N/A	Hydraulic modelling to include surface flow modelling as appropriate Discuss improvements with United Utilities	N/A
Area 3	N/A	May require Fluvial hydraulic modelling	See standard flood risk measures (Section 5.3)	Hydraulic modelling to include surface flow modelling as appropriate	Provide groundwater monitoring in high risk areas	N/A	N/A
Area 4	Fluvial hydraulic modelling	May require Fluvial hydraulic modelling	See standard flood risk measures (Section 5.3)	Hydraulic modelling to include surface flow modelling as appropriate	Provide groundwater monitoring in high risk areas	Hydraulic modelling to include surface flow modelling as appropriate Discuss improvements with United Utilities	Undertake T98 assessments
Area 5	Fluvial hydraulic modelling	May require Fluvial hydraulic modelling	See standard flood risk measures (Section 5.3)	Hydraulic modelling to include surface flow modelling as appropriate	Provide groundwater monitoring in high risk areas	Hydraulic modelling to include surface flow modelling as appropriate Discuss improvements with United Utilities	Undertake T98 assessments
Area 6	Fluvial hydraulic modelling	May require Fluvial hydraulic modelling	See standard flood risk measures (Section 5.3)	Hydraulic modelling to include surface flow modelling as appropriate	Provide groundwater monitoring in high risk areas	Hydraulic modelling to include surface flow modelling as appropriate Discuss improvements with United Utilities	Undertake T98 assessments
Area 7	Fluvial hydraulic modelling	May require Fluvial hydraulic modelling	See standard flood risk measures (Section 5.3)	Hydraulic modelling to include surface flow modelling as appropriate	Provide groundwater monitoring in high risk areas	Hydraulic modelling to include surface flow modelling as appropriate Discuss improvements with United Utilities	Undertake T98 assessments
Area 8	Fluvial hydraulic modelling	May require Fluvial hydraulic modelling	See standard flood risk measures (Section 5.3)	Hydraulic modelling to include surface flow modelling as appropriate	Provide groundwater monitoring in high risk areas	N/A	Undertake T98 assessments
Area 9	N/A	N/A	See standard flood risk measures (Section 5.3)	N/A	N/A	N/A	N/A
Area 10	N/A	N/A	See standard flood risk measures (Section 5.3)	N/A	N/A	Hydraulic modelling to include surface flow modelling as appropriate	N/A

						Discuss improvements with United Utilities	
Area 11	Fluvial hydraulic modelling	May require Fluvial hydraulic modelling	See standard flood risk measures (Section 5.3)	Hydraulic modelling to include surface flow modelling as appropriate	Provide groundwater monitoring in high risk areas	Hydraulic modelling to include surface flow modelling as appropriate Discuss improvements with United Utilities	Undertake T98 assessments

**Although no specific high flood risk areas were identified for canals, reservoirs, and other sources of flood risk all sources of flood risk should be considered in Flood Risk Assessments.*

6 Summary and Recommendations

6.1 Summary

In conclusion, this SFRA provides a detailed understanding of strategic flood risk frequencies and likely mechanisms for all identified Moderate to High risk sources of flooding identified in Detailed Assessment Areas within Stockport Town Centre. This assessment supports application of the Sequential and Exception Test to developments at High risk of flooding. New mechanisms of High flood risk have been identified in the Town Centre Area including surface water flooding and sewer flooding. Much of the Town Centre area is at risk of flooding by reservoir although this is considered Low. A new interactive flood map has been provided to summarise assessment of flood risk and this is supported by new flood risk hazard and flood depth mapping. Groundwater flood risk assessment supported by new Conceptual Site Models supports and directs future assessment of groundwater flood risk which at present is considered low to moderate. An approach to partnership working, strategic and site flood risk measures and site flood risk assessment has identified potential future projects for strategic flood storage and opportunities for improving management of surface water flood risk and sewer flooding.

The key flood risk issues within the Town Centre boundary shown in Section 4 are summarised below.

Fluvial Flood Risk

The Town Centre is predominantly at low risk of fluvial flooding. However, there are isolated areas of high flood risk (1% AEP event or greater) identified within Areas 4 and 5 that is driven by overtopping at low points along the Tame and Mersey. The extent of floodwaters impact properties within the Meadow Industrial Estate in Area 4, and properties along Ford Street in Area 5. The blockage scenarios along Hempshaw Brook show isolated areas of high flood risk within Area 11 during the 1% AEP event as floodwater spreads to commercial properties along Joules Court.

