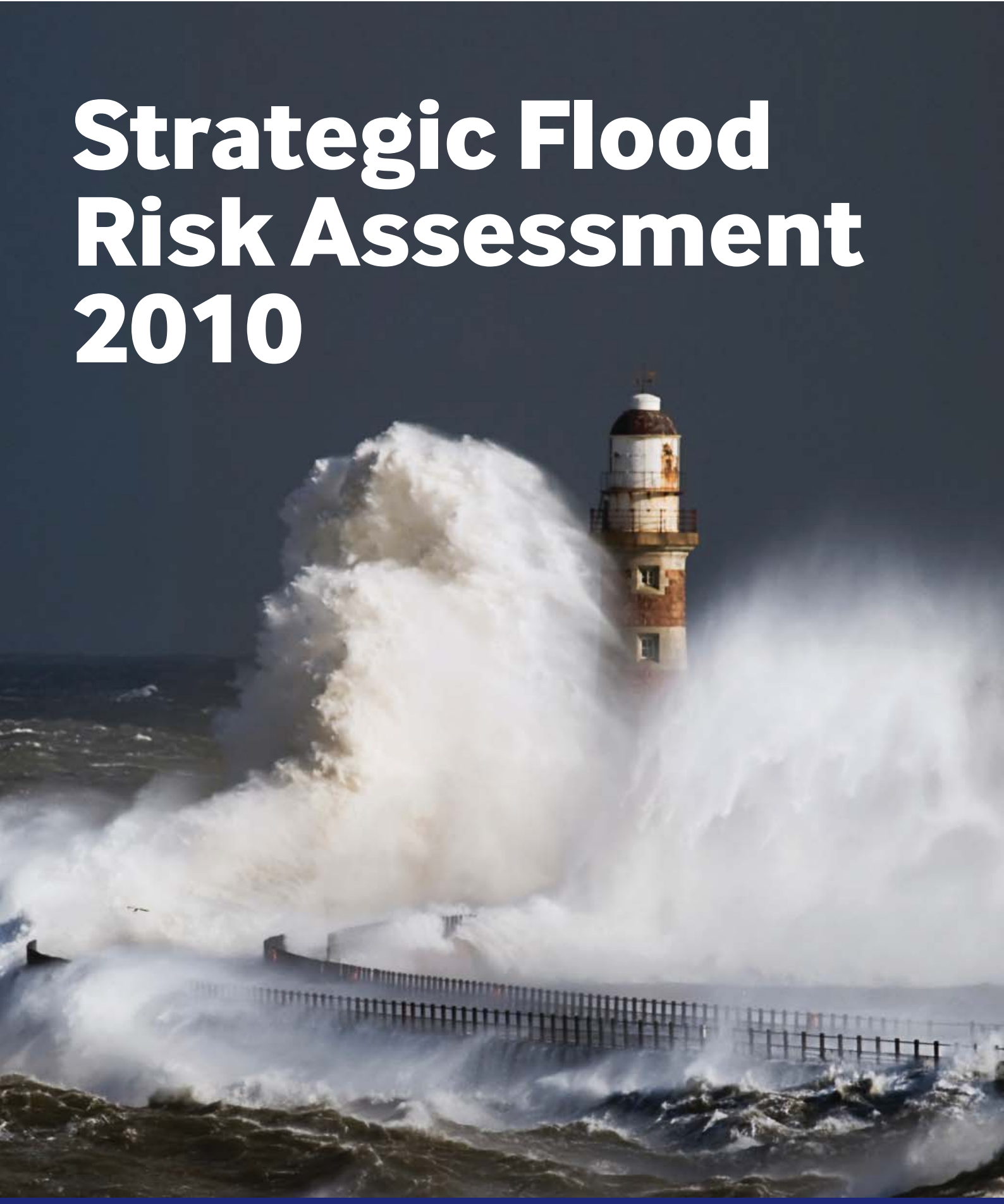
Strategic Flood Risk Assessment 2010



Volume II: Technical report

JBA consulting

Sunderland City Council

Sunderland City Council
Level 1 Strategic Flood Risk Assessment
Volume II: Technical Report

Final Report

June 2010

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Cover image: High Seas at Roker Lighthouse
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Revision History

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Sunderland Draft Level 1 SFRA v.3.0 (Volume I) 02/12/2009	Comments included from: Barry Luccock (21/10/2009) and Cameron Sked (29/10/2009). A meeting was also held on the 27/10/09 between SCC and JBA to discus draft report in more detail.	Barry Luccock Neil Cole Cameron Sked Niki Mather
Sunderland Final Level 1 SFRA v.4.0 (Volume II) 16/12/2009	Comments included on final draft from: Barry Luccock (14/12/2009) Report accepted by Niki Mather (NWL) on the 15/12/2009	Barry Luccock Neil Cole Cameron Sked Niki Mather
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Contract

This report describes work commissioned by Sunderland City Council's Head of Planning and Environment, by a letter dated 12th May 2009. Sunderland Council's representative for the contract was Barry Luccock. Chris Isherwood and Jonathan Cooper of JBA Consulting carried out this work.

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Purpose

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Acknowledgments

JBA would like to thank all those who provided information and data for this report. Special thanks go out to Barry Luccock and Neil Cole from Sunderland City Council and Cameron Sked and Sarah Baillie from the Environment Agency.

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Executive Summary

Level 1 SFRA Purpose and Approach

Flood risk in Sunderland arises from many potential sources. Whilst the level of flood risk may not be considered high throughout the City it is rightly a constraint to development, and great care is needed over the type and form of new development in these flood risk areas.

The Level 1 Strategic Flood Risk Assessment (SFRA) provides a spatial assessment of flood risk across Sunderland and includes sources of flooding from main rivers and Ordinary Watercourses, surface water runoff, the sewer system, groundwater, reservoirs and artificial sources. Residual risks and the impact of climate change are also introduced.

The risk associated with these sources of flooding has been mapped where possible to aid Sunderland City Council carry out the Sequential Test in line with PPS25 and its Practice Guide, identify the requirement for the Exception Test if required and to allocate appropriate development and flood risk policies within the Sunderland Local Development Framework (LDF).

Sunderland City Council is likely to have wider development aspirations and targets throughout the City. It is therefore recommended that the Sequential Test is carried out to the boundary of the five sub-areas of the City summarised below as it may not be appropriate to substitute development between each sub-area when searching for alternative development sites. The risk in each area is different to the next with multiple sources affecting all. The overall level of risk in Sunderland is low and by applying the Sequential Test with guidance from PPS25 and its Practice Guide, placing inappropriate development in higher risk areas can largely be avoided and where possible current and future risk to each community reduced.

Overall almost all housing sites identified as ‘deliverable’ or ‘developable’ in the council’s 2009 Strategic Housing Land Availability Assessment (SHLAA) are unaffected by any significant risk of flooding. Of the business sites identified, only the Port is very significantly affected and limited areas in Hendon and Dubmire (Coalfield).

Flood Risk in North Sunderland

Although there are a number of flooding sources within North Sunderland, the risk associated with them is low. Two main watercourses, the River Wear and Cut Throat Dene, run through the area but both fluvial and tidal risks are low placing relatively few properties at risk. The River Wear Flood Zones are constrained to the channel banks, except in the Fatfield locality.

The risk of coastal flooding is low with both Flood Zone 3 and 2 mainly following the Mean High Water Spring Level due high ground and cliff frontage. The coast line is also protected by coastal defences. Whilst assets are generally in good condition there is a risk of overtopping during climate change events. Although the overall level of risk is low along the coast, the coastal line should not see an increase in development according to CFMP and SMP policy and should be set back from the sea front where possible.

There are some critical surface water flow paths surrounding Roker to the east and Town Head Farm to the west. These should not influence the strategic placement of development during the Sequential Test but should be considered during the sequential approach to large scale developments. There is also a risk of sewer flooding in the area identified by NWL DG5 records and as such the area has been defined as a Critical Drainage Area within the SFRA.

This area may benefit from a Surface Water Management Plan in the long-term. However, large scale development on undeveloped land has not been identified, so it is unlikely the area would see a significant increase in pressure on the current drainage

system. It is however recommended in this SFRA any proposed development greater than 0.5ha will require a site-specific FRA and/or Drainage Impact Assessment. It is acknowledged that this is more stringent than PPS25 guidance of 1ha, but due to part of the area being defined as a CDA, this could potentially help reduce the current level of risk to the surrounding community by improving the current drainage system and/or reducing runoff rates.

Proposed development sites can be allocated in North Sunderland and the Sequential Test should be straightforward. Planning applications should however be supported by a sites-specific FRA where appropriate. Any development along the coastline should investigate the condition of the defence assets.

Flood Risk in South Sunderland

The flood risk associated with South Sunderland is significantly different from elsewhere in the City. The watercourses located in the coastal plain, mainly Hendon Burn, are not hydrologically connected to the Wear catchment. In these circumstances they have relatively limited floodplain extents as flow volumes are small.

Hendon Burn is located in a heavily urbanised area and culverted in sections which pose significant residual risk if they become blocked. Tidal locking is also a potential issue along with the backing up of surface water drains connected to the culverts. The true risk associated with the burn is unknown as there is no detailed hydraulic model available. It is recommended that a flood risk study is carried out in the future as climate change will only increase the level of risk to this densely urbanised area. As Hendon Burn is an Ordinary Watercourse, this should be carried out by Sunderland City Council assisted by the Environment Agency and Northumbrian Water either as a separate study, with any larger SWMP and PFRA or during any FRA for future development along the burn.

South Sunderland has a medium risk of surface water flooding, but areas identified at risk are mainly located within the natural valleys of Ordinary Watercourses with key flow routes and pooled areas being located in open land. These areas should not see an increase in development as they have the potential to increase risk elsewhere by removing natural flood storage.

Proposed development sites can be allocated in this area and the Sequential Test should be straightforward. Large scale development on currently undeveloped land should consider flood flow routes along smaller drains or natural surface water flow paths. These should be left free of development and obstructions. SUDs should be applied where possible to store surface water onsite and slow down conveyance to help reduce flood risk downstream.

Flood Risk in Central Sunderland

Flood risk in Central Sunderland is dominated by the tidal estuary of the River Wear. This said both Flood Zone 3 and 2 are constrained to the banks of the Wear, with only one property identified at risk (Pallion Shipyard). Sea levels are expected to increase due to climate change. However, modelled water levels during the 1 in 200 year tidal climate change event over the next 50 years are only just above the current 1 in 1000 year event level and are expected to remain in bank.

Large areas of the Port area are currently at risk of flooding from the sea. There is a risk of overtopping of coastal assets during climate change scenarios and a number of assets have been identified as being in poor condition. The south Port area is also at risk from fluvial flooding from Hendon Burn. Hendon Burn is currently culverted in this area and it is expected that flood risk will be lower than currently shown in the Flood Zone map. Any development within this area should consider Hendon Burn and surface water drains connected to it as a possible source of flooding.

There is a high risk of tidal flooding along the Port and the affected area should not be considered for housing where alternative sites are available. If housing is required within

this site, the Exception Test will be required. A detailed site-specific FRA will be required to master plan this site. There is little risk from other sources of flooding.

Proposed development sites can be allocated in Central Sunderland and the Sequential Test should be straightforward.

Flood Risk in Coalfield

The risk of flooding in some parts of the Coalfield area of Sunderland is high and can originate from a number of sources.

Fluvial risk is associated with Lumley Park Burn and its tributaries with a significant number of current properties identified as being at risk. Any development located around the upstream extent of the catchment (Hetton-le-Hole) should be placed back from the watercourse leaving land available to store flood water (these areas have been defined as functional floodplain using Flood Zone 3). This can be achievable without significantly reducing yield values due to the low percentage coverage of Flood Zones with the proposed development sites.

Further downstream around Houghton-le-Spring fluvial flooding is mainly on open land surrounding Lumley Park Burn. Development should be avoided in this area during the Sequential Test due to the level of risk and the possibility of increasing risk downstream outside of Sunderland within Chester-le-Street. Two defences provide a 1 in 200 year standard of protection to properties at Dairy Lane and Osman Terrance.

There is also a significant risk of both fluvial and surface water flooding surrounding Sedgeletch Sewage Works from Lumley Park Burn, Herrington Burn and surrounding rural land.

As there is currently a significant flood risk from a number of sources which can interact further downstream at Chester-le-Street, this area has been identified as a Critical Drainage Area within this SFRA. It is therefore proposed any development greater than 0.5 ha will require a site-specific FRA and/or Drainage Impact Assessment. This area may also benefit from a Surface Water Management Plan in the long-term if large scale development is planned, to determine the actual scale of risk, interactions between a range of sources and potential drainage strategies. However, risk could be successfully avoided and reduced in the meantime through the application of the Sequential Test, SUDs techniques and the restoration/protection of the functional floodplain.

The area of Coalfield also includes south Fatfield. This area has a high risk of both tidal and fluvial flooding from the Wear with a number of properties flooding in and above the 1 in 25 year event. This area has a medium risk of surface water flooding, although no proposed development sites have been identified. Further work is required by the Environment Agency and Sunderland City Council in reducing the level of risk. This is likely to be achieved by extending the coverage of the current flood warning service and increasing public awareness.

Flood Risk in Washington

Fluvial flood risk in Washington is relatively low, with Biddick and Usworth Burn the two main sources with the majority of Flood Zones constrained to parks or rural land lining the watercourses. There is a significant risk of surface water flooding surrounding the area; however this is again constrained to undeveloped land. Whilst surface water risk should not influence the spatial distribution of development during the Sequential Test it should be investigated further within any site-specific FRA and accounted for during the sequential approach to site layout and adoption of SUDs techniques.

The NWL Drainage Area of Washington Central has been identified as a Critical Drainage Area within the SFRA due to the level of surface water risk and high number of properties currently on Northumbrian Water's DG5 register. It is therefore proposed any development greater than 0.5 ha will require a site-specific FRA and/or Drainage Impact Assessment. This area may also benefit from a Surface Water Management Plan in the

long-term if large scale development is planned to determine the actual scale of risk, interactions between a range of sources and potential drainage strategies.

However, risk could be successfully avoided and reduced in the meantime through the application of the Sequential Test, SUDs techniques and the restoration/protection of the functional floodplain.

The area surrounding Nissan has a high risk of surface water flooding and is also known to be at risk of groundwater flooding. NWL DG5 records identify a low risk of sewer flooding. The area consists largely of undeveloped land, however should any large scale development be considered here (the SHLAA and Employment Land Review both indicate potential interest in development) it could potentially increase surface run-off and flood risk within the area.

Proposed development sites can be allocated around Nissan if required, but should be supported by a detailed site-specific FRA and/or Drainage Impact Assessment. Flood risk should be considered during the sequential approach to site layout. Any mitigation or SUD techniques should be considered strategically throughout this area rather than on a site by site basis.

Level 1 SFRA Key Recommendations

This SFRA (Volume II) has highlighted a number of key flood risk and future work recommendations throughout the report (green boxes). The aim of these recommendations is to allow Sunderland City Council, Environment Agency and other users of this SFRA to carry on the values of PPS25 when allocating proposed development sites, assessing flood risk at a site level and carrying out future studies in developing local understanding of current and future flood risk within Sunderland.

Below is a summary of theses key recommendations.

- Sunderland City Council should carryout the Sequential Test in line with PPS25 and its Practice Guide, avoiding allocating any development within flood risk areas
- The vulnerability of land use, flood zone compatibility and the Exception Test must only be used once the Sequential Test has been applied
- Sunderland City Council should take onboard CFMP and SMP2 policies with regards to future flood risk management frameworks and the adoption of any mitigation measures proposed
- Upstream planning authorities should also adhere to theses rules and avoid inappropriate development within the natural floodplain
- FRAs along urban watercourses or within the functional floodplain should investigate the true extent of the functional floodplain
- FRA/DIA should be carried out in CDAs for development sites greater than 0.5ha
- The risk of groundwater flooding should be considered within a FRA for all proposed development sites within Sunderland
- Mitigation or SUDs techniques in Washington should be considered strategically
- Flood warnings areas south of the River Wear at Fatfield should be extended to cover all properties within the 1 in 100 year or greater flood extent
- Sunderland City Council should update the historical flood register with any new information
- Sunderland City Council should continue to liaise with NWL in understanding the risk associate with the drainage system
- A flood risk mapping study should be carried out along Barnes and Hendon Burn
- This Level 1 SFRA should be updated on a regular basis within 3-4 years or if a review trigger prompts an earlier update

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Abbreviations

ABD	Areas Benefiting from Defences
AEP	Annual Exceedance Probability
ANEC	Association of North East Councils
CFMP	Catchment Flood Management Plans
CLG	Communities and Local Government
COW	Critical Ordinary Watercourse
CS	Core Strategy
DIA	Drainage Impact Assessment
DPDs	Development Plan Documents
EA	Environment Agency
EU	European Union
FAS	Flood Alleviation Schemes
FEH	Flood Estimation Handbook
FCERM	Flood and Coastal Erosion Risk Management
FRA	Flood Risk Assessment
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan
GI	Green Infrastructure
IFM	Indicative Floodplain Map
LDDs	Local Development Documents
LDF	Local Development Framework
LPAs	Local Planning Authorities
NEA	North East Assemble
NFCDD	National Fluvial and Coastal Defence Database
NLRF	Northumbria Local Resilience Forum
NPD	National Property Dataset
NWL	Northumbrian Water Ltd
PFRA	Preliminary Flood Risk Assessments
PPG	Planning Policy Guidance
PPS	Planning Policy Statement
RBD	River Basin District
RBMP	River Basin Management Plan
RFRA	Regional Flood Risk Assessment
RPB	Regional Planning Bodies
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategy
RVFD	Receptors Vulnerable to Flooding Database
SA	Sustainability Appraisal
SAC	Special Areas of Conservation
SCC	Sunderland City Council
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SFVI	Social Flood Vulnerability Index
SMP	Shoreline Management Plans
SNCI	Sites of Nature Conservation Importance
SoP	Standard of Protection
SPA	Special Protection Area
SPD	Supplementary Planning Document
SSSI	Sites of Special Scientific Interest
SUDS	Sustainable (Urban) Drainage Systems
SWMP	Surface Water Management Plan
UDP	Unitary Development Plan
WCS	Water Cycle Study
WFD	Water Framework Directive

1 Introduction

1.1 Commission

JBA Consulting was commissioned on the 27th May 2009 by Sunderland City Council to undertake a review of its existing Strategic Flood Risk Assessment (SFRA) and update it in accordance with the current requirements of Planning Policy Statement 25 (PPS25).

Building on information already available, a Level 1 SFRA study was undertaken to identify and analyse current and future flooding issues for key locations in the local authority area, to support LPA assessment of specific development allocation sites.

1.2 Sunderland Level 1 SFRA Volume II

The purpose of this investigation is to provide a spatial assessment of flood risk within Sunderland, and to develop on the detail included in the North East Regional Flood Risk Appraisal published by the Association of North East Councils (ANEC)[1]. Together these sources will assist the Local Development Framework (LDF) and the policies and proposals produced for the development and use of land within Sunderland.