Areas 6, 7 and 8 are at high risk of fluvial flooding directly due to the consideration of climate change. During the 1% + 70% climate change AEP event, overtopping occurs along the Mersey in Area's 6 and 7. Floodwaters during the event impact properties adjacent to Astley Street, Cotton Tree Street (Area 6), and areas of the Merseyway Shopping Centre and Great Underbank (Area 7). At Area 8, notable flooding during the 1% + 35% climate change AEP event is identified due to overtopping along the Goyt, impacting properties located along Millgate, and areas of the Peel Centre and Richard Street Industrial Estate.

Based on the understanding that all assets were in "private" ownership and that defences were classified as "high ground", it was agreed that there would be minimum benefit in collecting new data to fill this data gap such as undertaking a full T98 assessment throughout the Town Centre Area. However, a site visit undertaken on October 25th, 2022, did identify that there are some locations where walls may form part of a flood defence in addition to private high ground. Any proposals to provide an improved Standard of Protection to linear defences in areas with existing Flood Zone 3 would require a detailed FRA. Any strategic programmes to improve the Standard of Protection of Town Centre areas is likely to include multiple development sites.

Surface Water Flood Risk

The Town Centre is predominantly at low risk of surface water flooding. However, there are areas of moderate risk (1% AEP event) to high risk (3.3% AEP event) identified in Areas 1 to 9 and 11 as a result of ponding due to topographical low points and flow paths over the ground surface. The most notable locations that are at high risk from surface water flooding include Meadow Industrial Estate (Area 4), Ford Street and Chestergate Street (Area 5), the bus stands adjacent to Swaine Street (Area 6), and properties adjacent to Great Underbank (Area 7).

Climate change predictive modelling for surface water has not been provided for this SFRA. Therefore, it is important to note that the Environment Agency's climate change allowances show that peak rainfall intensity

could potentially increase by 20 -30% over the next 100 years. Therefore, the mentioned flood events could have more severe consequences in the future. Within Section 4 of this report guidance on surface water management has been provided for Detailed Assessment Areas. Strategic approaches could also be taken as there is the potential to combine surface water management with Green Infrastructure such as SuDS

Sewer Flood Risk

The Town Centre is predominantly at low risk of sewer flooding. However, areas of high risk (2% AEP or greater) are identified in Areas 1, 2, 4 to 8, 10 and 11. The most notable locations at high risk include Brighton Road Industrial Estate (Area 1), areas adjacent to Green Lane (Area 2) and along Station Road (Area 10). Climate change events have not been modelled and has therefore not been considered in the assessment of sewer flooding.

If sustainable drainage is implemented in the Town Centre, this could relieve pressures on the wider system. The United Utilities DWMP mentions that if United Utilities were to invest in Stockport over the next 25 years, around 29% of the investment could be to address flooding issues. Potential investment could include surface water source control measures such as SuDS. These form a key part of the strategy to manage rainwater from entering the sewer system in Stockport. Repair and rehabilitation programmes could also be implemented to replace or update the existing intelligent network monitoring system.

Groundwater Flood Risk

The Town Centre is predominantly at low risk of groundwater flooding. However, there are areas of moderate risk that have been identified. Moderate risk of groundwater flooding to the south of Area 3 and to the west of the River Tame on the floodplain, east of Penny Lane in Area 4. Moderate risk of groundwater flooding is also shown around the banks of the River Mersey, the A560, Brinksway and Ford Street in Area 5, and within the centre of the area at Bridge Street, Daniel's Lane and Great Underbank in Area 7.

Within Area 11, two licensed groundwater abstractions located at Robinson's Unicorn Brewery have a maximum daily abstraction rate of 3637m3/day from the sandstone bedrock aquifers. Therefore, it is likely that the licensed groundwater abstractions control existing groundwater levels and localised groundwater flood risk. Therefore, should the abstractions cease, or partially cease, groundwater levels could rebound, increasing groundwater flood risk. Should the existing groundwater abstraction within Detailed Assessment Area 11 be stopped, consideration of longer term flood risk management, including a suitable pumping strategy may be required for existing and proposed development.

A summary of the flood risk to each Detailed Assessment Area is shown in Table 6-1.

Table 6-1: Level of flood risk against each Detailed Assessment Area

Area	Fluvial	Surface Water	Sewers	Groundwater	Canals	Reservoirs
1	Low	High	High	Low	Low	Low
2	Low	High	High	Low	Low	Low
3	Moderate	High	Low	Moderate	Low	Low
4	High	High	High	Moderate	Low	Low
5	High	High	High	Moderate	Low	Low
6	High	High	High	Low	Low	Low
7	High	High	High	Moderate	Low	Low
8	High	High	High	Low	Low	Low
9	Low	High	Low	Low	Low	Low

10	Low	Low	High	Low	Low	Low
11	High	High	High	Low	Low	Low

Where possible, opportunities should be identified for strategic partnerships such as United Utilities, the Environment Agency or the LLFA to reduce flood risk at a strategic level.

6.2 Recommendations

It is important to recognise that this SFRA is a living document and as a result should be updated when new information on flood risk and flood warning, or new planning guidance or legislation becomes available.

Additional guidance should be sought from SMBC, Environment Agency and United Utilities to ensure the most up to date information is considered within any new assessments. Such information may be in the form of:

- New hydraulic modelling results
- Flood event information following a future flood event
- Policy/ legislation updates
- Environment Agency flood map updates, and
- New flood defence schemes, or alleviation schemes

The main recommendations of this assessment are summarised below:

- It is recommended that SMBC use the SFRA to apply the Sequential Test while allocating development sites. If development sites fail to satisfy the Sequential Test as it shows that it isn't possible to use an alternative site, the Exception Test is recommended.
- Flood storage compensation is recommended for any new development or redevelopment (both major and minor) if the development is located in Flood Zone 3 and increases the built ground level.
- The impact of climate change on surface water, sewer and ground water flood risks should be assessed. This is to ensure a proactive approach is taken to mitigate and adapt to climate change, taking into account the long-term implications of flood risk.
- Work in partnership with the Environment Agency should be undertaken to determine where upstream storage can be implemented.
- Work in partnership with the United Utilities should be undertaken to identify Critical Drainage Areas and implement strategic solutions to potential sewer flooding.
- Further assessment should be undertaken of the potential groundwater risk to Stockport Town Centre. This may include long term groundwater monitoring in partnership with the Environment Agency.
- A requirement of the SMBC Flood Risk Management Strategy (2016) is provision of a Surface Water Management Plan. At the time of writing this has not been produced. The Local Planning Authority should be consulted to determine if any appropriate guidance is available on strategic measures to manage surface water.

Appendix A. Interactive Map User Guide

The SFRA interactive map (AppendixAppendix B) provides a strategic overview of the Town Centre boundary. It should be used in reference to Section4 of the Level 2 SFRA. The interactive map should be opened using Adobe Acrobat. Note that some versions of Adobe will not allow functionality of this map. Once opened, the map shown in should be displayed.