This technical volume of the Level 1 SFRA introduces the key sources and mechanisms of flood risk in Sunderland and current measures which have been taken to manage the risk. This Volume then provides sufficient data and information to inform the application of the Sequential Test by Sunderland City Council. This information includes the suite of strategic flood risk maps:

SET A	**Fluvial and Tidal Flood Risk Maps**	
	PPS25 Flood Zone Map	*2009s0243-SCC-A1 to A12*
	River Wear Modelled Outlines at Fatfield	*2009s0243-SCC-A13*
	Lumley Park Burn Undefended Modelled Outlines	*2009s0243-SCC-A14*
	Lumley Park Burn Defended Modelled Outlines	*2009s0243-SCC-A15*
SET B	**Climate Change Sensitivity Maps**	
	Fatfield Climate Change Outlines	*2009s0243-SCC-B1*
	Lumley Park Burn Climate Change Outlines	*2009s0243-SCC-B2*
SET C	**Surface Water & Sewer Flood Risk Maps**	
	Areas Susceptible to Surface Water Flooding	*2009s0243-SCC-C1*
	NWL Drainage Areas	*2009s0243-SCC-C2*
	Proposed Critical Drainage Areas	*2009s0243-SCC-C3*
SET D	**FRM Asset Maps**	
	Flood Risk Management Measures	*2009s0243-SCC-D1*

A greater level of flood risk information has been made available in Fatfield and Lumley Park Burn as they are considered high risk areas. These two areas also have detailed hydraulic models which made this level of detail possible.

To aid Sunderland City Council undertaking the Sequential Test, a spreadsheet has been developed which provides the results of a spatial assessment for each proposed development site against Flood Zones and surface water susceptibility zones. The analysis includes area (ha) and percentage (%) cover of each zone and the proposed development land use. Sites assessed included Sunderland City Councils Strategic Housing Land Availability Assessment (2009) and Employment Sites.

This Volume then provides recommendations for further work.

[1] ANEC (2009) Regional Flood Risk Appraisal Scoping Study. Can be found at: http://www.strategyintegrationne.co.uk/document.asp?id=999 [15/12/2009]

1.3 Sunderland Study Area

The study area comprises the whole of the City of Sunderland. Sunderland is located in the north east of England and is the largest city between Leeds and Edinburgh with a population of 282,000. The City covers an area of 137km² and is one of five metropolitan districts that compromise the conurbation of Tyne and Wear (the others are; Newcastle, Gateshead, North Tyneside and South Tyneside).

Sunderland has been considered using five main sub-areas, **North, South, Washington, Coalfield and the Central Sunderland area**, which includes the city centre.

Sunderland contains both a main river and a coastline. Both are considered critical assets to Sunderland contributing to its environmental, social and economical well-being. The River Wear can be described in two sections, west and east of the A19.

West of the A19, the Wear is predominantly rural in character with public open space and agricultural land situated on either bank. There are a number of Sites of Nature Conservation Importance (SNCI) and Sites of Special Scientific Interest (SSSI) located in close proximity to the Wear including the:

- Wear River Bank Woods SNCI
- Washington Wildfowl and Wetlands Centre SNCI
- James Steel Park: Mount Pleasant Riverside SNCI
- Wear River Bank SSSI

The tidal limit of the Wear is located at Chester-le-Street weir upstream of Sunderland.

East of the A19, the Wear runs largely though the urban areas of Sunderland, including Sunderland City centre and is in contrast to the rural nature of the upstream catchment. The city centre is the location for a number of critical development sites and strategic locations for change, which will link the river system with the wider community. There are two SSSI and four SNCI located adjacent to watercourses and the coast including:

- Claxheugh Rock and Ford Limestone Quarry SSSI
- Durham Coast SSSI
- Barons Quay Wood and Barons Quay SNCI
- Claxheugh Riverside SNCI
- Timber Beach SNCI
- Wearmouth Riverside Park/Wearmouth Colliery SNCI
- Sunderland South Docks SNCI

There are a number of smaller main rivers within Sunderland including the:

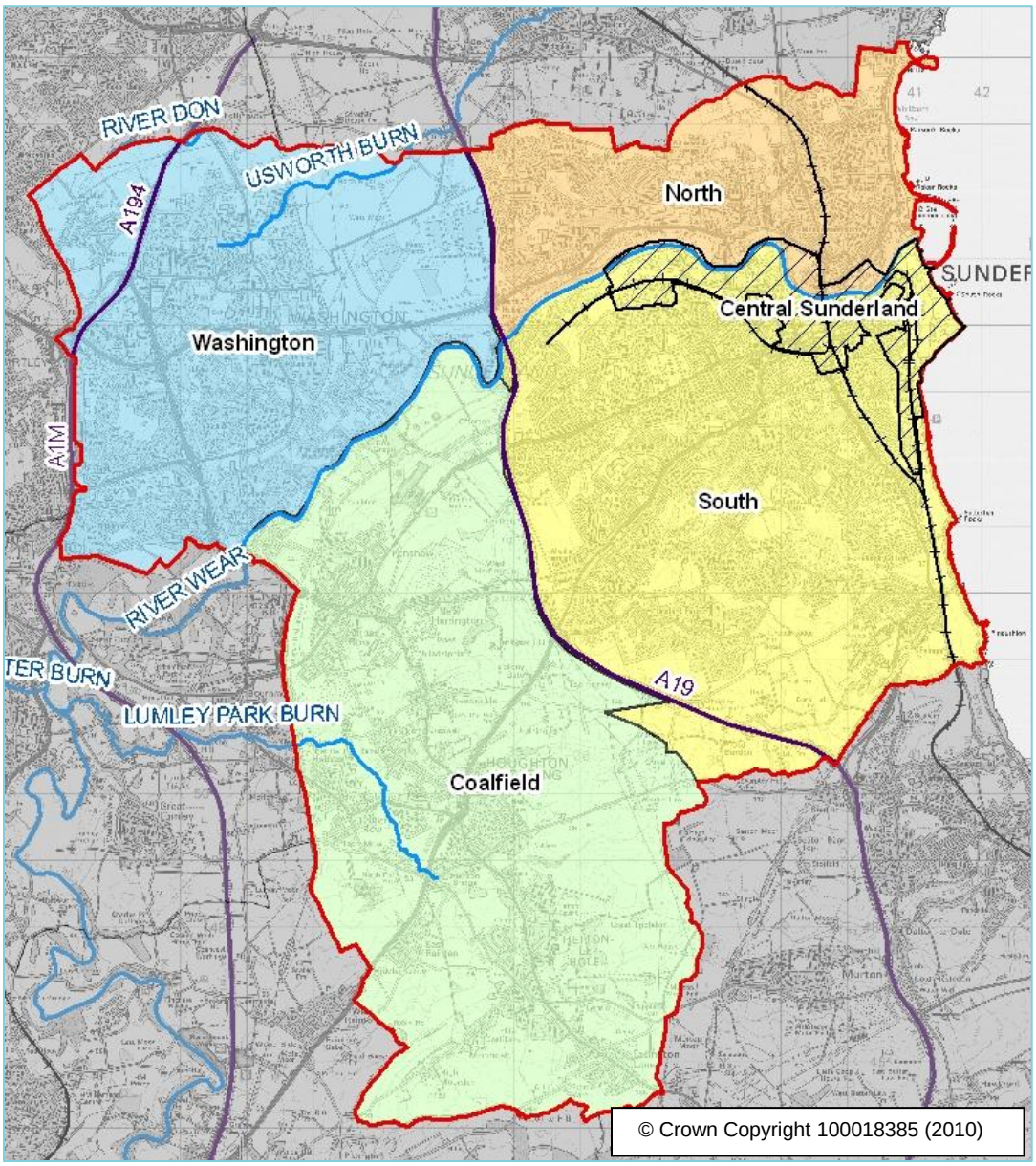
- River Don (tributary of the Tyne);
- Usworth Burn (tributary of the Don); and
- Lumley Park/Hetton Burn (tributary of the Wear).

As well as these main rivers, Sunderland has a number of smaller denes and Ordinary Watercourses located throughout the city. Some of these are tributaries to the main rivers discussed above; however, some located in the coastal plain are not hydrologically connected to the Wear catchment. In these circumstances the watercourses have relatively limited floodplain extents as flow volumes are small. However, they are still critical where they are located in densely urbanised areas.

The coastline is a mix between developed and undeveloped coast. The developed coast extends from the South Tyneside boundary south to Hendon Beach covering residential areas of Roker, Seaburn and its river mouth. It includes part of the Northumbria Special Protection Area (SPA) and RAMSAR site at Parson's Rock. This area also includes a significant port area south of the Wear Estuary. South of Hendon Beach to the southern extent of Sunderland City Council boundary with Easington District Council is known as the undeveloped coastline. The coastline also includes part of the Northumbria SPA and Durham Special Area of Conservation (SAC).

Figure 1-1 provides a graphical overview of the SFRA study area including main rivers, key infrastructure and the five sub-areas.

Figure 1-1: Sunderland Level 1 SFRA Study Area



2 Consultation and Data Management

2.1 Introduction

To carry out an appropriate and comprehensive assessment of flood risk, it is essential to collate and build upon the best available data and studies already carried out. This information has been used to form the foundation of the Level 1 SFRA.

The Environment Agency Flood Map is the main source of fluvial and tidal flooding across England and Wales and is the basis of PPS25 Flood Zones. However, the SFRA must also consider flooding from all sources and this is only achievable through consulting with those stakeholders with specific interest or knowledge in other sources of flooding. This data collection process is a key part of the SFRA and has enabled this Level 1 SFRA to be based on a significant amount of information that already exists on Sunderland.

PPS25 outlines a number of key consultees to the planning process. There are two main types of stakeholders: those that are consulted on their expert knowledge in a particular field and are requested to provide flood risk information and those who are consulted on the actual SFRA. Each Stakeholder and their involvement in the Sunderland SFRA are discussed below.

2.2 Key Stakeholders

2.2.1 Sunderland City Council

Sunderland City Council was the main stakeholder for the preparation of this Level 1 SFRA. Its officers provided the Brief and some of the detail needed for its production.

An initial SFRA meeting was held to discuss the requirements of PPS25 in producing a Level 1 SFRA and to determine the main tasks needed to be completed. The meeting also outlined the Council's own timetable relating to preparing an evidence base for their LDF process.

Correspondence has occurred since the initial meeting requesting information on historical flooding along with other key information outlined below.

- Strategic Housing Land Availability Assessment (SHLAA);
- Business and Industrial Sites;
- Shoreline Management Plan 2 (SMP2);
- Coastal Defence information;
- Historical flooding data and information;
- Ordinary Watercourse data; and
- OS MasterMap.

2.2.2 Environment Agency (EA)

The Environment Agency is a statutory consultee for Regional Spatial Strategies (RSSs), Local Development Documents (LDDs), Sustainability Appraisals and Strategic Environmental Assessments. It is also a statutory consultee for planning applications.

With regards to the Sunderland Level 1 SFRA, the Environment Agency has discretionary powers under the Water Resources Act (1991) to manage flood risk and, as a result, hold the majority of flood risk data in the UK. The External Relations Team were the main provider of data however other departments were consulted including Development Control, Flood Mapping and Reservoir Safety Teams on the SFRA approach and available data. A full list of data provided by the Environment Agency is available in the Data Register discussed in Section 2.3 but the main themes can be summarised below:

- Tyne and Wear Catchment Flood Management Plans;
- Strategic flood risk mapping models;
- National Flood & Coastal Defence Dataset (NFCDD);

- Light Detection and Ranging (LIDAR) topographic data (Geomatics Group);
- Historical flood outlines; and
- Flood warning data.

The Environment Agency was also consulted on all draft versions of this Level 1 SFRA and their comments and guidance have been included within the final report. Revisions of the SFRA reports and general changes made can be found on page ii 'Revision History' within each Volume.

2.2.3 Northumbrian Water Limited (NWL)

Local water authorities are identified as a key consultee within PPS25 as they are generally responsible for surface water drainage from developments. This SFRA should therefore take account of any information they may hold on capacity issues or historical flood incidences.

Sewers are a significant source of flooding especially within urban areas. Flood risk data that Northumbria Water (NWL) holds on the public sewer network are seen as critical in getting an understanding of flooding from all sources in Sunderland.

The main source of information requested from NWL was a copy of their historical flood records. NWL has provided internal and external DG5 and DG10 records at a strategic drainage area level which has been used within the Level 1 SFRA. They are also willing to supply DG5 and DG10 records at a more local and street level if Sunderland City Council were to carry out a Level 2 SFRA.

NWL were also sent the final draft copy of this Level 1 SFRA report and maps to review during the final consultation period, in which they accepted the wording and approach taken during the assessment of sewer flooding. NWL also stated they will continue to offer support to the LPA throughout the whole process and see their involvement being a key partner at short term, medium term and long term intervals being valuable for the mitigation of Flood Risk Management with regard to SWMP and WCS.

Recommendation

Sunderland City Council should continue to liaise with NWL over flood risk and management issues as a good relationship has been established during the production of this SFRA for future work on the subject.

2.2.4 Highways Agency (HA)

All major roads and motorways have the potential to impact on flood risk. This is especially the case in an urban environment when roads can form potential flow routes or major structures such as bridges or culverts can significantly reduce the capacity of watercourses and therefore increase flood risk. Road networks that are at risk of flooding also have the potential for wider impacts reducing access and egress routes to and from sites which could increase the vulnerability of areas to flooding.

The Highways Agency was consulted on all know flood incidences on their road networks. The Highways Agency forwarded this request on to A-One who manage and maintain the trunk roads and motorway network in the north east of England on behalf of the Highways Agency.

A-One supplied a number of important datasets including the location of a number of historical flood incidents and GIS layers of their network including the location of balancing ponds, gullies, manholes and outfalls into surround watercourses or wetlands. A-One also supplied photographs of all structures within the North East of watercourses and culverts which flow underneath their networks. This was extremely helpful in identifying possible flood risk areas.

2.2.5 Tyne and Wear Fire and Rescue Service (TWFRS)

Emergency services are a good source of historical flood data. For instance when the fire brigade are called out to flood related incidences, they keep a detailed register of all call outs which includes the source of flooding and the action taken.

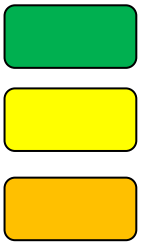
The Tyne and Wear Fire and Rescue Service (TWFRS) were extremely helpful in providing this information producing a database of over 300 flood related call outs dating back to January 2004.

2.3 SFRA Data Management and Review

This Level 1 SFRA Technical Report (Volume II) should be viewed as a 'living' document in which flood risk information and data maybe updated when available by Sunderland City Council. Updates will be added to the City councils SFRA website.

It is therefore important that datasets collected for the Sunderland Level 1 SFRA are transparent and accessible. A Data Register has been produced and supplied to Sunderland City Council listing all data received throughout the SFRA process. A hard copy of the register has been provided in Appendix A of this report.

All data was reviewed on receipt and its quality and confidence rated for use in the SFRA. This process was purely based on professional judgement and rated on the scaling below.



Most data requested was high quality and accurate as expected. Whilst the majority of the datasets could be mapped geographically (GIS) helping to visualise the risk of flooding others were not reducing its usefulness. Historical flooding information was generally marked as of both medium quality and confidence, as whilst it could be placed on a map there was no detail behind it stating the source of flooding. The confidence in its precision was also questionable; however, this would always be expected.

The Data Register will allow intended users of the SFRA to review the accuracy, currency and relevance of all datasets used and for Sunderland City Council to manage and update datasets when available. The Data Register also provides details of all contacts who supplied the data. The organisations listed should be the first contact for any update to the SFRA, making sure the most up-to-date information is used.

This register will also allow for a control on the publication and release of SFRA data to third parties outside of the main stakeholders. Initially the SFRA report and associated maps should be published on the Sunderland City Council website as the central source of SFRA data and available to download.

Whilst the majority of data collected and produced will be supplied (report, maps, GIS, modelled output) there should be controls on its use. Sunderland City Council will be able to use any modelled output (depths, hazards and outlines) or GIS created during the SFRA for internal use. The use of this information must consider the context within which it was produced (i.e. strategic). Sunderland City Council will not be supplied with any actual models supplied by the Environment Agency or created during the SFRA process, only the modelled outputs.

Any information produced on the back of data collected from the Environment Agency (hydraulic river models, flood zones) will fall under the SFRA license agreement between Sunderland City Council and the Environment Agency. Any third party wishing to use these flood risk datasets should contact External Relations in the Environment Agency.

2.4 SFRA Monitoring

There are a number of key outputs from possible future studies and dataset which are known to be regularly updated. These should be incorporated in any update to the SFRA. Table 2-1 contains a list of SFRA review triggers. Not all future sources of information should trigger an immediate full update of the SFRA; however new information should be collected and kept along side the SFRA until it is updated.

Recommendation

Whilst this SFRA has been produced using the most up-to-date national guidance and flood risk data, it is recommended that the SFRA should be updated on a regular basis. The Environment Agency has suggested this be every 3 to 4 years, unless there is a significant flood affecting the area, arising to new information or areas at flood risk.

A review of the SFRA should also be undertaken if there are any major national policy changes, including updates to PPS25 and its Practice Guide. An updated PPS25 is expected in spring 2010; however the anticipated changes have already been discussed in Volume I and are not expected to be significant enough to trigger a review.

All datasets collected for the SFRA have been supplied to Sunderland City Council in the form of SFRA reports, maps and figures. GIS data used to produce the maps have also been supplied. Once maps or the SFRA document is updated it should be reissued to the relevant stakeholders.

Table 2-1: SFRA Review Triggers

Trigger	Source	Possible Timetable
Tyne CFMP	Environment Agency	Updated every 5 years
Wear CFMP	Environment Agency	Updated every 5 years
River Tyne to Flamborough Head Shoreline Management Plan 2	Northumbria Coastal Authorities Group	2019
Flood Map	Environment Agency	Updated quarterly (significant change is not expected)
Significant Flood Events	All	Unknown
Planning Policy	Communities & Local Government	Unknown
Completion of SWMP and/or Drainage Strategies	Sunderland City Council	Unknown

3 Flood Risk in Sunderland

3.1 Introduction

There is a need to understand the risk of flooding from all sources in Sunderland considering where the high risk locations are, possibly from multiple sources and plan future development and regeneration accordingly.

This section of the Level 1 SFRA assesses flood risk from all sources, now and in the future. It makes use of all the data and information collected during the consultation period. It includes a discussion on tidal and fluvial Flood Zones and assesses flood risk from other sources, with the aim of providing enough information for Sunderland City Council to perform the Sequential Test.

Whilst it is unlikely that land use change in districts upstream of the City will have significant impacts on the tidal stretch of the River Wear through central Sunderland, major land use change surrounding smaller watercourses could potentially have localised impacts. This highlights the need for the Sunderland City Council, the Environment Agency and Northumbrian Water to work together on flooding problems, particularly where new developments could exacerbate flooding downstream or to surrounding communities.

3.2 Flooding History

Historical flood records can help build a picture of which catchments are susceptible to flooding. By looking into the past it can provide an insight in to possible areas in the future which may also be susceptible to flooding. Historical flood records also provide an understanding of the severity or magnitude of flooding in the catchments and can help spatial planning decisions.

The River Wear has a long and varied flood history with significant events occurring in the 1940s, 1960s, 1990s and most recently in 2000 and again in 2005. Due to the differences in the catchments between the main river Wear and the tributary rivers catchment, widespread floods are rare and flooding generally occurs on either the Wear, or the tributaries, but rarely on both at the same time.

According to the Wear CFMP the majority of historical flooding has occurred along the Wear upstream of Chester-le-Street and along its major tributaries. There is little evidence of flooding along the Wear through Sunderland. All historical flooding incidents identified in the Wear CFMP associated with Sunderland have been identified below.

Table 3-1: Environment Agency Historical Flood Records[2]

Date	Reported Damage
November 1771	Great flood on the Wear, Tees and Tyne. In Durham the flood water was reported to be 8 feet 10 inches higher than had ever been known. At Sunderland the flood water was 7 feet higher. Bridges at Frosterley, Wolsingham and Witton-le-Wear were destroyed.
July 1789	Rainfall concentrated in lower reaches. Flooding at Sunderland Bridge delayed passage of travellers. Much agricultural losses. 2 mills, a skin mill and an iron forge mill destroyed at Bracken Hill on the Lumley Park Burn. Houses flooded at Chester-le-Street. The flood event was said to be highest flood since 1771.
1924	Tidal flooding along the Wear at Fatfield
1968	Tidal flooding along the Wear at Fatfield
1975	Fluvial flooding of Lumley Park Burn at Sedgeletch

[2] Environment Agency (2008) Wear CFMP Appendix D

Date	Reported Damage
November 2000	On the 6-7 November 2000 flooding occurred on the River Wear at Durham, at Chester-le-Street and at Fatfield. The peak discharge at Sunderland Bridge was estimated at 363m³/s the peak at Chester-le-Street was recorded at 368m³/s. The return period of the event was estimated at 18 years at Sunderland Bridge and 40 years at Durham and Chester-le-Street. Flooding also occurred at Lanchester. Flooding also occurred at south Church and West Auckland from the River Gaunless.

Historical flooding records were also collected from Sunderland City Council Risk Management and Insurance and Highway Maintenance Section and the Tyne and Wear Fire and Rescue Service (TWFRS). The types of data provided are highlighted in more detail below:

Table 3-2: Other Historical Flood Records

Date	Reported Damage
Sunderland City Council Risk Management and Insurance Section	Data included flood losses claimed by the City against their insurer. This mainly refers to schools apart from a number of tenanted properties. Flooding information mainly related to internal sources like drains rather than external sources entering the buildings. This data provided little evidence in supporting the level of flood risk described within the SFRA.
Sunderland City Council Highway Maintenance	The Highway Maintenance Section provided a copy of the City's Highway's Outstanding Drainage Problems spreadsheet which is split into the councils 6 regeneration areas. This indicates historically the highway drainage based problems throughout the City via a priority 1, 2, or 3 system: 1 - Flooding from the highway, water ingress into building or serious hazard to road users 2 - Property flooding to the garden or exterior of building 3 - Flooding to highway only, not serious hazard to road user In some case a solution has been identified or work has been completed to solve the problem.
Tyne and Wear Fire and Rescue Service	The TWFRS provided a dataset of flooding incidents in which the service responded to between 01/04/2004 and 01/04/2009. This information included incidents of all sources of flooding from internal drains or leaks to large fluvial and surface water flooding in which action was required. This dataset was manually sieved within the SFRA to only include those instances which were relevant.

An electronic register of all historical flood incidents collected above has been produced. The register provides a complete list of all historical flooding locations received providing its specific location (easting & northing if available), source of flooding, number of properties affected and the organisation who supplied the data. This information has also been transferred into a GIS layer for use.

Recommendation

Sunderland City Council should take control of the historical flood incident register and update it with any future flood events and locations of flooded properties or infrastructure. This should be made readily available for future SFRA updates and FRAs. **The historical flood incidents database can be found in Appendix B**

3.3 Coast Flooding

The Sunderland coastline covers the length of coast from Whitburn Bay in the north at the boundary with South Tyneside Council down to Ryhope in the south, with the council boundary with Easington District. The coastline covered in this area has a rich diversity in

its physical form, human usage and natural environment being designated as Natura2000, SPA and SAC sites and included in the Durham Heritage Coast designation. The majority of Sunderland's coastline is low/medium height cliffs backing sand or shingle beaches, interspersed by the River Wear and a number of denes.

According to the River Tyne to Flamborough Head SMP2:

"The geological exposures of the coast, certainly over the northern section of the frontage, are clear evidence of how sea levels in the area have changed. Over the last 2,000 years, this change has been quite minimal (averaging less than a millimetre per year). However, we are now entering a period of accelerating sea level rise that will impose greater pressure on the coast to erode and could in some areas; particularly where the shoreline is dependent on natural protection provided by beach material, result in significant change… In general terms we have to expect greater energy against the coast and against defences coupled with a potential reduction of sediment along sections of the shoreline. If we choose to continue to defend our shorelines in the same locations that we do at present, then the size of the defences may need to increase.[3]*"*

Both Flood Zone 2 and 3a follow the Mean High Water (MHW) line, placing no properties at risk. Flood Risk is heavily dependent on the presence of coastal defences and or high ground levels. There is the potential for those watercourses discharging to the coast becoming locked during high tides. This may result in increased fluvial flood risk immediately upstream or surrounding the inlet of outfall culverts. This risk to individual watercourses is discussed later.

3.3.1 Coastal Assets

Sunderland City Council maintains all coastal defences including walls, splash walls armour, breakwater and revetment. As part of the evidence base for this SFRA, Sunderland City Council provided the North East Coastal Authorities Group (NECAG) Coast Protection Assets and Coastal Slope Condition Analysis report (2009)[4] and the Environment Agency supplied the latest version of the National Flood and Coastal Defence Database (NFCDD).

The structural assessment of coastal protection assets along the Sunderland City Council frontage was carried out by a team of asset inspectors and structural engineers during November and December 2008. All assets were graded based on their condition, residual life and urgency of repair work. Observations were photographed and all data was stored in the NFCDD. Brief descriptions of the condition of the coastal margin for any areas of undefended coastline were also entered into the NFCDD.

During the inspection each asset was graded based on the Environment Agency Condition Assessment Manual, a standard adopted by the Environment Agency to reflect the condition according to performance. These standards are listed below.

Table 3-3: Environment Agency Condition Standards

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

According to the report, the coastal defence assets of the Sunderland City Council frontage are generally in good condition and minor remedial work as part of a routine

[3] North East Coastal Authority Group (2007) River Tyne to Flamborough Head SMP2
[4] NECAG (2009) Coast Protection Assets and Coastal Slope Condition Analysis report

maintenance programme carried out alongside regular asset inspections will provide an appropriate solution to the majority of issues/defects identified (See Appendix C). However, some structures were also identified as requiring urgent remedial action. These are described below:

- **North East Pier, Port of Sunderland** - The concrete and masonry structure was in very poor condition due to significant erosion, undercutting, and washout of material. The roundhead of the structure has collapsed, leaving the pier more susceptible to further damage.
- **South West Breakwater, Port of Sunderland** - The concrete and masonry structure is generally in fair condition although local areas of significant damage require attention. Concrete blocks on the northern face are significantly displaced, forming voids in the structure. Previous underwater surveys have identified degradation of toe piling (both holing and undermining).

Both NFCDD condition grade and recommended actions from the NECAG Coast Protection Assets and Coastal Slope Condition Analysis report have been summarised in Appendix C. Condition ratings should be used within any further assessment into the risk of breaching of coastal defence assets.

Since the NECAG Coast Protection Assets and Coastal Slope Condition Analysis report was published in April 2009, repairs to the coastal defences have been limited to concrete deck repairs on Roker Pier and New South Pier. Sunderland City Council is currently undertaking a Whitburn Bay to Ryhope Coast Protection Strategy Review. Following approval by the Environment Agency of this Strategy Review, Sunderland City Council intends to pursue funding from them for prioritised capital works to the coastal defences.

3.3.2 Risk of Coastal Assets Overtopping

As part of the evidence base for this SFRA, Sunderland City Council provided the results of a physical modelling study undertaken by Scott Wilson (2004)[5] which was produced as part of the recommendations arising from the Whitburn Bay to Ryhope Coastal Strategy.

The objective of the physical modelling study was to provide modelling results which could be used as an input in producing design guidelines that will underpin future coast protection designs in a consistent manner. The three main aspects of the tests were to evaluate the following:

- The overtopping performance of the existing and proposed structures
- The stability of the proposed rock armour protection
- Beach response

Five structures where physically modelled and there response to a range of scenarios investigated. These included:

1. Seaburn Seawall
2. Roker Seawall
3. Hendon Foreshore Barrier
4. North East Pier (Deep)
5. North East Pier (Shallow)

The physical modelling results showed that in almost all cases each asset was at significant risk of overtopping especially during the sea level rise scenarios (climate change). A summary of mean overtopping rates are summarised in Table 3-4 below.

Table 3-4: Coastal Asset Modelled Overtopping Rates

Asset	Mean Overtopping rates (m^3/sm)*		
	1 in 10	1 in 200	1 in 200 + CC
Seaburn Seawall	0.0282	0.0841	> 0.3

[5] Sunderland City Council (2004) Whitburn Bay to Ryhope Coastal Strategy: Physical Modelling Study

Asset	Mean Overtopping rates (m³/sm)*		
	1 in 10	1 in 200	1 in 200 + CC
Roker Seawall	0.0447	0.138	0.2814
Hendon Foreshore Barrier	0.358	0.4259	0.45
North East Pier (Deep)	0.33	0.4204	0.403
North East Pier (Shallow)	0.446	0.538	0.559
*m³/sm = meters cubed per sectional meter length per second			

Along with the current situation the physical modelling investigated possible mitigation measure to reduce to rate of overtopping along each asset, which included increasing the height of the crest level, setting back defence from the face of the sea wall and modified geometrics including the addition of rock armoured revetments. The recommended mitigation technique or that which offers acceptable levels overtopping rates for each asset is highlighted below:

Table 3-5: Coastal Asset Mitigation Technique

Asset	Mitigation Technique
Seaburn Seawall	Original structure with crest wall, crest level 6.5m set back 5m from face of seawall
Roker Seawall	Original structure with crest wall, crest level 6.0m
Hendon Foreshore Barrier	Original structure with crest wall, crest level 5.5m
North East Pier (Deep)	Single slope (1:1.5) rock armoured revetment with upper crest level of 6.5m
North East Pier (Shallow)	Single slope (1:1.5) rock armoured revetment with upper crest level of 6.5m

3.4 Tidal and Fluvial Flooding

Sunderland contains around 26.5km of inland designated main rivers and another 37km of Ordinary Watercourses. Ordinary Watercourses are those that are not designated as Main River and therefore come under the control of the local authority, who have Permissive Power to carryout works should this be deemed necessary. These Ordinary Watercourses will usually be a tributary to a main river (River Wear, Don, Lumley Park and Usworth Burn); however those which are situated along the eastern side of Sunderland will not be hydraulically connected and flow into the North Sea.

There are also a number of smaller watercourses or drains throughout Sunderland identified on the identified on the 1:10,000 scale OS map as Gills, which drain golf courses, ponds and woodlands woodlands surrounding the River Wear. Table 3-6 and

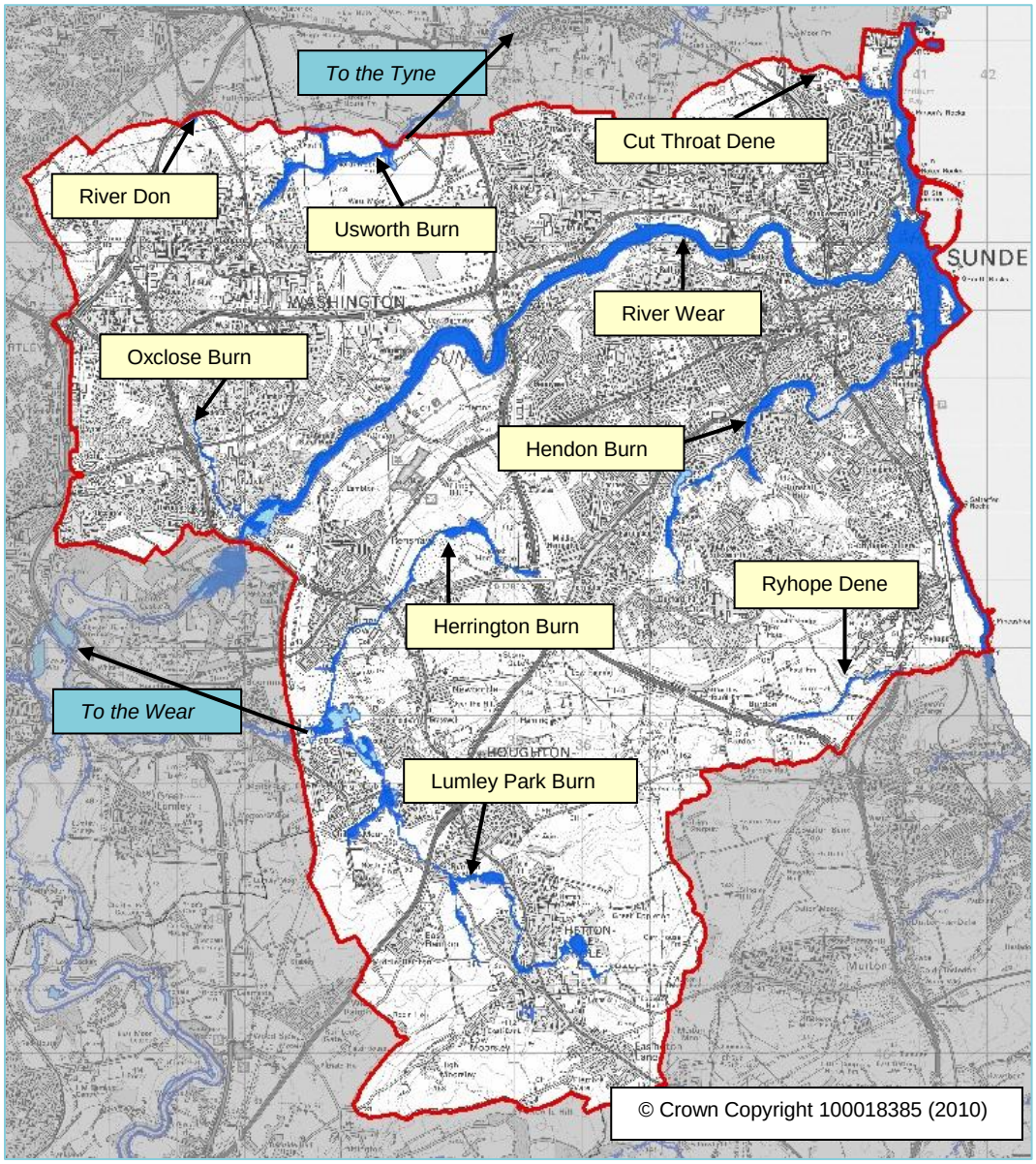
Figure 3-1 illustrates all key watercourses within Sunderland, there designation, downstream extent (i.e. if there are a tributary to a large watercourse or flow in to the North Sea) and the source of flooding.

Table 3-6: Watercourses within Sunderland

Watercourse Name	Designation	Downstream Extent	Source of Flooding
Barnes Burn	Ordinary Watercourse	River Wear	Fluvial
Biddick Burn	Ordinary Watercourse	River Wear	Fluvial/Tidal
Burdon Dene, Cherry Knowles Dene, Ryhope Dene	Ordinary Watercourse	North Sea	Fluvial/Tidal

Watercourse Name	Designation	Downstream Extent	Source of Flooding
Cut Throat Dene	Ordinary Watercourse	North Sea	Fluvial/Tidal
Hendon Burn	Ordinary Watercourse	North Sea	Fluvial/Tidal
Herrington Burn	Ordinary Watercourse	Lumley Park Burn	Fluvial
Hylton Dene Burn	Ordinary Watercourse	River Wear	Fluvial/Tidal
Lumley Park Burn	Main River	River Wear	Fluvial
Red Burn	Ordinary Watercourse	Lumley Park Burn	Fluvial
River Don	Main River	River Tyne	Fluvial
River Wear	Main River	North Sea	Tidal
Rough Dene Burn	Ordinary Watercourse	Lumley Park Burn	Fluvial
Usworth Burn	Main River	River Don	Fluvial
Whittle Burn	Ordinary Watercourse	River Don	Fluvial

Figure 3-1: Location of Key Watercourses in Sunderland



Flood risk associated with these watercourses can be both fluvial and tidal dominated. Tidal flooding along watercourses is caused by extreme tide levels exceeding river ground/bank/defence levels. In the case of Sunderland, this means extreme tide levels along the River Wear estuary caused by high tides or storm surges in the North Sea.

Flooding along estuaries can be complex and difficult to predict because it is influenced not just by the volume of fresh water travelling down the estuary from the river system, but also by the height of tides and tidal surges coming up the estuary. Tidal flood events usually dominate in these circumstances and have greater influence on peak water levels than fluvial events. The tidal limit usually identifies the extent of the tidal influence of flooding. Along the River Wear, this is located at Chester-le-Street weir outside of the Sunderland City boundary.

Fluvial flooding of watercourses is associated with the exceedance of channel capacity during higher flows. The process of flooding on watercourses depends on a number of characteristics associated with the catchment including; geographical location and variation in rainfall, steepness of the channel and surrounding floodplain and infiltration and rate of runoff associated with urban and rural catchments. Fluvial flood risk within Sunderland is low due to the small catchment areas of those watercourses originating within Sunderland and the large capacity of the River Wear.

3.4.1 Environment Agency Flood Zones

The Environment Agency Flood Zone Map provides an overview of areas considered susceptible to flood risk in the study area as a result of fluvial and tidal flooding. These maps have been prepared in a consistent manner across England and Wales and provide an estimation of the extent of flooding for the 1 in 100 year fluvial, 1 in 200 year tidal and both 1 in 1000 year fluvial and tidal flood events.

The Flood Zone maps were prepared using a methodology based on the national digital terrain model (NextMap), derived river flows (Flood Estimation Handbook (FEH)) and two dimensional flood routing.

There are a number of watercourses that pose the greatest flood risk to Sunderland that have been investigated by the Environment Agency. These include the River Wear and Lumley Park Burn; both have been explicitly modelled in detail as part of the Environment Agency Flood Risk Mapping Studies. These studies have been used to update the theoretically derived Flood Zone extents. The remaining watercourses are still based on broad scale modelling and have not been modelled in detail.

The Environment Agency Flood Zone Maps are precautionary in that they do not take account of flood defences because these can be breached, overtopped and may not be in existence for the lifetime of the development and, therefore, represent a worst-case extent of flooding. They do not consider other forms of flooding and do not take account of climate change.

PPS25 divides the country into three basic flood zones, Flood Zones 1, 2 and 3, corresponding to areas of low, medium and high flood risk, respectively. Version 3.15 of the Environment Agency Flood Zones issued in September 2009 has been used within this SFRA.

PPS25 Flood Zones have been produced on a set of twelve maps covering the entire Sunderland study area labelled **2009s0243-SCC-A1 to A12**. These maps have been produced to a 1:10,000 scale to allow for detailed identification of flood zone extents. These maps can be used to identify the extent of:

- Main Rivers
- Ordinary Watercourses
- Flood Zone 2
- Flood Zone 3a
- Flood Zone 3b (Functional Floodplain)
- Sunderland City Council proposed development sites

The Functional Floodplain (Flood Zone 3b), as described in Appendix A of Volume I, has been defined using modelled 1 in 25 year outlines where available in accordance with PPS25. The modelled outlines were then edited using the following methodology:

- Inclusion of land which provides a function for flood conveyance or flood storage (e.g. washlands)
- Removal of areas benefitting from defences (ABDs)
- Removal of developed (Brownfield) land
- Removal of major transport infrastructure (e.g. motorways and railways)
- Removal of 'dry islands' defined using the 'size standards' within the Environment Agency SFRM Specification for Flood Risk Mapping6

For those watercourses that do not have modelled 1 in 25 year outlines, the Functional Floodplain has been identified based on the Environment Agency Flood

[6] Environment Agency (2006) Strategic Flood Risk Management Specification for Flood Risk Mapping release 1.2

Zone 3 outlines as a precautionary approach and also edited using the above methodology.