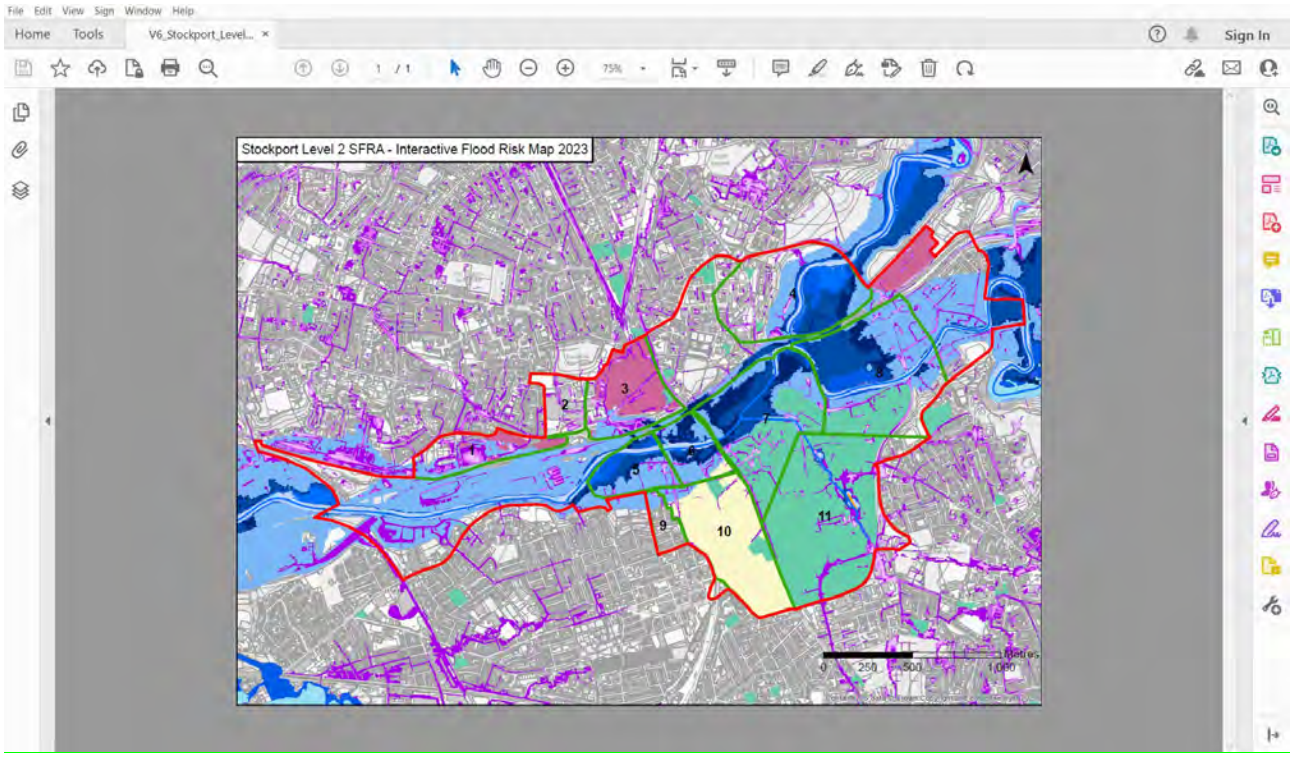

Figure 6-1: Displaying the interactive map

When the document opens the user can then click on the “Layers” button (highlighted yellow in Figure 6-2 – Step 1) in the navigation pane on the left-hand side of the screen to open and close the relevant layers. If this navigation pane does not automatically open, click the view button at the top of the screen, show/hide, navigation panes, then layers.