It is difficult to distinguish at a strategic level, without detailed planning/building design information or 2D modelling results, storage areas or critical flow routes within the urban domain. Just because an area is within the 1 in 25 year outline does not mean it provides a floodplain function. Urban areas have therefore been removed from the functional floodplain within the SFRA in both modelled 1 in 25 year and Flood Zone 3 outlines.

Recommendation

It must be acknowledged some urban areas may still provide a floodplain function and as it is crucial that the outline for the functional floodplain is as accurate as possible, the true extent should be reviewed in more detail during a site-specific FRA.

This is also recommended for those watercourses where the functional floodplain has been precautionary derived using Flood Zone 3 due to the lack of modelled data identified in Table 3-4.

The approach used to define the functional floodplain for each watercourse is summarised in Table 3-7.

Table 3-7: Functional Floodplain (Flood Zone 3b) Mapping

Watercourse	Type	Data Source
Barnes Burn	Ordinary Watercourse	Flood Zone 3
Biddick Burn	Ordinary Watercourse	Flood Zone 3
Cut Throat Dene	Ordinary Watercourse	Flood Zone 3
Hendon Burn	Ordinary Watercourse	Flood Zone 3
Herrington Burn	Ordinary Watercourse	Flood Zone 3
Hetton Burn	Ordinary Watercourse	Flood Zone 3
Houghton Burn	Ordinary Watercourse	No Flood Zone available
Hylton Dene Burn	Ordinary Watercourse	No Flood Zone available
Lumley Park Burn	Main River	1 in 25 modelled outline
Red Burn	Ordinary Watercourse	Flood Zone 3
River Don	Main River	Flood Zone 3
River Wear	Main River	1 in 25 modelled outline
Rough Dene Burn	Ordinary Watercourse	No Flood Zone available
Ryhope Dene	Ordinary Watercourse	Flood Zone 3
Usworth Burn	Main River	Flood Zone 3
Whittle Burn	Ordinary Watercourse	No Flood Zone available

Those key watercourses that pose the greatest risk of flooding to people and property within Sunderland are discussed in detailed below.

3.4.2 River Wear upstream of the City

As the River Wear is the only main river originating outside of Sunderland, it is useful to obtain a brief understanding of flood risk upstream, potential flood storage areas or key development which could influence risk downstream within Sunderland.

The River Wear rises in the North Pennine Moors and descends rapidly eastward past several small towns, before turning north at Bishop Auckland where it is joined by the River Gaunless and flows into Durham. The topography of the Upper Wear is characterised by high gradients, steep valleys and narrow floodplains. This topography is a significant factor in the runoff response to rainfall. The steepness of the valley sides contributes to the rapid and sharply peaked flood events characteristic of the upper Wear.

Before Durham, the Wear is joined by another two main tributaries the River Deerness and Browney. The Wear continues to meander north before flowing north east and into Sunderland. This area is characterised by an undulating topography with lower channel gradients, more gently sloping valley sides and wider natural floodplains.

According to the Wear CFMP:

"Due to the differences in the catchments between the main river Wear and the tributary rivers catchment, wide floods are rare and flooding generally occurs on either the Wear, or the tributaries, but rarely on both at the same time.

The largest floods on the Wear have historically been associated with winter storms, when milder weather fronts have resulted in significant volumes of rainfall falling and melting large amounts of lying snow in the upper catchment. Flooding has occurred in all of the principal settlements along the Wear including Stanhope, Frosterly and Wolsingham in the upper Weardale areas.

While recent floods have flooded limited areas of Durham City, major flooding did occur in the 1960s flooding areas around the Framwellgate and Elvet riverside and up towards the rugby grounds and rowing club to the east of the city.

In 2000 major flooding affected the River Gaunless and large numbers of properties were flooded in West Auckland and further downstream in South Church near Bishop Auckland. Flooding on the Gaunless occurred again in 2005.

In the lower sections of the Wear catchment, flooding in the Chester-le-Street area has been associated with both the Chester Burn and the River Wear. Major flooding occurred in 1979 and again in the mid 1990s when the Chester Burn over topped its banks to the west of the town and flooded large areas of the market place and residential areas. In the tidal section of the river, flood risk is limited by the steep riverbank topography.[7]*"*

Sunderland City Council should be aware of how future changes in the upstream catchment could influence flood risk within Sunderland, mainly urbanisation and/or the loss of natural floodplain.

Strategic modelling undertaken by the Environment Agency during the Wear CFMP, shows that the potential increase in urban extents would not make a significant difference to flood flows catchment wide (due to the increase runoff rates of the urban area). However, there could be potential adverse localised effects on the runoff characteristics of individual sub-catchments. Whilst the CFMP investigated the expansion of the urban area, the location of development in this instance is the key to increasing flood risk.

Recommendation

Upstream planning authorities should still implement PPSS25 and avoid allocating and developing inappropriate development within the natural floodplain.

[7] Environment Agency (2008) River Wear Catchment Flood Management Plan

However, flood risk from the Wear is determined by the flow volumes from upstream areas and not from individual tributary catchments in the lower part of the catchment. Urbanisation can therefore be expected to not have a significant influence on the future generation of flood flows from the upper catchment impacting on the lower part of the catchment.

3.4.3 River Wear at Fatfield

The village of Fatfield is located to the south of Washington, on the tidal River Wear. The majority of the settlement is elevated above the River Wear, but some lower locations, including Mount Pleasant south of the Wear, have a history of flooding.

The flood risk associated with this section of the Wear was originally investigated in 2003, where a 6.5km HEC-RAS hydraulic model was created for the Wear between the A1 Bridge crossing upstream and the Victoria railway viaduct at the downstream limits of the town. This model was updated in 2007 as part of the Environment Agency flood risk management pre-feasibility study for Fatfield.

Map **2009s0243-SCC-A13** has been produced at a scale of 1:3,000 and shows modelled flood extents for a range of undefended flood events including the 1 in 5, 25, 50, 75, 100, 200 and 1000 year. Figure 3-2 is an extract from this map and show the extent of modelled flood extents along the River Wear at Fatfield.

Figure 3-2: Fatfield Modelled Flood Extents

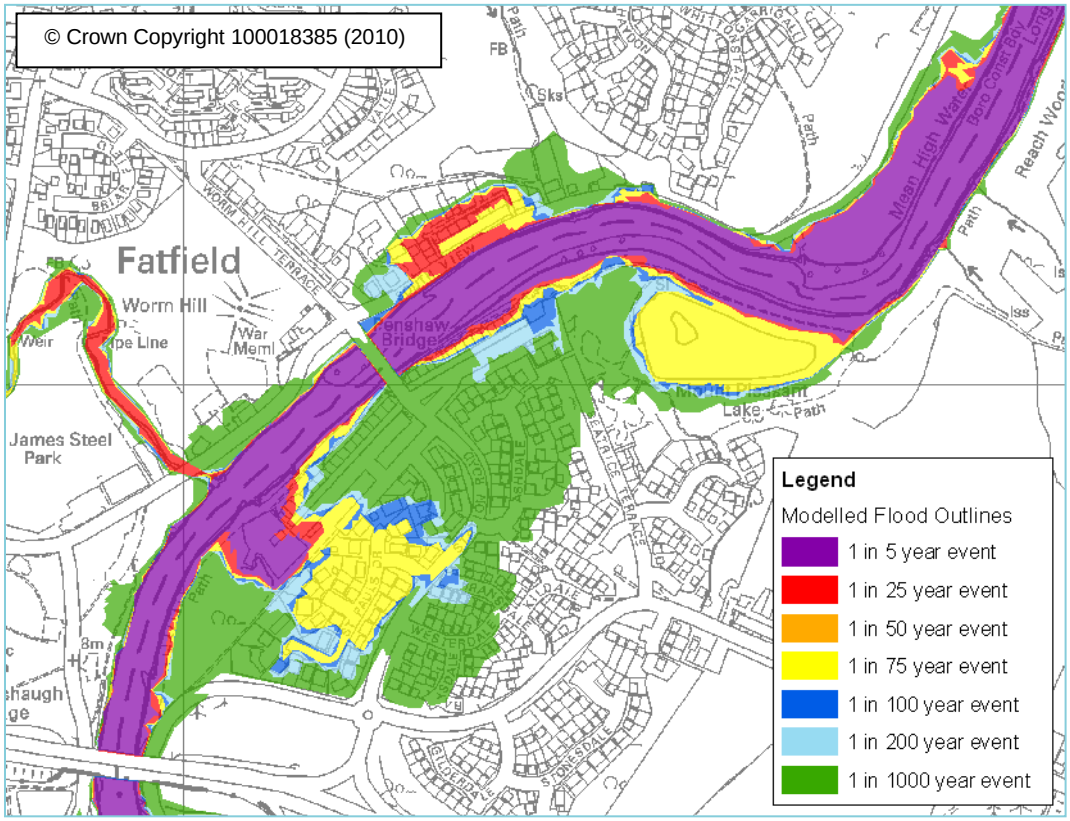


Table 3-8: Flooded Properties for a Range of Return Periods in Fatfield

Return Period / Number of Properties						
25	50	75	100	150	200	1000
29	67	76	83	92	98	182

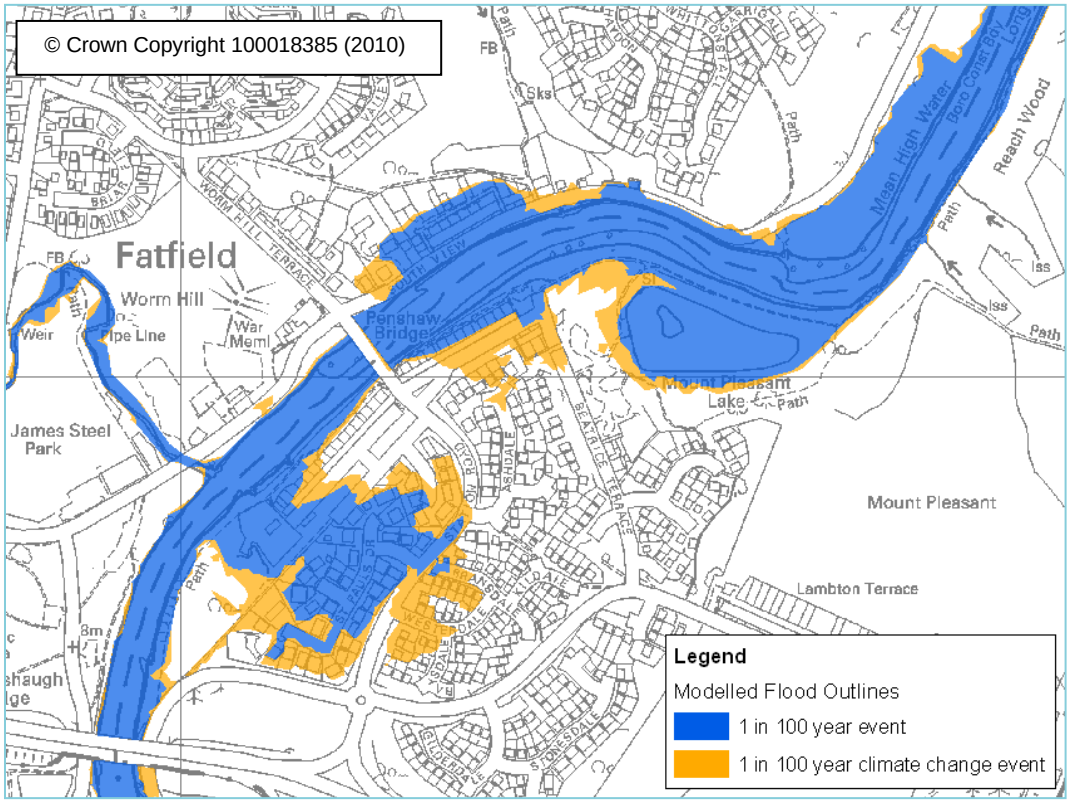
83 properties are inundated during the 1 in 100 year (Flood Zone 3) and 182 properties during the 1 in 1000 year flood event (Flood Zone 2). 29 properties are affected in a 25 year flood event. PPS25 uses this return period as a starting point in defining the functional floodplain. Whilst the majority of the 1 in 25 year flood extent is urban in from, it was built within the natural floodplain. However, as the majority of this area has not been designed to store or route flood water it has not been defined as functional floodplain within this SFRA. Sections of the 1 in 25 year flood extent around open land west of West Bridge Street and land north of the Wear immediately upstream of the Victoria railway viaduct have been defined as functional floodplain.

The sensitivity of the 1 in 100 year flood event along River Wear to climate change has been investigated using modelled flood extents collected from the Environment Agency.

In Sunderland, the extent of flooding does not increase significantly along the River Wear when including the effects of climate change due to the capacity of the river in dealing with large fluvial and tidal flood events. However, the area of Fatfield does show some increase in flooded area during the 1 in 100 year event when including an allowance for climate change. This is not a significant increase; however the flood extent is larger than the modelled 1 in 200 year flood event.

The results the climate change assessment at Fatfield is provided on map **2009s0243-SCC-B1**. Figure 3-3 is an extract from this map.

Figure 3-3: Climate Change impact at Fatfield



A number of possible flood alleviation options were investigated during the 2007 pre-feasibility study including the development or improvement of:

- The current flood warning coverage
- Flood proofing of current properties
- New flood walls

On review of the information and recommendations provided in the 2007 pre-feasibility study, the raised defences options is considered to be the only improvement option that is both technically and environmentally viable, as not overwhelming constraints had been identified. According to the 2007 study,

"The scheme has a low priority score. As such it is unlikely that Defra funding would be forthcoming for some years to come. Direct funding from the Local Levy may be a possibility, although at a cost in the region of £1.9m for a community scheme this is unlikely. Also, as there has been no flooding of property in recent years there is unlikely to be social or political pressure to promote a scheme. It is unlikely that the area would benefit from the building of flood defences."

There are a number of current Environment Agency Flood Warning and Flood Watch Areas along the River Wear at Fatfield. These include:

Table 3-9: Fatfield Flood Warning Areas

Code	Name	Description
121FWTNWT53	Wear Estuary from Fatfield to Queen Alexander Bridge	Areas including Fatfield, Cox Green, South Hylton and Pallion

Figure 3-4: Fatfield Flood Warning Areas

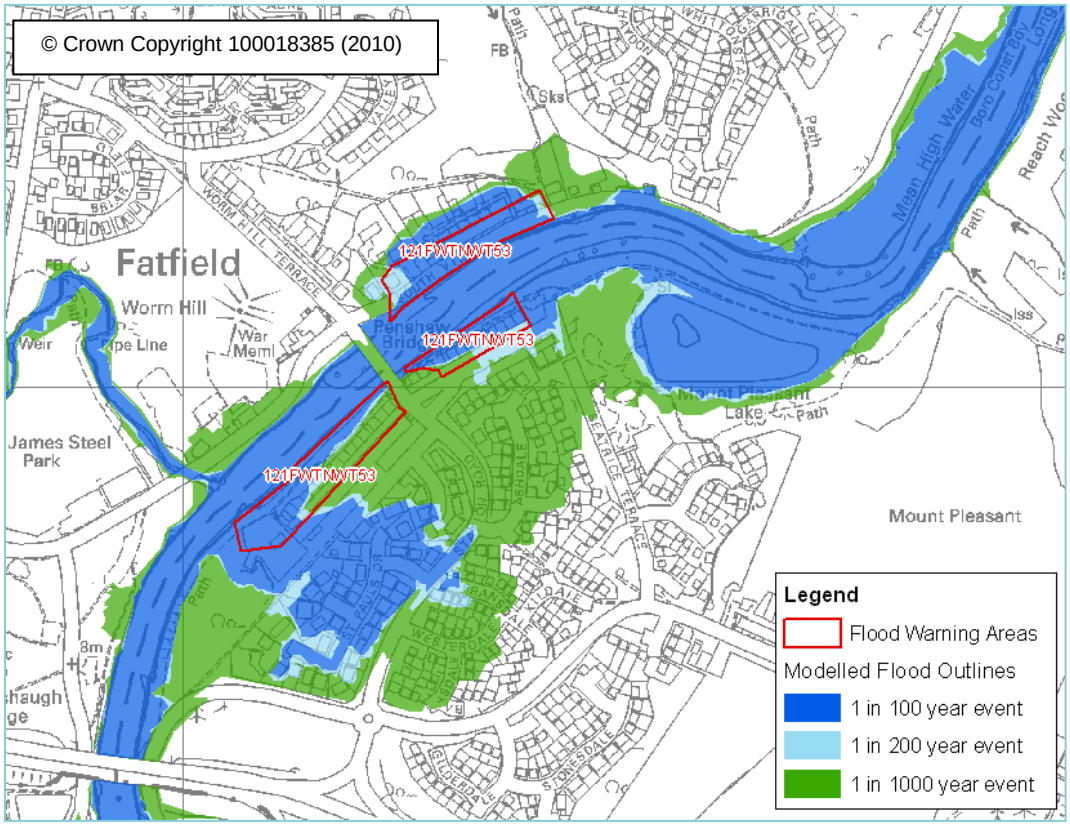


Figure 3-4 shows the extent of current Flood Warnings in Fatfield. The warning system doesn't cover all properties at risk during the 1 in 100 year flood event and only covers those properties directly adjacent the to River Wear.

Recommendation

As proposed in the 2007 Fatfield Pre-Feasibility Study, the Flood Warning area south of the River Wear should be extended to those properties surrounding St. Pauls Drive (1 in 100 year event or greater).

3.4.4 River Wear between A19 and Victoria Railway Viaduct

The Flood Zones between the A19 road bridge and the Victoria railway viaduct in Washington are still based on this broad scale model outputs. As such the flood extents are obviously different when compared to those downstream of the A19 or upstream of the Victoria railway viaduct.

In this reach Flood Zone 3 is wide whilst down stream of the A19 they are constrained to the river banks. 27 properties are at risk within Flood Zone 3 with an additional 2 properties at risk during the 1 in 1000 year event (Flood Zone 2). The majority of these properties are located along the river bank at Cox Green.

There are a number of Flood Warning and Flood Watch Areas along this reach of the River Wear. The areas of Fish Quay, Crown Works and land at Oferton Lane which are located within Flood Warning Area 121FWTNWT53 are no longer within Flood Zone 3 (1 in 100 year event) due to the flood mapping study in 2006. These include:

Table 3-10: River Wear Flood Warning Areas

Code	Name	Description
121FWTNWT53	Wear Estuary from Fatfield to Queen Alexander Bridge	Areas including Fatfield, Cox Green, South Hylton and Pallion
121FWTNWT54	Roker Sea front	Amusement Arcades and Smugglers Pub
121FWTNWT55	Wear Estuary at Sunderland Low Street	Properties at Wylam Wharf, Low Street

3.4.5 River Wear through Central Sunderland

The flood risk associated with Reach 1 (Wearmouth to A19 Road Bridge) of the River Wear was investigated by the Environment Agency in 2006 as part of their Strategic Flood Risk Mapping programme[8]. The study involved a detailed hydrological and hydraulic model of the reach and the production of flood risk maps for a number of design events. The model itself extended from the mouth of the Wear upstream to the tidal extent.

As Reach 1 of the River Wear is tidally influenced, flood risk is driven by peak tidal levels. The tidal levels for a range of return periods were calculated during the Flood Risk Mapping Study of Reach 1 of the River Wear in 2006. The extreme sea analysis for Sunderland Pier Heads was calculated using the Proudman Oceanographic Laboratory (POL) method and are provided below in Table 3-11. The POL method can only calculate extreme tidal levels for return periods 1, 10, 25, 50, 100, 500, 1000 and 10,000 years and therefore interpolation was used for the other values.

Table 3-11: Extreme Tidal Levels Estimates (mAOD)

Tidal Return Period (years)									
1	2	5	10	25	50	75	100	200	1000
3.38	3.46	3.56	3.63	3.71	3.78	3.81	3.84	3.89	4.02

Prior to this study, there was no detailed model of the Wear and the Flood Zones were based on early broad scale modelling completed on behalf of the Environment Agency by JBA Consulting. These original Flood Zones were used within the first Sunderland SFRA in 2006.

According to the 2006 flood mapping report:

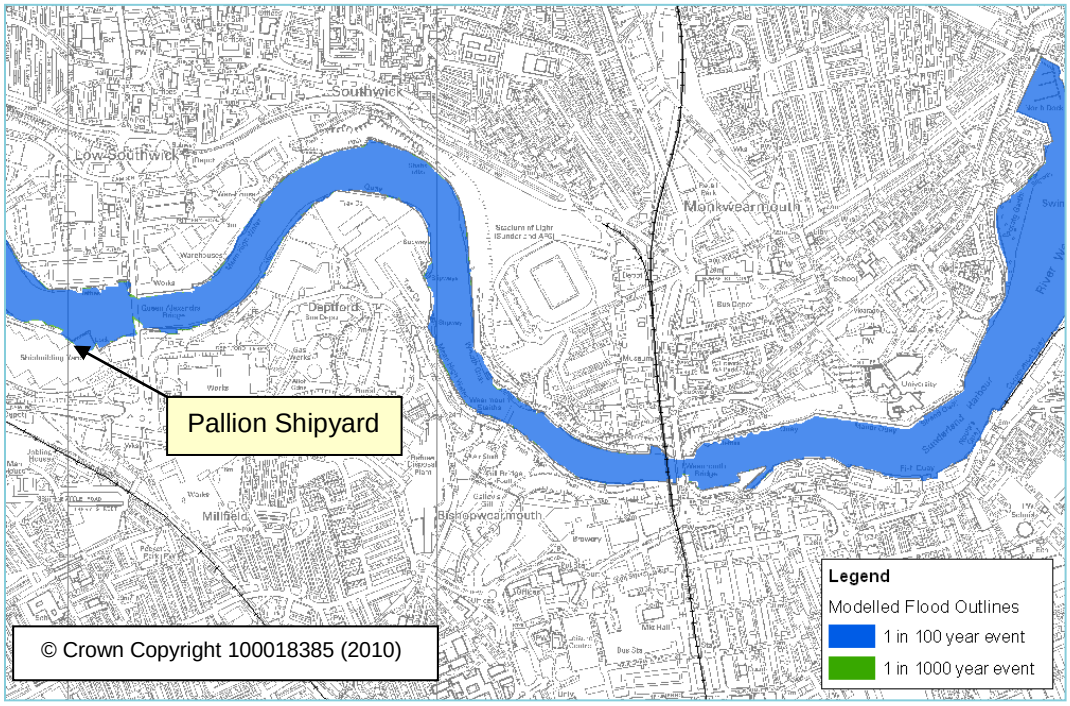
"The study results show a decrease in floodplain area when comparing the maximum extent of the 200 year tidal event and the 100 year fluvial event with the Flood Zone 3 map. This change in floodplain area, results in 322 properties being removed from the Flood Zone and 7 new properties being added to the Flood Zone.

The study results also show a decrease in floodplain area when comparing the maximum extent of the 1000 year tidal event and the 1000 year fluvial event with the Flood Zone 2 map. The change in floodplain area results in 344 properties being removed from the Flood Zone, and none added.[9] "

According to the current Environment Agency Flood Zones (Version 3.15, September 2009) there is only one property are risk through Sunderland Town Centre; Pallion Shipyard along Pallion New Road.

[8] Environment Agency (2006) River Wear at Sunderland (Reach 1) Flood Mapping Study
[9] Environment Agency (2006) River Wear at Sunderland (Reach 1) Flood Mapping Study

Figure 3-5: River Wear through Central Sunderland*



**Larger maps of all Flood Zones within Sunderland are provided on maps 2009s0243-SCC-A1 to A12.*

Table B.1 of PPS25 gives recommended contingencies for net sea level rise up to 2115. For Sunderland, the 2006 sea level is predicted to rise by 0.22m over the next 44 years (to 2050), and by 0.75m within 94 years (to 2100). Table 3-12 outlines the effect of climate change on extreme tidal levels at the Sunderland Pier Head.

Table 3-12: Effects of Climate Change on Extreme Tidal Levels (mAOD)

Date	Tidal Return Period (years)									
	1	2	5	10	25	50	75	100	200	1000
2006	3.38	3.46	3.56	3.63	3.71	3.78	3.81	3.84	3.89	4.02
2050	3.60	3.68	3.78	3.85	3.93	4.00	4.03	4.06	4.11	4.24
2100	4.13	4.21	4.31	4.38	4.46	4.53	4.56	4.59	4.64	4.77

The 1 in 200 year peak tidal level is expected to increase from 3.89 to 4.11 mAOD by 2050. This tidal level is just above the current 1 in 1000 year peak tidal level. It is therefore expected that the extent of flooding would not increase, as the current 1 in 1000 year tidal event remains in bank. Over the next 100 years, the 1 in 200 year tidal event could increase by over 0.5m to 4.64 mAOD, just over 0.6m above the current extreme 1 in 1000 year tidal level.

3.4.6 Lumley Park Burn

Lumley Park Burn is a small tributary on the right bank of the River Wear at Chester-le-Street. Its catchment area is 51 km², with a mixture of urban and post-industrial land uses. Lumley Park Burn catchment includes other watercourse including:

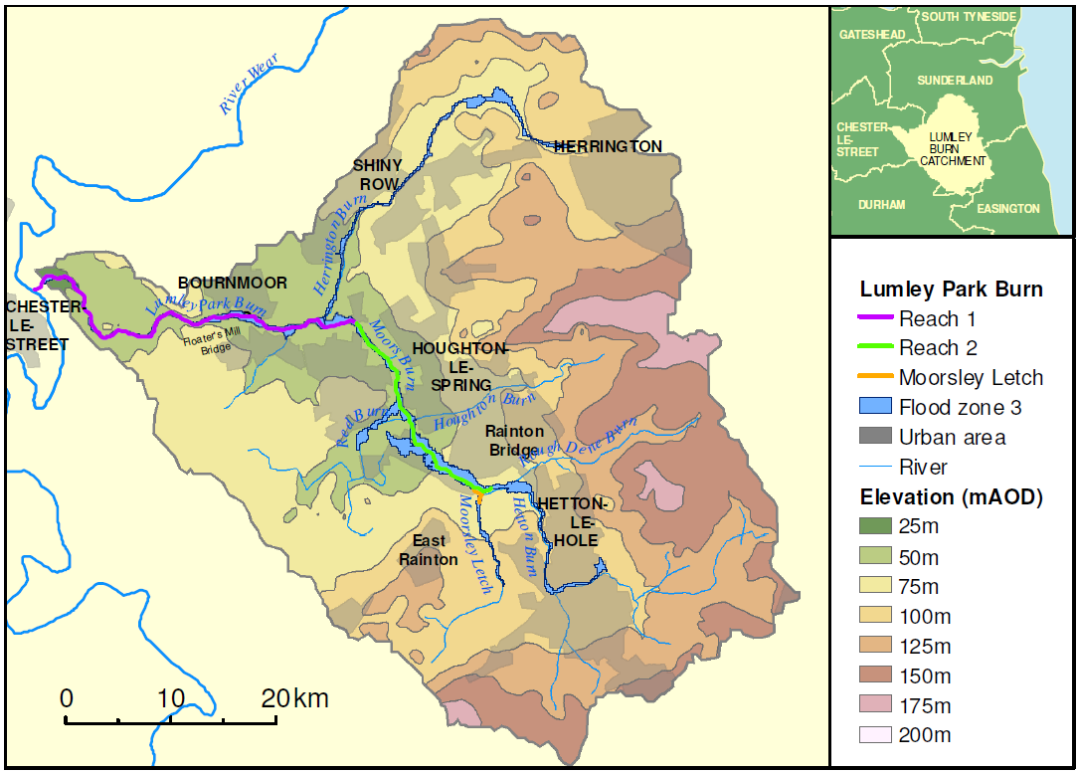
- Herrington Burn;
- Moors Burn;
- Red Burn;
- Houghton Burn;

- Moorley Letch;
- Hetton Burn;
- Rainton Burn; and
- Rough Dene Burn.

There is very little history of flooding along the model reach (from the A1 to confluence with Rough Dene). Sunderland City Council Drainage Operations Manager identified a culvert underneath Welfare Road at the Hetton Centre that cause significant flooding during heavy rain due to the amount of debris which can be deposited on the upstream grill.

The flood risk associated with Lumley Park Burn was investigated in 2008 by the Environment Agency as part of a Strategic Flood Risk Mapping (SFRM) Study. The modelling showed a substantial reduction in areas at risk from flooding compared to the previous Flood Zone extents, which were used in the first Sunderland SFRA. However, the modelled flood extents identify a number of current properties along Dairy Lane and Longacre estate at risk of fluvial flooding from Lumley Park Burn.

Figure 3-6: Lumley Park Burn Study Area[10]



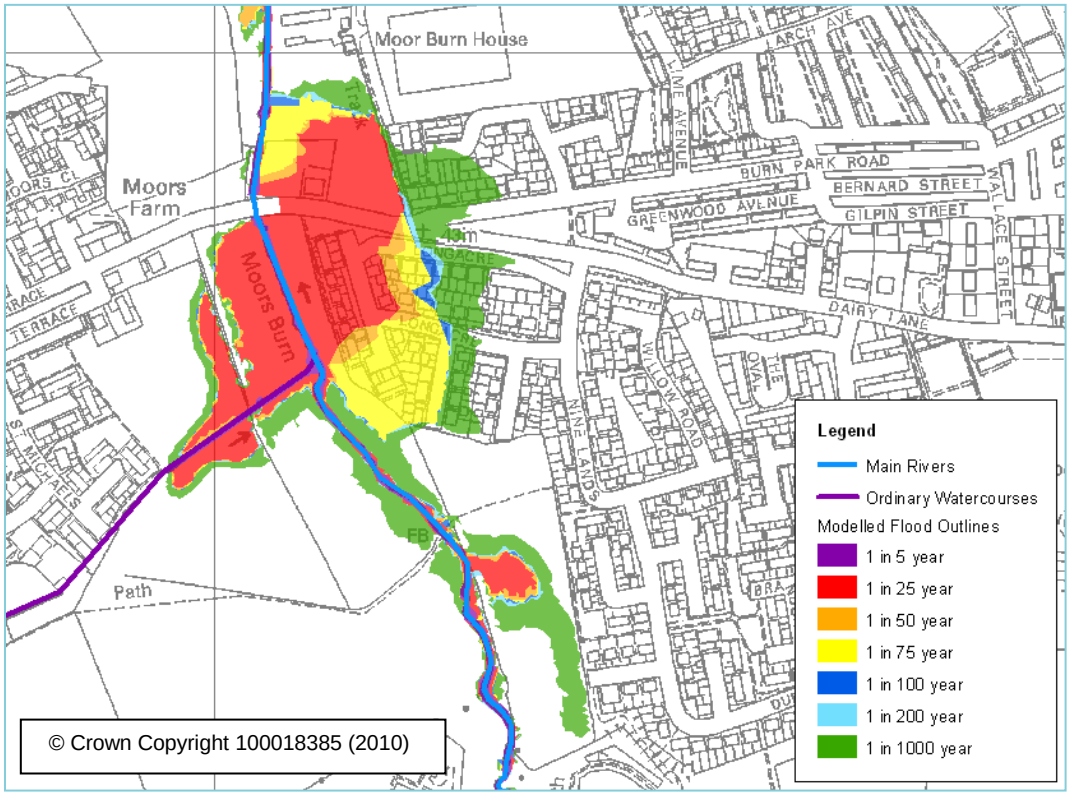
Map 2009s0243-SCC-A14 has been produced at a scale of 1:6,000 and shows the undefended modelled flood extents for a range of flood events including the 1 in 5, 25, 50, 75, 100, 200 and 1000 year.

Both the undefended 1 in 100 and 1 in 1000 year flood extents have been used to update the Environment Agency Flood Map. The defended 1 in 25 year flood extent has also been used within this SFRA to define the functional floodplain.

Figure 3-7 is an extract from map 2009s0243-SCC-A14 and show the extent of modelled flood extents along Lumley Park Burn at Dairy Lane.

[10] Environment Agency (2008) Lumley Park Burn Flood Risk Mapping Study (Figure 1.1 extract)

Figure 3-7: Lumley Park Burn Modelled Undefended Flood Extents



There are two main raised defences within Sunderland. Both are located along Lumley Park Burn on the left hand bank at Osman Terrace and the second on the right hand bank at Dairy Lane. Areas Benefitting from Defences (ABDs) can be identified in Figure 3-9 and Figure 3-10 as the difference between the undefended and defended flood extents. Both defences protect the adjacent area to a 1 in 200 year standard.

66 properties are at risk during the 1 in 100 year flood event (Flood Zone 3). However, 55 of these benefit from the defences at Dairy Lane and Sedgeletch. 110 properties are at risk during the 1 in 1000 year flood event (Flood Zone 2). During such an extreme event, previous areas benefitting from defences would be inundated as defences overtop or are bypassed by flood waters to the south.

Peak flows in fluvial floods are likely to increase by around 20% over the next 50 to 100 years. The area surrounding Lumley Park Burn shows an increase in extent during the 1 in 100 year plus climate change based event (an undefended climate change extent is illustrated Figure 3-11). However there is not a significant difference between the future and current extents.

Since both Osman Terrace and Dairy Lane are protected up to a 1 in 200 year flood event, it is likely that these defences will continue to protect the adjacent land when taking into account the effect of climate change. However, a freeboard (or safety margin) will be reduced. This area will still be at risk for extreme event greater than the 1 in 200 year event now and in the future.