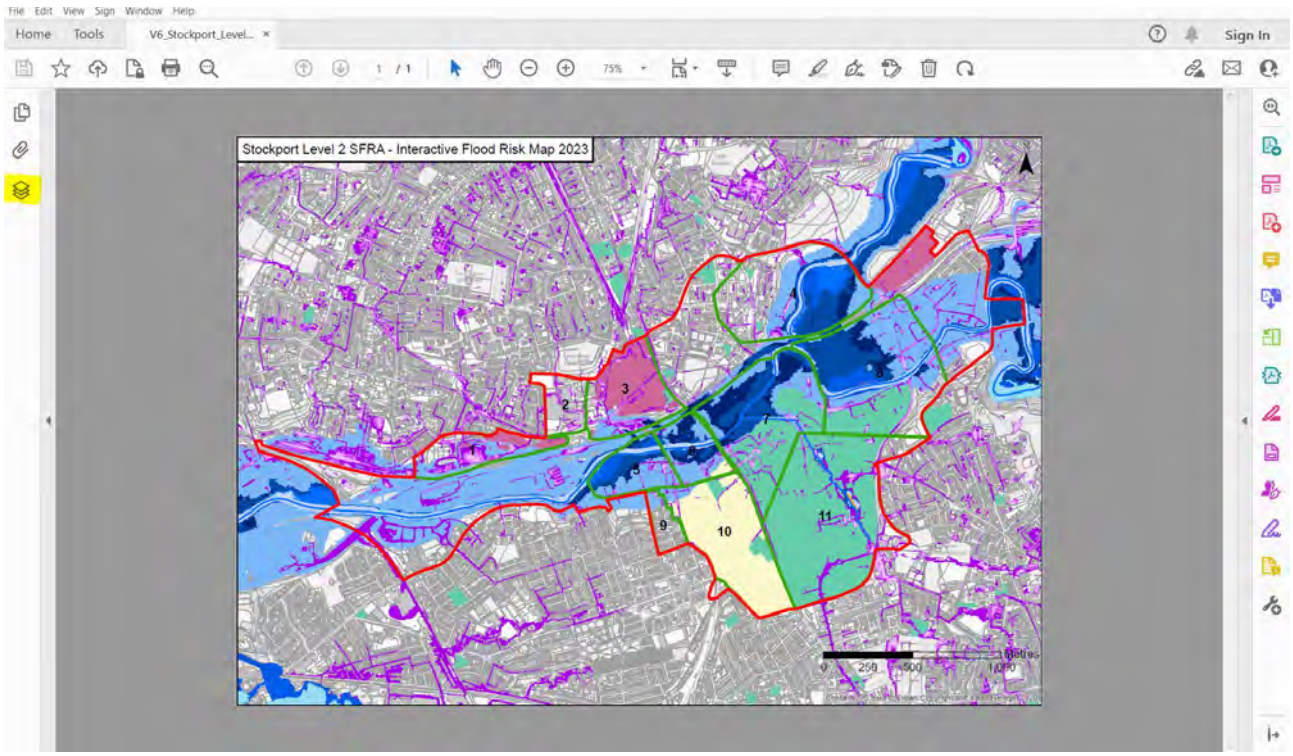

Figure 6-2. Interactive map user guide – Step 1

These layers can be expanded where there is an arrow (highlighted yellow in Step 2) and turned on and off by clicking the “eye” check box to enable better viewing of the provided layers (highlighted yellow in Figure 6-3 – Step 3).