Figure 3-8: Dairy Lane Flood Defence

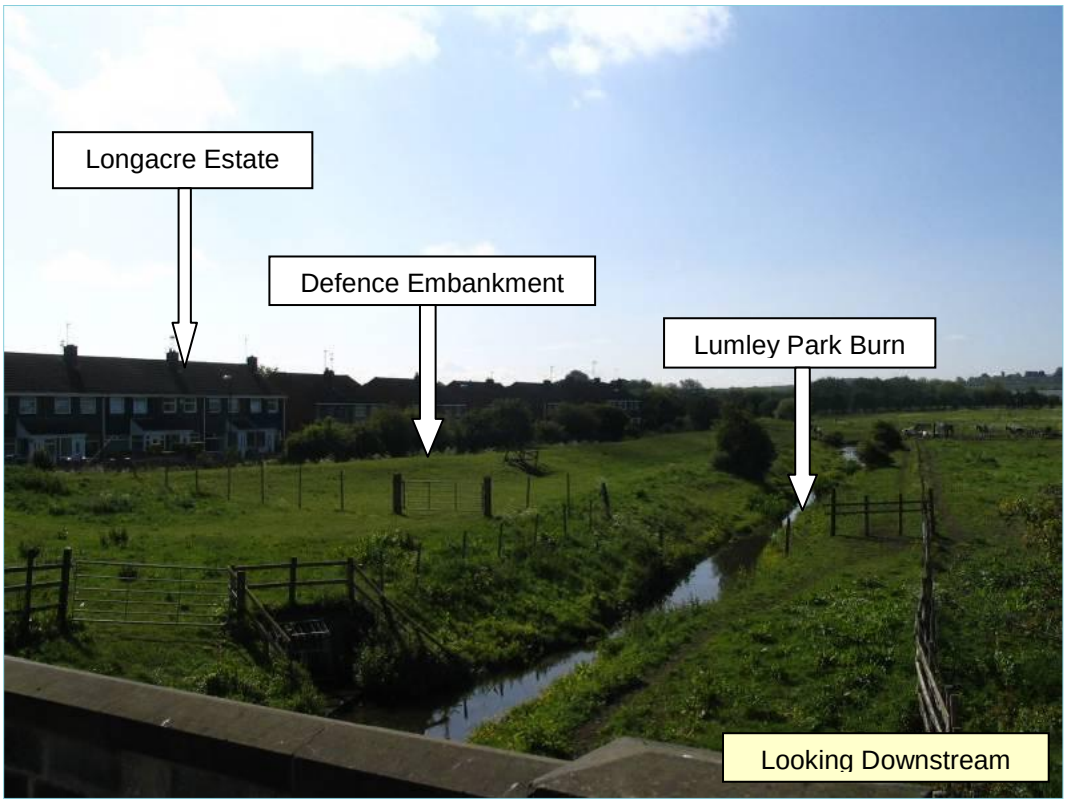


Figure 3-9: Dairy Lane Area Benefitting from Defence

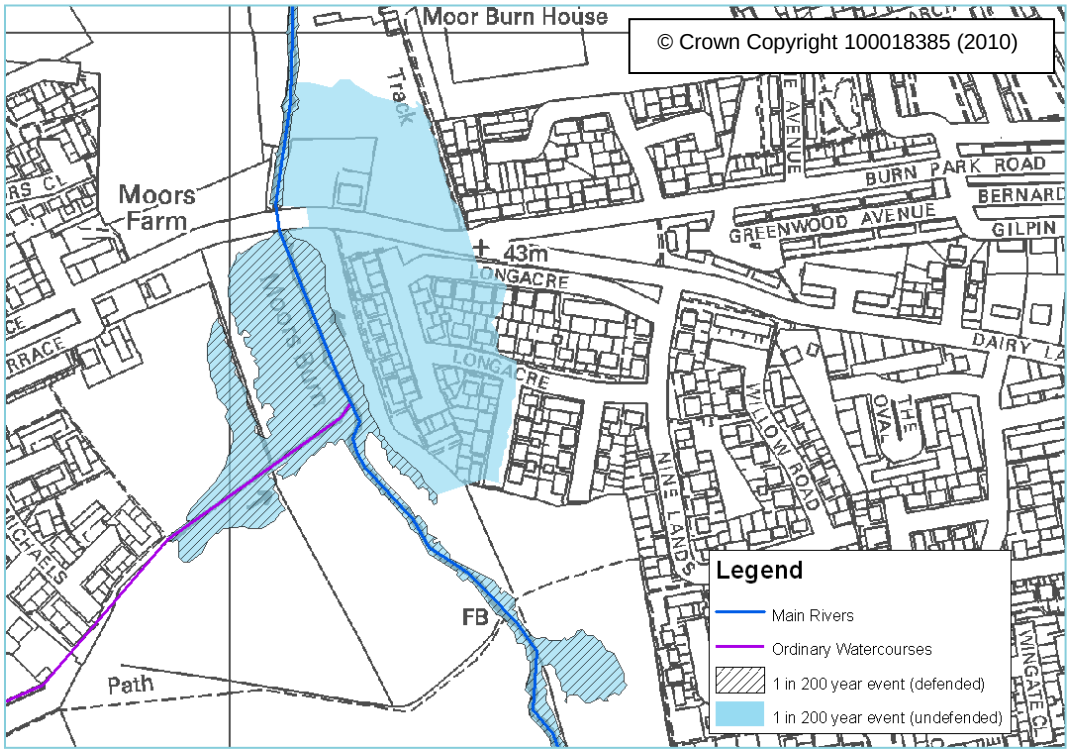


Figure 3-10: Osman Terrace Area Benefitting from Defence

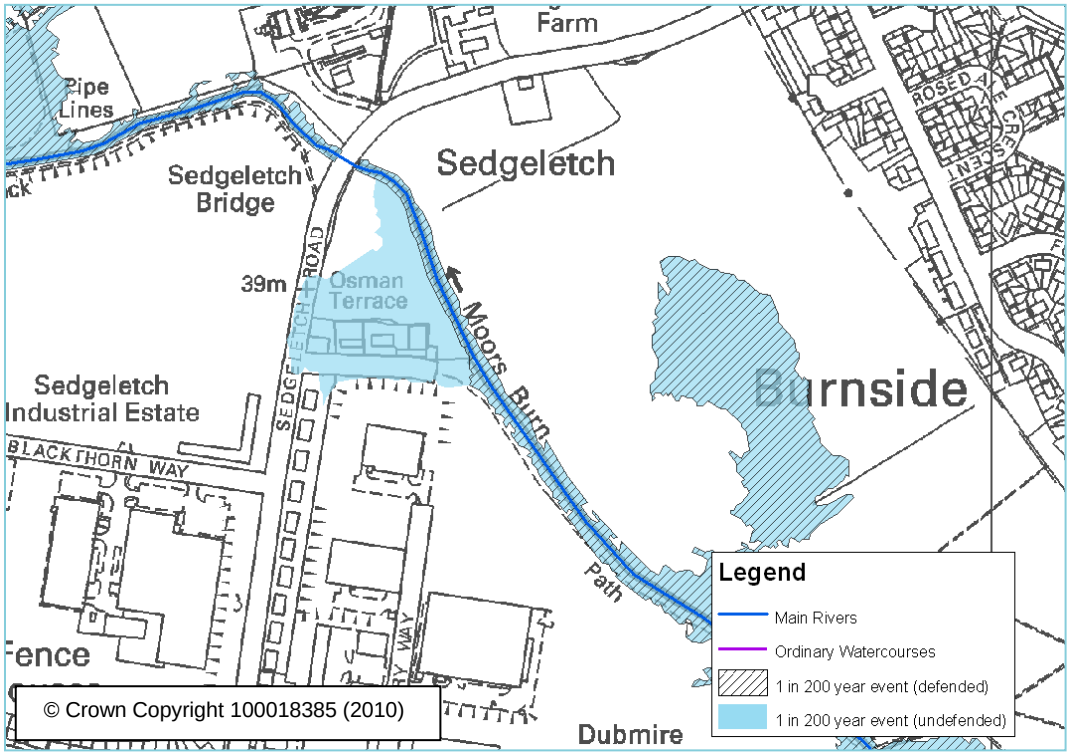
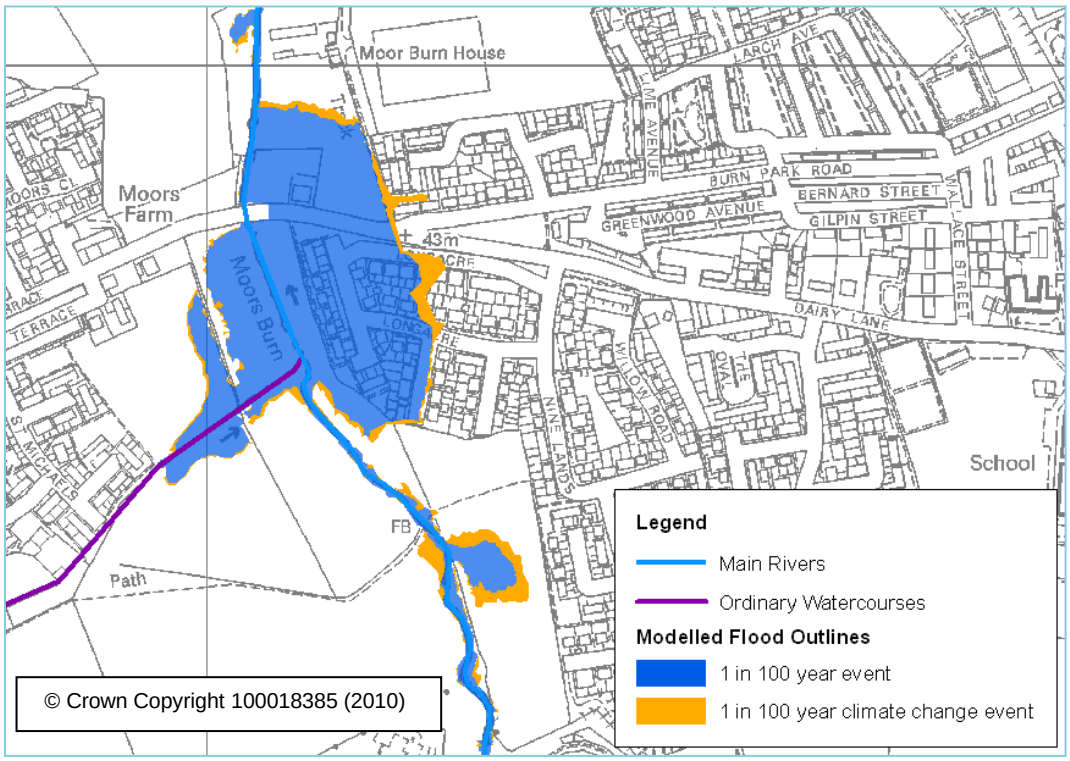


Figure 3-11: Undefended Climate Change Impact at Dairy Lane



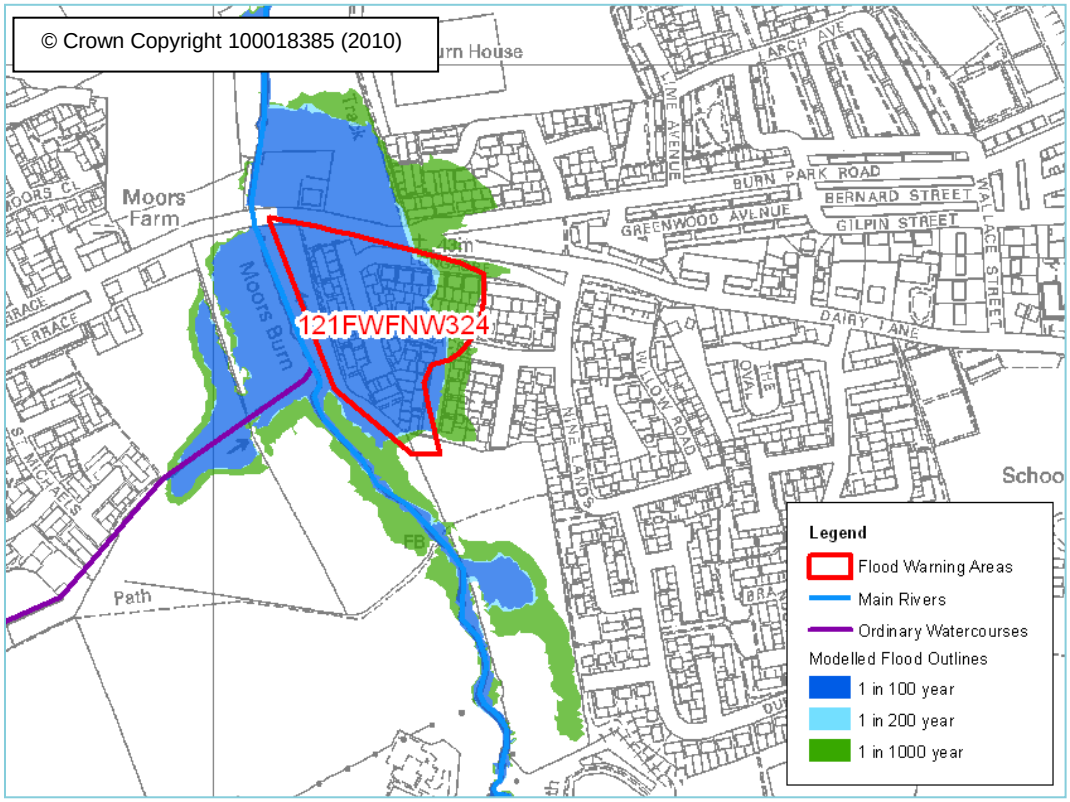
Dairy Lane is also covered by a current Environment Agency Flood Warning Areas along Lumley Park Burn:

Table 3-13: Dairy Lane Flood Warning Area

Code	Name	Description
121FWFNW324	Moors Burn at Dairy Lane	Properties and low lying areas around Long Acre and Aireys Close

Figure 3-12 identifies those properties off Dairy Lane and which are currently covered by Environment Agency Flood Warning. All those properties within the undefended 1 in 100 year event are covered.

Figure 3-12: Dairy Lane Flood Warning



The overall level of risk associated with Lumley Park Burn and its tributaries is understood and is concluded to be low, as a significant number of those properties at risk are defended to a high standard. The remaining areas that flood are located on rural undeveloped land reducing the risk to the community. Any increase in development within these areas will increase flood risk to the immediate community and further downstream by removing natural storage of the floodplains and increase surface water runoff. Any future development within the natural floodplain should be avoided.

3.4.7 Hendon Burn

Hendon Burn, a major drain, south of the River Wear flows eastwardly towards the North Sea. Originating at Doxford Park, the drain flows eastwardly through Farringdon, Ashbrooke and Hendon before finally flowing out to the North Sea, creating Flood Zones covering large residential neighbourhoods, especially around Hendon.

Currently the Environment Agency Flood Zones are still based on the early broad scale modelling outputs as shown in Figure 3-13 and are likely to be inaccurate in both scale and direction.

Firstly, the contributing catchment of the watercourse is urban in nature and any inflows are likely to rely on urban surface water drainage system rather than natural runoff. This type of contributing catchment will significantly alter the volume, speed and location at which water enters the burn.

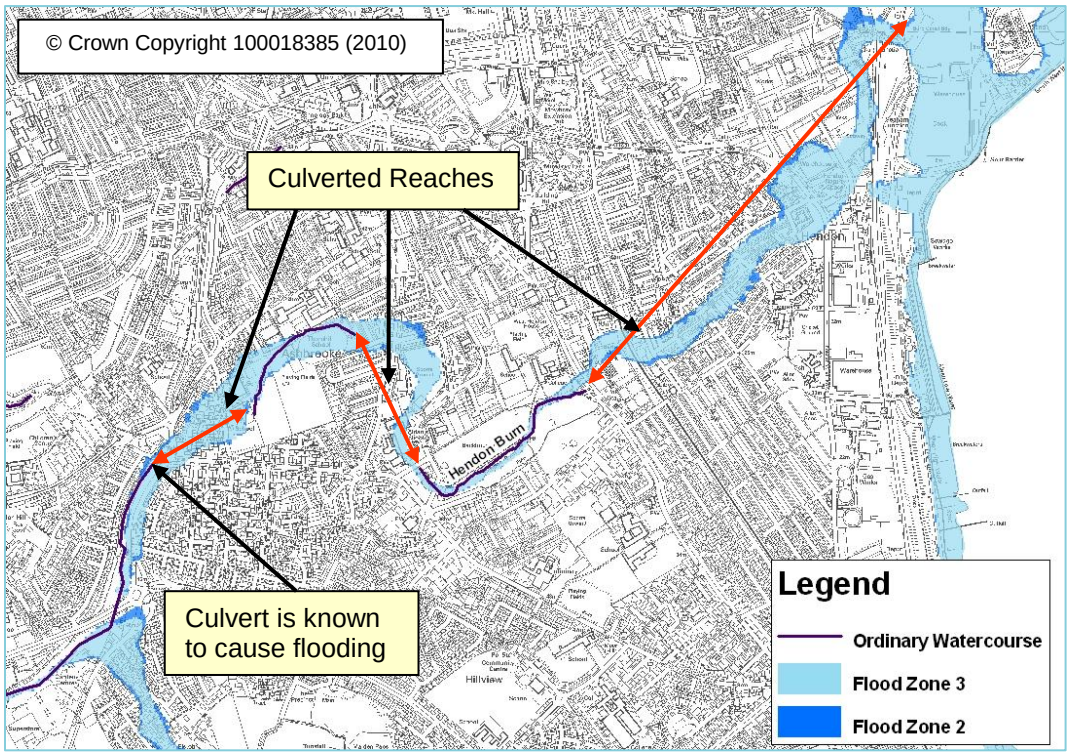
Secondly, the flood zones do not take account that large sections of the watercourse are culverted. The largest culvert is downstream of the A1018 (Ryhope Road) to the North Sea outfall.

A number of culverts further upstream along Hendon Burn have been identified by Sunderland City Council Drainage Operations Manager that cause significant flooding during heavy rain due to the amount of debris which can be deposited on the upstream grill. These include;

- **Gilley Law - Culvert underneath Amsterdam Road**
- **Silksworth Lane - Culvert underneath Queen Alexandra Road**

It would be expected that any flooding in these areas would be due to the surcharging of the culverts during a large flood events and/or culvert blockage from debris. The downstream culvert could also become tidal locked during high tides. If this happens flooding would occur around Backhouse Park or further upstream. Flooding could possibly occur from any internal drains connected to the culvert.

Figure 3-13: Hendon Burn Flood Zone Extents



However, since large sections of the watercourse are culverted, it is likely that flood waters surcharging from Hendon Burn would follow the same path as the current Flood Zones as these are driven by topography (natural slope of the land). This is what would happen in an actual flood event i.e. flood water will flow towards to lowest point in the catchment naturally. It is difficult however to say for certain if the Flood Zone extents associated with Hendon Burn will be fully flooded during an event especially further downstream as flood waters may become obstructed by the urban environment or pool around large parks upstream.

As Hendon Burn is an Ordinary Watercourse, the risk of flooding is expected to be low. If risk was high it would have been previously designated as Critical Ordinary Watercourse

(COW) and responsibility took over by the Environment Agency as a Main River. However, due to the number of historical flood incidents in the area and the significant interaction between the burn and the contributing drainage system, risk is likely to be more significant than first estimated.

Considering the effects of climate change and the highly urbanised catchments that it runs through, Hendon Burn does have the ability to flood large numbers of properties with only a small increase in flow. Any increase in surface runoff due to urban development or an increase in rainfall in the catchment could place the current drainage system under pressure. This could result in higher flood risk along Hendon Burn due to the interaction between the watercourse and the urban drainage system.

A detailed hydraulic model of Hendon Burn will be required to make this assessment. Due to the urban nature of the watercourse any modelling will be more detailed than that in a rural catchment and will require significant input from NWL on the size and capacity of the local surface water drainage network and the location of outfalls into the burn and combined sewer overflows (CSOs). It is likely that any modelling of the watercourse would benefit from a combined urban drainage model.

Recommendation

In order to assess the level of risk associated with Hendon Burn, a detailed flood risk study should be carried out. This should be carried out by Sunderland City Council, the Environment Agency and NWL in order to improve local knowledge and support further flood risk management.

This modelling work is likely to require significant input and cooperation from all flood risk stakeholders and could benefit from being part of a SWMP for the area or during the evidence preparation of a Preliminary Flood Risk Management Assessment (PFRA) identified in the Flood Risk Regulations (2009) and the future Floods and Water Management Bill (see Volume I Sections 3.2.1 and 3.2.2).

Improving the mapping of urban watercourses within Sunderland is also identified within Sunderland City Council's Local Area Agreement 189 (see Volume I Section 3.6.3) which has been used to filter down CFMP and SMP2 actions.

In the mean time, Sunderland City Council should continue to maintain the watercourse. All culverts should also be inspected and cleared of any blockages.

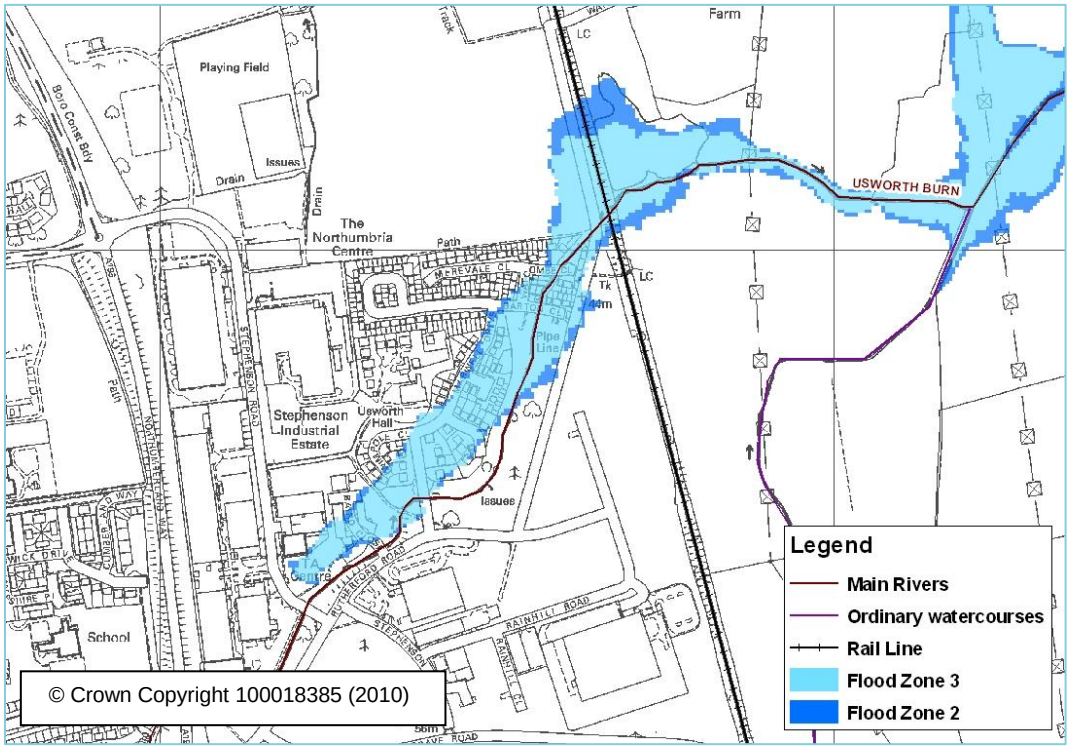
3.4.8 Usworth Burn

Usworth Burn is situated in the north west of Sunderland within the sub-area of Washington. It is a minor tributary to the River Don which follows the northern boundary of Sunderland before flowing north into Gateshead and joining the River Tyne in South Tyneside.

Usworth Burn originates in the urban area of Usworth flowing in a north easterly direction underneath the disused Leamside railway line and out into surrounding farmland. Currently the Environment Agency Flood Zones are based on the early broad scale modelling outputs and show some inconstancies with the river centreline as shown below in Figure 3-14. Currently the risks associated with the Burn are to those properties immediately upstream of the railway around Stephenson Industrial Estate identified with the Flood Zones.

It is difficult to say for certain the extent of flooding associated with Usworth Burn until a detailed hydraulic model is developed. It is likely that any modelling would show a significant difference to the current Flood Zones.

Figure 3-14: Usworth Burn Flood Risk



Recommendation

Any future development within the current Flood Zones or located within 20m of Usworth Burn bank tops (or culverted reach) should carry out a site-specific Flood Risk Assessment (FRA).

The FRA will require the development or a 1D hydraulic model of Usworth Burn to investigate the true nature of flood risk from the watercourse. Any modelled flood extents should be used to update the Environment Agency Flood Map during future revisions.

3.4.9 Cut Throat Dene

Cut Throat Dene is located in the north east extent of North Sunderland at Seaburn. Cut Throat Dene itself is a relatively small Ordinary Watercourse, which originates north of Witherwack, flowing easterly along the City of Sunderland Council boundary before flowing into Sunderland and discharging into the North Sea at Seaburn.

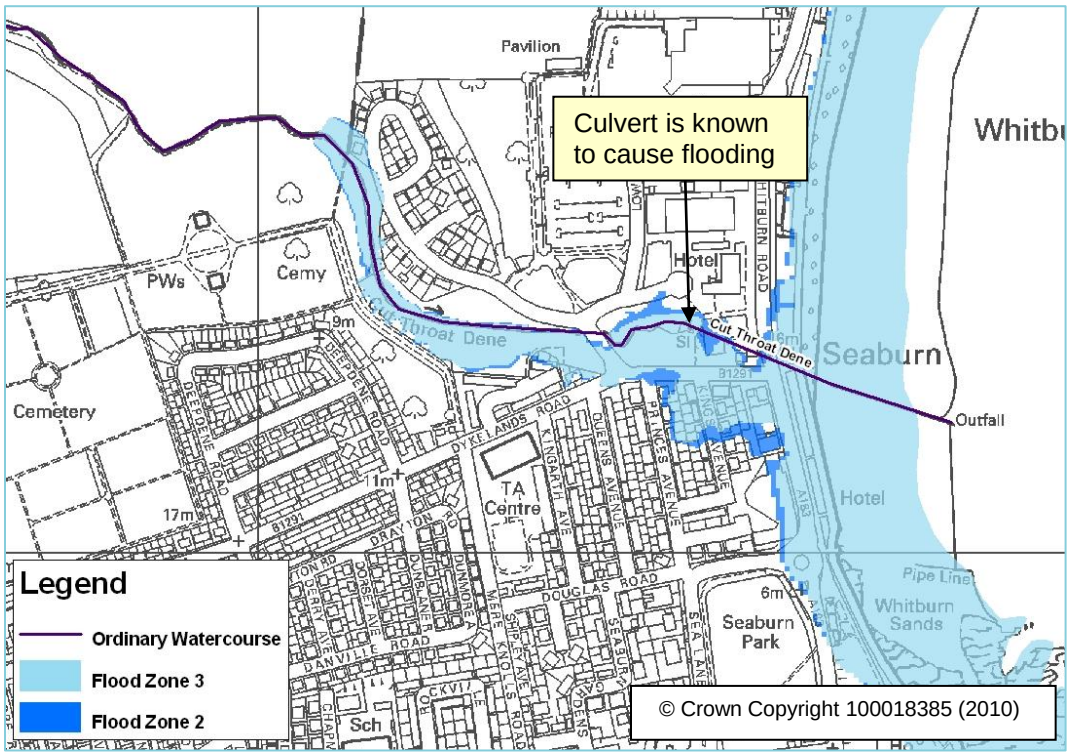
Flood risk associated with the watercourse is small due to the size and natural of the catchment. Currently Environment Agency Flood Zones only cover the downstream extent of the Dene as it enters Sunderland. According to the Flood Map, Flood Zones along this reach are fluvial dominated, placing a number of current properties at risk around Lowery Road and Kingsway Avenue.

However, there is no detailed model available for the Dene therefore a full understanding of fluvial and tidal interactions are unknown. Backing up of fluvial flow is likely during high tides.

A culvert at Seaburn Ocean Park (culvert underneath Whitburn Road) has been identified by Sunderland City Council Drainage Operations Manager as causing significant flooding

during heavy rain due to the amount of debris which can be deposited on the upstream grill.

Figure 3-15: Cut Throat Dene Flood Risk



3.5 Surface Water Flooding

Surface water runoff is usually caused by intense rainfall that may only last a few hours and follows natural valley lines, creating flow paths along roads and through and around developments and ponding in low spots.

Surface water flooding has been assessed within this Level 1 SFRA using the Environment Agency Areas Susceptible to Surface Water Flooding map. Due to the nature of the surface water map produced at a national scale there is a need to review the data, rather than just accepting the predicted flow paths and pooling areas. To do this, historical flood records have also provided on the map as a means of validating the zones.

As the map has been produced strategically it excludes the underground sewerage and drainage systems, smaller over ground drainage systems and the obstructions of buildings. These could influence surface water flow paths and the volume of water remaining on the surface.

In the case of these surface water flooding maps, water is purely driven by topography and not by the underlying sewer system. The end result provides three risk zones highlighted below:

High

Medium

Low

The areas that have been identified as 'high' susceptible to surface water will be vulnerable to flood first, flood deepest and flood during lower rainfall events. These areas will also tend to be predominantly located in valley bottoms, in the Main River floodplain or on flat low lying land, in generally those areas already at fluvial risk.

From the maps it can also be seen that there are many areas of land outside Flood Zone 3 and 2 that are susceptible to surface water flooding. These will typically be located on tributaries and feeder streams to Main Rivers, where steeper sloping valleys exist and on the edge of the natural floodplain of Main Rivers, again where land levels tend to rise more steeply.

Specifically within Sunderland, there is limited correlation between historical flood incidents collected and key flow paths identified by the surface water map with no obvious patterns emerging. This is more likely to be a result of limited historical data collected.

Key surface water flow paths identified represent the natural valley of watercourses throughout Sunderland with limited additional high risk areas shown. The surface water map does however clearly define the natural catchment and flow direct of Ordinary Watercourses.

Key areas susceptible to surface water flooding identified by the national map include:

- **The area around Nissan, north east Washington - which shows large areas of surface water pooling**
- **The catchment of Lumley Park Burn**
- **Clearly defined catchment of Hendon Brook and Barnes Burn**

It is widely acknowledged in PPS25 that the frequency and duration of extreme rainfall events is likely to increase under climate change. If this is the case and unless drainage and combined flooding issues are addressed, then it should be expected that surface water, sewer and groundwater flooding incidents will also increase.

The actual effect of climate change for other sources of flooding is difficult to assess without the availability of detailed models and assessing the capacity of sewers etc. in coping with the extra volume of water anticipated.

3.6 Sewer Flooding

Northumbrian Water Limited (NWL) has provided internal and external DG5 records at a strategic drainage area level. DG5 records are a dataset of all properties flooded from the drainage system with internal records being those where sewer flooding has occurred within the property and external to those areas outside.

Table 3-14 provides an overview of DG5 records in Sunderland according to NWL drainage areas. Drainage areas have also been attributed with a flood risk rating. The categories, suggested by NWL, listed below have been used for this rating: Low Risk

- **Low Risk** Less than 10 properties on internal register
- **Medium Risk** Less than 10 properties on internal register and some on external register
- **High Risk** Greater than 10 properties on internal register and some on external register

The risk rating associated with NWL drainage areas have been provided on map **2009s0243-SCC-C2**.

Table 3-14: NWL DG5 Register Overview

Drainage Area	Return Period/ Internal Records			Return Period/ External Records			Flood Risk Rating
	2 in 10	1 in 10	1 in 20	2 in 10	1 in 10	1 in 20	
Houghton/Hetton	5	0	0	6	0	2	**Medium**
Hylton Castle	3	0	0	0	0	0	**Low**
Herrington	8	12	0	8	1	1	**High**
Seaburn & Roker	5	6	0	3	0	0	**High**
Hendon Burn	0	0	0	0	0	0	**Low**
Barnes Burn	4	1	0	1	0	0	**Medium**
Ryhope & Silksworth	0	0	0	0	0	0	**Low**
Fatfield	3	0	0	0	0	0	**Low**
Pallion	2	1	0	0	0	0	**Low**
Washington Central	8	1	3	11	3	2	**High**
Washington North	2	6	0	2	0	0	**Medium**
Wearmouth	0	0	0	0	0	0	**Low**
Nissan	0	0	0	0	0	0	**Low**
Leam Lane/ Wardley/ Bill Quay	0	0	0	0	0	0	**Low**
Chester le Street	49	3	16	24	5	7	**High**

Whilst DG5 records provide a good indication of the risk of sewer flooding within Sunderland, it must be acknowledged that DG5 records are historical data only and it is not a true representation of current risk or a prediction of future risk. What this information can provide, is a starting point in which further discussion can take place with Sunderland City Council, the Environment Agency and NWL in planning large scale future development or between individual developers and NWL when considering the current standard of the drainage system.

New large scale development will need to connect to the current drainage network, which could already have capacity issues. Adding further pressure on the system could place that new development site at risk of flooding and exacerbate the issue to the surrounding community.

As this data is purely based on NWL drainage areas (underground), it should be used in conjunction with the Areas Susceptible to Surface Water Flooding Map (overland) and Critical Drainage Areas identified to obtain a full appreciation of surface water and drainage flooding and their interactions.

NWL has a list of current improvement schemes in place within Sunderland which can be found on their website (**http://www.nwl.co.uk/TyneandWeararea.aspx**). Currently there is one scheme identified. The location of the scheme identifies that there is a current issue with drainage capacity within the area, the fact there are ongoing schemes show that the risk should be reduced once complete. The scheme includes:

- Dovedale Road and Torver Crescent area of Sunderland - *where a £1m upgrade of the sewage network began in November 2008 lasting 6 months. The scheme involves upgrading 330m of sewer pipe along Dovedale Road to the junction of Torver Crescent which will reduce the risk of flooding to six properties.*

3.7 Critical Drainage Areas

Critical Drainage Areas have been indicated in Sunderland by combining high risk NWL drainage areas identified above in Section 3.6 and those which have a high risk of flooding from other sources. Contributing natural catchments have also been identified for those CDAs as the source or surface water flooding may originate outside of the drainage area but still contribute to the overall risk. Natural catchments were derived from the Flood Estimation Handbook (FEH) CD-ROM.

Within CDAs, an increase in the rate of surface water runoff and/or volume from a new development may exacerbate the degree of flood risk to areas downstream or to the surrounding community.

Recommendation

In CDAs a detailed Flood Risk Assessment (FRA) or Drainage Impact Assessment (DIA) would be expected regardless of which Flood Zone applies for all development greater than 0.5ha in size. This does include a Level 1 FRA which may just require consultation between the developer, Environment Agency, Sunderland City Council and NWL to identify the level or risk to that site. Levels of FRAs are described further in Volume I Section 5.

PPS25 recommends that those developments greater than 1ha will require a FRA, however by using a more stringent trigger of 0.5ha within CDAs highlights the need for development to consider the current flood risk issues when planning their drainage system or implementing SUDS.

The FRA should demonstrate that the development will not adversely affect existing flooding conditions in these critical areas by increasing the rate of surface runoff and should define and address the constraints that will govern the design of the drainage system and layout of the development site. Developers should look to reduce or control runoff to Greenfield rates.

The use of appropriate mitigation measures should be investigated. Ideally, Sunderland City Council should work closely with the Environment Agency, NWL and individual developers to ensure surface water runoff is controlled as near to the source as possible which will include the application of SUDs.

As part of the consultation on the final draft of the SFRA, NWL were sent the SFRA reports and maps for comments. With specific regards to Section 3.5, 3.6 and 3.7 NWL stated,

"With regard to the methodology adopted in these sections, NWL are happy with the wording and approach to be taken[11]"

CDAs have been provided on map **2009s0243-SCC-C3**. CDAs have been proposed in the drainage areas of:

Table 3-15: Proposed Critical Drainage Areas

NWL Drainage Area	Comments
Barnes Burn & Hendon Burn	Due to the urban nature of both watercourses flooding can arise directly from the burns themselves, the contributing urban surface water drainage system or surface water runoff. Whilst the drainage area itself does not have any DG5 or DG10 records and there is currently no major development proposed in the area, it has been classified as a CDA purely on the fact that significant future work is required to understand the level of current and future risk to the community.

[11] Email correspondence between Chris Isherwood (JBA) and Niki Mather (NWL) dated 15/12/2009

NWL Drainage Area	Comments
Houghton & Hetton	There is a high risk of both fluvial flooding along Lumley Park Burn and surface water flooding. Fluvial flood extents are mainly concentrated on greenfield land however any removal of the functional floodplain will increase risk downstream at Chester-le-Street which is known to have a high risk of flooding. Critical surface water flow paths and large areas of pooling show there is a high risk of surface water flooding. Again any increase in surface water runoff from new development will increase risk downstream.
Herrington	There is medium fluvial and high risk surface water flooding; however this is currently located on greenfield land. DG5 and DG10 records also show there is a history of sewer flooding. Any large scale development in this area could significantly increase surface runoff and flood risk downstream at Chester-le-Street.
Seaburn & Roker	There is a low risk of fluvial and tidal flooding in this area, however DG5 and DG10 records show there is a history of sewer flooding. This could be related to the surface water risk in the area. Tidal locking could also be an issue for surface water drainage. As this area is located at the downstream extent of the catchment, any development could potentially improve the current surface water issues to the surrounding community through storage or reducing conveyance.
Washington Central	There is a low risk of fluvial flooding in this area and flood extents are mainly concentrated along open space surrounding the small watercourses. There are however critical surface water flow paths and large areas of surface water flooding. DG5 and DG10 records also show there is a history of sewer flooding. Tidal locking of those watercourses and surface water drainage discharging in to the River Wear could also be an issue. Any development in this area could improve the current drainage and surface water issues through storage or reducing conveyance.

Final CDAs have also been used within this Level 1 SFRA to identify the requirement for FRAs, Drainage Impact Assessments (DIAs) and high Level Surface Water Management Plans (SWMPs) and Preliminary Flood Risk Assessments (PFRAs) discussed in Section 5.

3.8 Groundwater Flooding

According to the Wear CFMP:

"Within the Wear catchment groundwater flooding is not known to be a major problem, due to the geology of the catchment. The impermeable geology as discussed in Chapter 2 (within Wear CFMP) means that groundwater cannot build up. Rather, sub-surface flow will enter the river network rapidly or surface water flooding will occur when soils are saturated, as water cannot drain into the rock below.

There have been no major flooding problems reported in the catchment, and therefore groundwater flooding is not taken into account for strategic decision making."

It is therefore considered as part of this SFRA guidance that the risk groundwater flooding within Sunderland should not influence the spatial planning of development. However, Sunderland City Council has identified a number of local areas which have suffered from groundwater flooding in the past. These include:

- **The area north of Washington and Nissan which is known to have a high water table. There is also a history of property being flooded due to groundwater.**
- **The area of North Sunderland surrounding the amusement park**

Recommendation

The risk of ground water flooding should be considered within a site-specific Flood Risk Assessment (FRA) for all proposed development sites within Sunderland, specifically for developments in the above locations.

3.9 Flooding from Reservoir & other Artificial Sources

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

There are a number of smaller water bodies within Sunderland such as Swan Industrial Estate reservoir in Washington, Joe's Pond in Houghton-le-Hole, Lyon Lake and Blossom Pond in Hetton-le-Hole and the lakes surrounding the sports complex at Farrington however they pose little risk of flooding to the surrounding areas. All natural ponds have been identified on the PPS25 Flood Zone maps (**2009s0243-SCC-A1 to A12**) produced with this SFRA.

There are relatively few current or future planned developments surrounding the features, the majority of which are lowered into the ground rather than raised, reducing the risk of breaching. They could become key locations of surface water storage draining the surround land. However, higher water levels could increase the risk of low bank levels overtopping but this would occur over a long period of time reducing the risk to the immediate community.

3.10 Flood Risk Management Assets

The Environment Agency maintains records of all flood risk management assets using the National Flood and Coastal Defence Database (NFCDD). The database has been made available for the Sunderland Level 1 SFRA.

The database highlights a number of Environment Agency, Local Authority and privately owned defences assets ranging from fluvial raised defences, maintained and culverted channels, coastal protections and non-flood defences structures such as bridges.

Sunderland City Council provided a detailed Coastal Protection Survey and location plan of the Sunderland frontage which was undertaken by Halcrow in 1995. This is provided within Appendix C of this report.

All critical defence assets with Sunderland have been discussed above with their relevant watercourse. All assets have been provided on map **2009s0243-SCC-D1**.

4 Sunderland Proposed Development Sites

4.1 Introduction

A Level 1 SFRA should enable Sunderland City Council to carry out the Sequential Test as outlined in Annex D of PPS25.

This Level 1 SFRA has provided Sunderland City Council with PPS25 Flood Zone classifications for all locations identified for development provided within this assessment. Sunderland City Council will be required to prioritise the allocation of land for development in order from Flood Risk Zone 1 to 3, including the subdivisions of Flood Risk Zone 3, if necessary. Other sources of flooding will also have to be considered as described within Volume I Section 4.

The Environment Agency has statutory responsibility and must be consulted on all development applications allocated with medium and high risk zones, including those in areas with critical drainage problems and for any development on land exceeding 1 hectare outside flood risk areas. In these circumstances, the Environment Agency will require Sunderland City Council to demonstrate that there are no reasonable alternatives, in lower flood risk categories, available for development. Where appropriate, the Exception Test is to be applied.

An electronic Sequential Test spreadsheet has been produced showing the results of all allocations provided by Sunderland City Council against PPS25 Flood Zones and as an extra layer of information against the surface water zones. Area (ha) and percentage cover of each Flood Zone is provided. This has been provided within the digital deliverables of the Level 1 SFRA. Extracts from the Sequential Test spreadsheet can be found in Appendix D of this report.

Recommendation

Sunderland City Council spatial planners and development management should use this information to carry out the Sequential Test as discussed in PPS25 and guidance in Volume I, by identifying and removing those sites at high risk, when considering all sources.

Those sites in Flood Zone 1 with a low probability of flooding from other sources should be given a higher priority and developed first, avoiding developing those sites at risk until they are possibly required in 15-20 years time.

It is recommended that the Sequential Test process is carried out at a local or community level, especially when it comes to identifying and substituting more vulnerable development in land outside of flood risk areas. It must be noted that the PPS25 Practice Guide (2009) states this approach is acceptable. However, evidence must be supplied in why the area of search has been reduced from the full council area.

By reducing the area of search during the Sequential Test, avoidance can still occur as well as the Sunderland City Council meeting their own relevant objectives in the RSS or LDF i.e. a local need for affordable housing within a town centre may restrict the area of search to within the regeneration area.

The local communities suggested in this SFRA include:

- **Central Sunderland**
- **North Sunderland**
- **South Sunderland**
- **Washington**
- **Coalfield**

Further information on those development sites at flood risk is provided below to help Sunderland City Council carry out the Sequential Test. For those housing sites identified within the SHLAA and at high risk of flooding, the likelihood of passing the Exception Test is also discussed.

4.2 Sites at Fluvial and Tidal Risk

Development sites identified by Sunderland City Council include:

- Strategic Housing Land Availability Assessment (SHLAA) sites
- Existing Business and Industrial Areas
- New Business and Industrial Sites

Table 4-1 provides a summary of the Sequential Test spreadsheet developed. It identifies the total number of sites, within each category, at fluvial and tidal flood risk and the total area covered by each Flood Zone.

This table should provide an indication of the level of risk to proposed development sites, also the loss of potential proposed development sites if all flood risk areas are avoided.