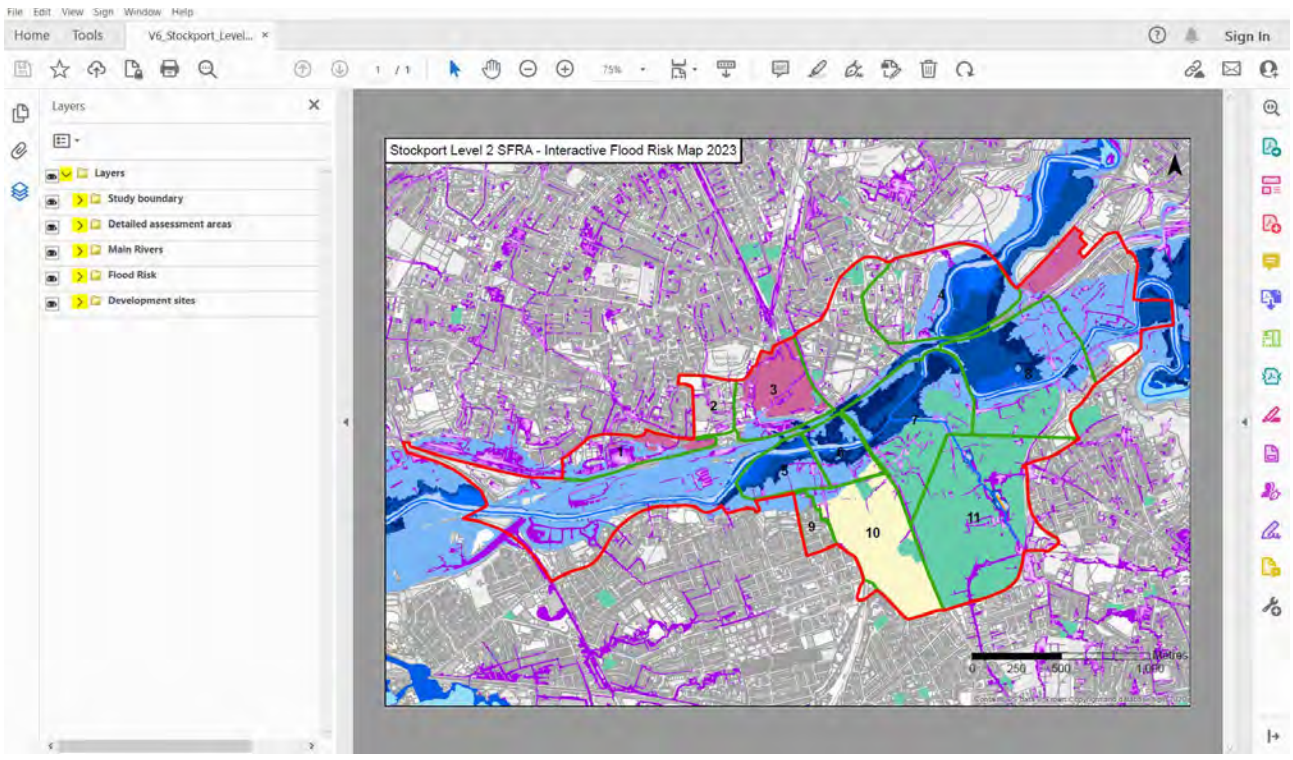

Figure 6-3. Interactive map user guide – Step 2

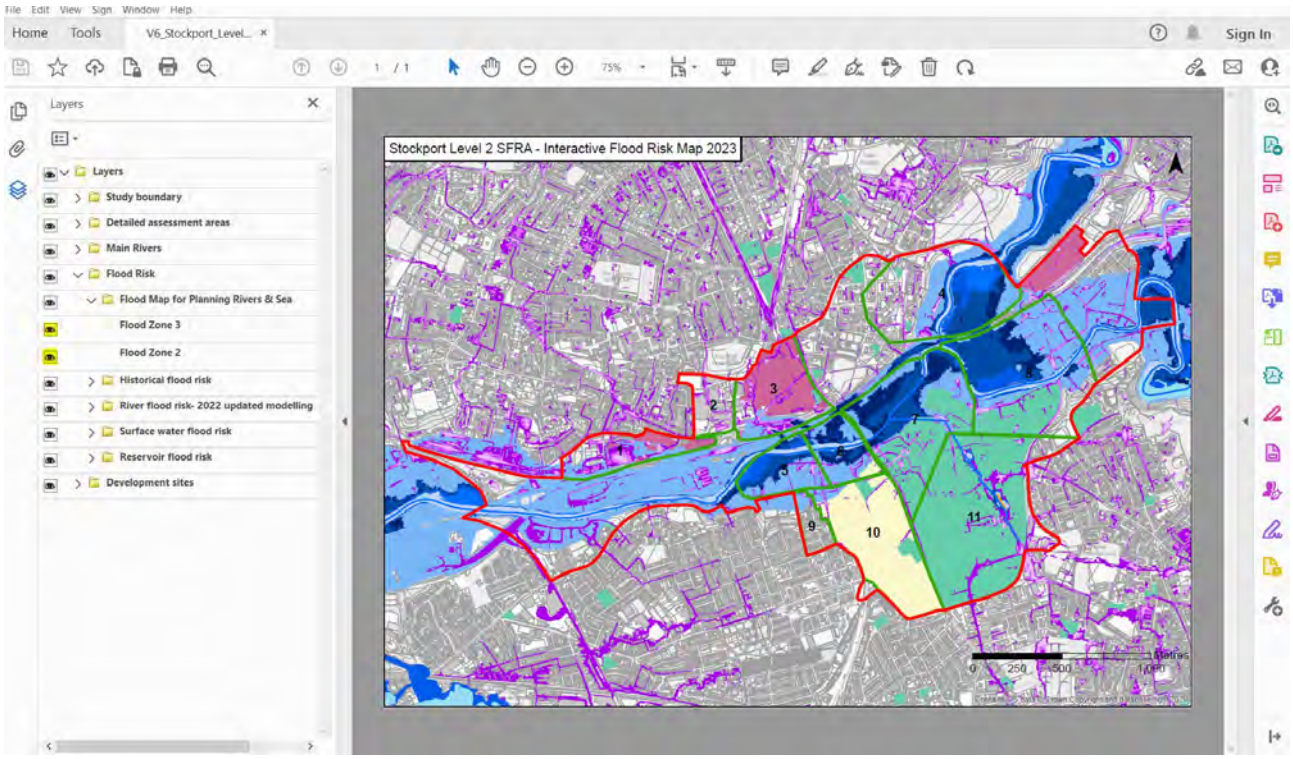

Figure 6-4. Interactive map user guide – Step 3

Appendix B. Interactive Map

Appendix C. Fluvial Flood Risk Hazard Maps

Area	1% Depths	1% + CC Depths	0.1% Depths
1	✓	✓	✓
2	No flood	No flood	No flood
3	No flood	No flood	✓
4	✓	✓	✓
5	✓	✓	✓
6	✓	✓	✓
7	✓	✓	✓
8	✓	✓	✓
9	No flood	No flood	No flood
10	No flood	No flood	No flood
11	✓	✓	✓

Appendix D. Fluvial Flood Depth Maps

Area	1% Depths	1% + CC Depths	0.1% Depths
1	✓	✓	✓
2	No flood	No flood	No flood
3	No flood	No flood	✓
4	✓	✓	✓
5	✓	✓	✓
6	✓	✓	✓
7	✓	✓	✓
8	✓	✓	✓
9	No flood	No flood	No flood
10	No flood	No flood	No flood
11	✓	✓	✓

Appendix E. Hydraulic Modelling Technical Note

B2444900 -JAC-XX-XX-TN-HY-0001

Appendix F. Groundwater Desk Study

B2444900 -JAC-XX-XX-TN-Z-0001

Appendix G. End Notes

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