Table 4-1: Summary of Sites at Fluvial and Tidal Risk

Development Sites	No. Sites	Total Area (ha)	Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
			Area (ha)	No.	Area (ha)	No.	Area (ha)	No.
SHLAA	283	1400	14.82	28	68.74	23	11.27	18
New Business Industrial Sites	15	79	0.95	3	0.57	3	0.06	2
Existing Industry Boundary	53	1269	7.10	12	69.77	13	0.33	4
Total	**351**	**2748**	**22.87**	**43**	**139.09**	**39**	**11.65**	**24**

- 51 out of 283 housing sites considered in the SHLAA 2009 are in Flood Zone 3, of which 23 are partially located in the functional floodplain
- However, of the 23 housing sites currently in the functional floodplain, the developable footprint only covers 11.27ha which is on average 12% of the total footprint. These highlights that the functional floodplain could be avoided through the Sequential Test without have a large impact on the proposed development footprint or yield values achieved.
- Housing sites listed below have large areas within the functional floodplain. These sites should be avoided or the allocation footprint altered to remove functional floodplain areas, as housing developments are not allowed in this Flood Zone. They are also located on Greenfield land.
    - **SHLAA 131 - Southern House Farm (30%)**
    - **SHLAA 181 - Houghton Road (20%)**
    - **SHLAA 341 - Redburn Road (27%)**
    - **SHLAA 375 - Stott's Pasture (32%)**
    - **SHLAA 383 - Dairy Lane Site 2 (14%)**
    - **SHLAA 387 - Sedgeletch site 3 (36%)**
    - **SHLAA 413 - Seaburn Amusements (21%)**

  According to Sunderland City Council, of these sites the current SHLAA indicates that most are considered 'not developable'. Southern House Farm and Seaburn Amusements are currently classed as developable but will be reconsidered in the light of the SFRA information during the Sequential Test.

- 23 housing sites are located in Flood Zone 3a. On average 7% of each site is at risk. These sites should be avoided or the allocation footprint altered to remove flood risk areas. Currently these sites will need to pass the Exception Test. The Environment Agency is likely to object in principle to these sites. The requirement for large compensational area would significantly impact on yields achievable. Sites with large flood risk coverage include:
    - **SHLAA 217 - The Port (71%)**
    - **SHLAA 383 - Dairy Lane Site 2 (30%)**
    - **SHLAA 386 - Sedgeletch Site 2 (17%)**
    - **SHLAA 404 - Site west of Waterloo Road (33%)**

  According to Sunderland City Council, the current SHLAA has already classed all these sites as 'not developable' and therefore will be avoided during the Sequential Test.
- A total of 6 existing and new business and industrial sites are partially located in the functional floodplain. These sites should be avoided or developable footprint removed from flood risk areas.
- 16 existing and new business and industrial sites are partially located in the Flood Zone 3a. The developable footprint at risk should be avoided from the development site or a FRA should be undertaken to prove the development and its occupants can remain safe during a flood event. If the whole site is required, the sequential approach to site layout should be adopted.

4.3 Likelihood of Sites at Flood Risk Passing the Exception Test

As discussed above only a minor percentage of the majority of current housing development sites are within Flood Zone 3a and 3b. However, as they stand they will be undeliverable in Flood Zone 3b (see PPS25 Table D1, D2 and D3). If required by Sunderland City Council those proposed development sites within Flood Zone 3a will need to pass the Exception Test.

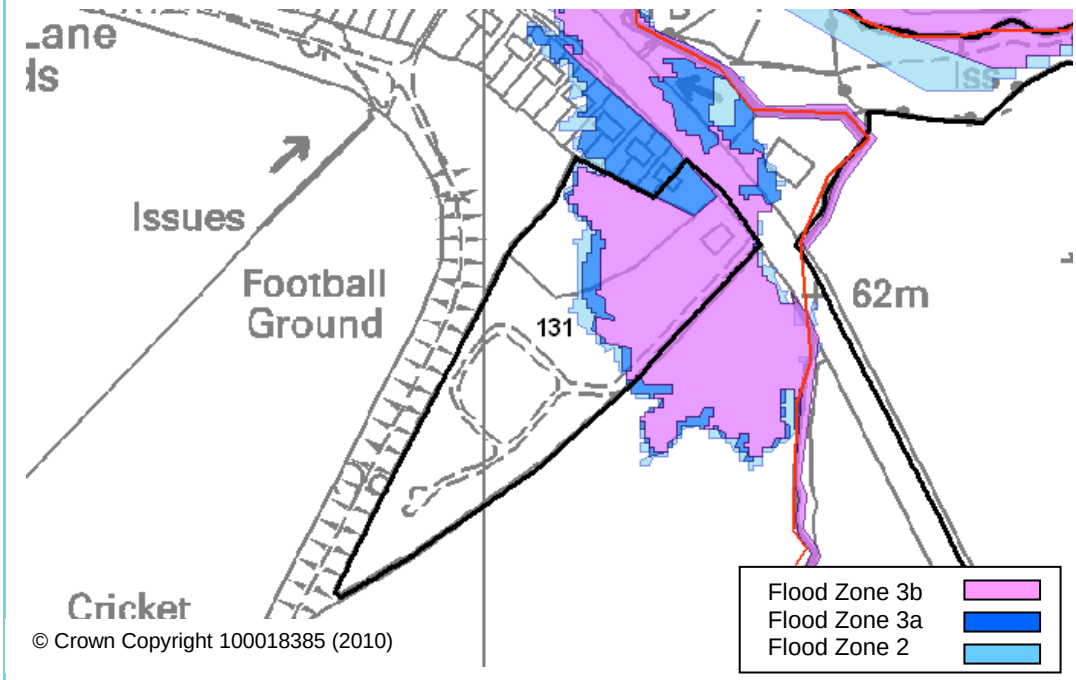
Recommendation

It is always recommended that these proposed development sites are avoided during the Sequential Test, especially those sites within the functional floodplain or have high percentage cover within Flood Zone 3a. This approach should be carried out first before considering the vulnerability of the proposed development and substituting lower vulnerable uses. The Exception Test should only be considered in exceptional circumstances.

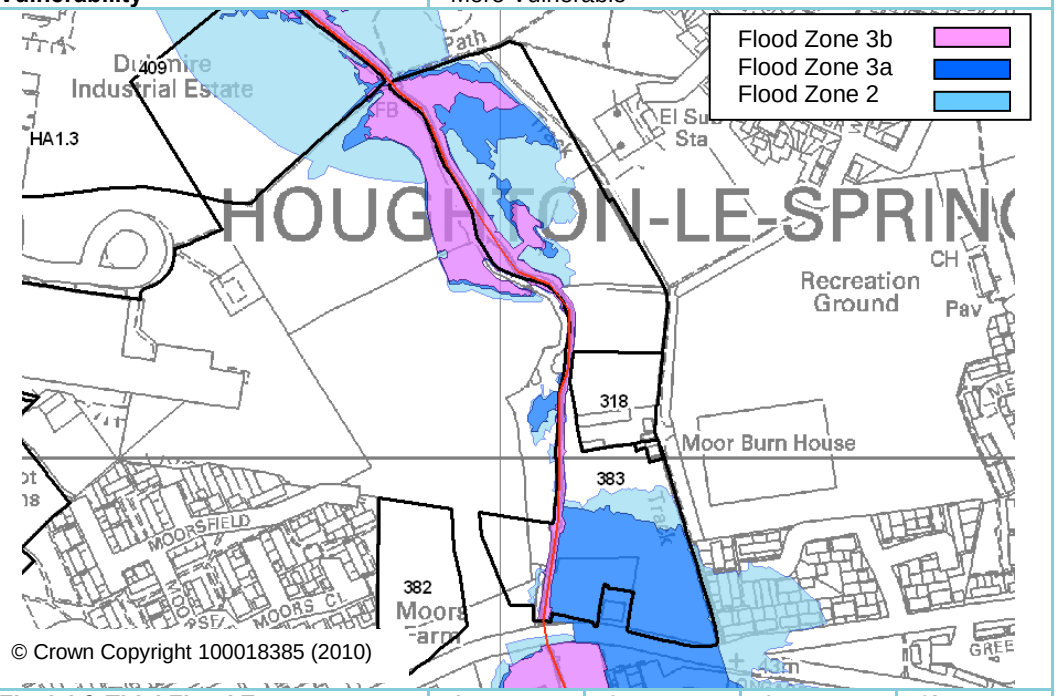
If these proposed housing development sites are required (due to a need to meet future regional or community housing numbers) in these specific communities and no alternative sites are available, then they must pass the Exception Test. More often than not the need for this test could be bypassed by removing the area at flood risk from the developable footprint at the LDF allocation process or during the master planning of the site layout.

However, if the total developable footprint is required to reach housing numbers, then the site must pass all sections of the Exception Test. A number of tables are provided below for key proposed housing development sites that will need to pass the Exception Test if they are required. These tables highlight the degree of flood risk from all sources, current flood risk management measures, residual risks and the likelihood of the site passing the Exception Test if undertaken.

Sunderland City Council should use these tables to reconsider those proposed development sites that remain once the Sequential Test has been carried out. Those sites which are unlikely to pass the Exception Test should be avoided at this high level before being allocated. Sunderland City Council should also consider the developable timetable of their proposed development sites.

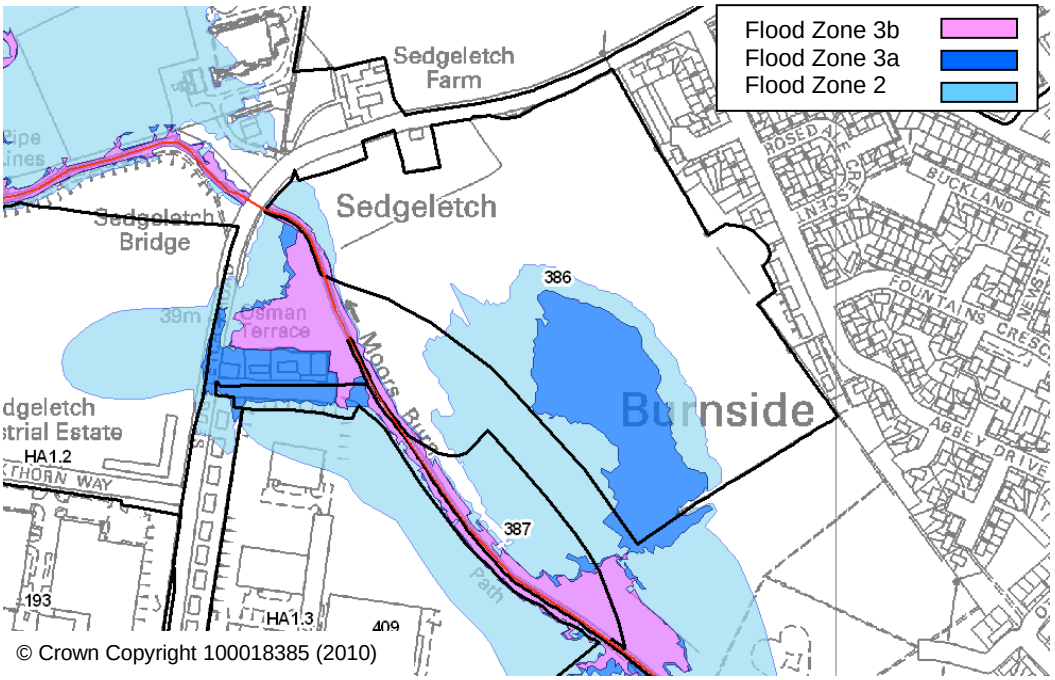
Site	131 Southern House Farm				
Area	1.33 ha				
Catchment	Lumley Park Burn				
Development Type	Residential (SHLAA)				
Vulnerability	More Vulnerable				
					
Fluvial & Tidal Flood Zone Coverage	**1**	**2**	**3a**	**3b**	
	62%	3%	5%	30%	
Climate Change Sensitive	Low				
Surface Water Zone Coverage	**Low**	**Medium**	**High**		
	20%	0%	0%		
NWL Drainage Area	Medium Flood Risk				
Critical Drainage Area	Houghton/Hetton CDA				
Historical Flooding	No records				
Defended	No				
Flood Warning	No				
Brownfield/Greenfield	Greenfield				
Likelihood of passing Exception Test	Southern House Farm is currently a caravan site. The 1 in 25 year outline is confined to the northern area of the site surrounding the current house and driveway. The area has been defined as functional floodplain. In this instance only water compatible uses are allowed in this zone. Any development in this area could increase flood risk elsewhere if compensational storage is not provided. This area of the site should be removed from the developable footprint. It is recommended that this is left as open space. The sequential approach to development should be applied by placing vulnerable development to the southern extent of the site. It is recommended that this site is avoided during the Sequential Test.				

Site	383 - Dairy Lane, Site 2
Area	4.70 ha
Catchment	Lumley Park Burn
Development Type	Residential (SHLAA)
Vulnerability	More Vulnerable

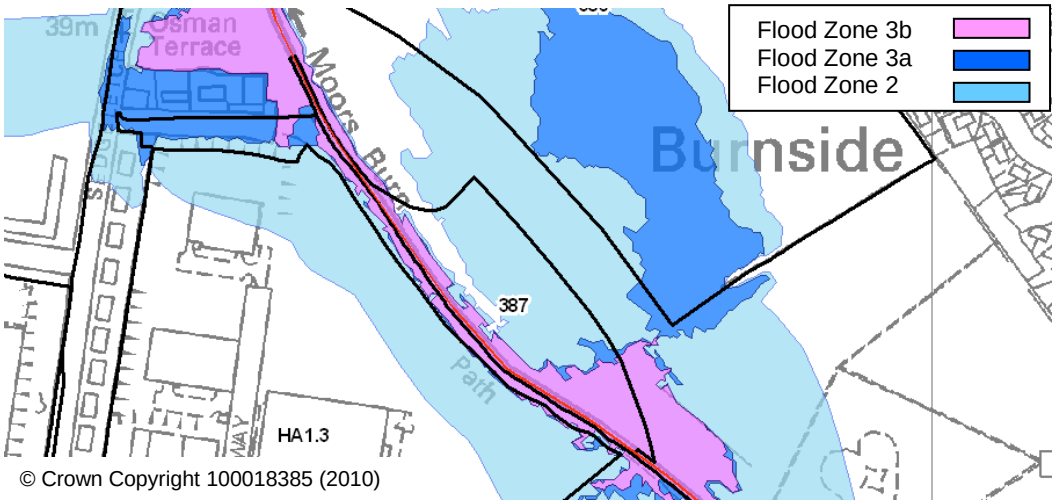


Fluvial & Tidal Flood Zone Coverage	**1**	**2**	**3a**	**3b**
	39%	17%	30%	14%
Climate Change Sensitive	Low			
Surface Water Zone Coverage	**Low**	**Medium**	**High**	
	8%	32%	37%	
NWL Drainage Area	Medium Flood Risk			
Critical Drainage Area	Houghton/Hetton CDA			
Historical Flooding	No Records			
Defended	Southern area of site north of Dairy Lane is protected to a 1 in 200 year standard.			
Flood Warning	No			
Brownfield/Greenfield	Greenfield			
Likelihood of passing Exception Test	The majority of the right hand bank of Lumley Park Burn is undeveloped land. The site can be described between two main developable areas; to the north and south Moor Burn House. Although the area south of the farm is within Flood Zone 2 and 3a the area benefits indirectly from a defences south of Dairy Lane, which removes risk up to a 1 in 200 year event. However, the defence has been designed to protect those current properties along Longacre and should not be used as mitigation for this site as residual risks are still present. The area north of the farm is mainly at risk during the 1 in 25 year event or above. Designated functional floodplain should be removed from the development, whilst the sequential approach to site layout should be adopted. It is recommended that both areas of the site are avoided during the Sequential Test.			

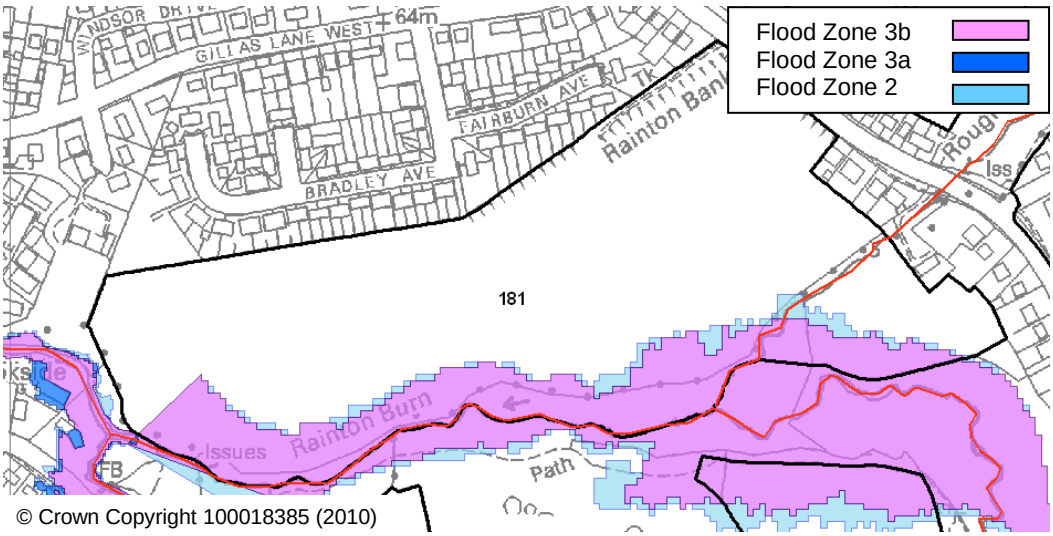
Site	386 - Sedgeletch site 2
Area	9.10 ha
Catchment	Lumley Park Burn
Development Type	Residential (SHLAA)
Vulnerability	More Vulnerable



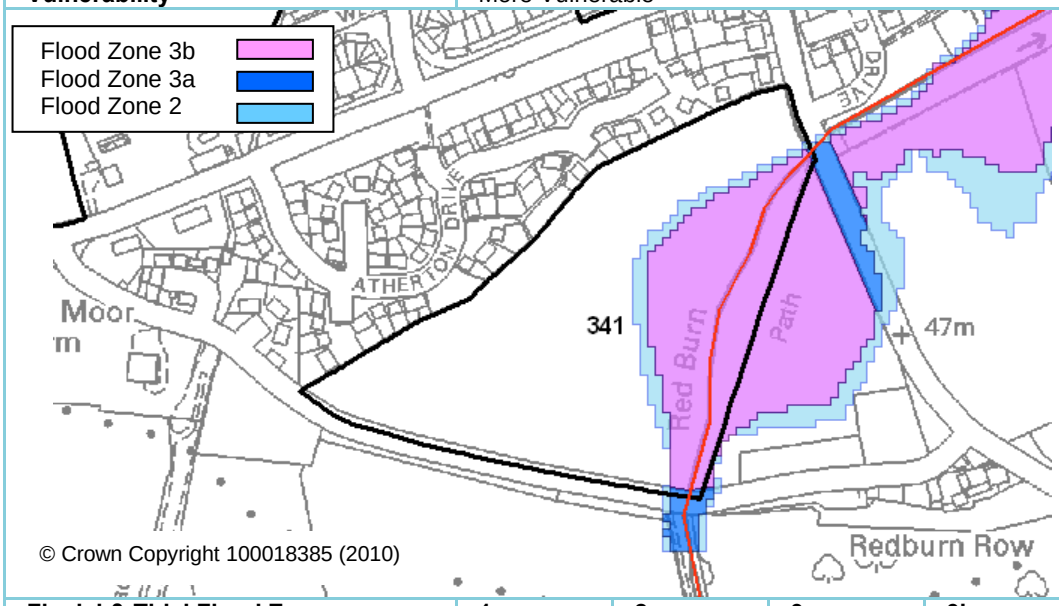
Fluvial & Tidal Flood Zone Coverage	**1**	**2**	**3a**	**3b**
	68%	15%	17%	1%
Climate Change Sensitive	Low - Little change between 1 in 100 year modelled outline and 1 in 100 year + 20%			
Surface Water Zone Coverage	**Low**	**Medium**	**High**	
	8%	15%	4%	
NWL Drainage Area	Medium Flood Risk			
Critical Drainage Area	Houghton/Hetton CDA			
Historical Flooding	Southern corner within EA historical flood map			
Defended	No			
Flood Warning	No			
Brownfield/Greenfield	Greenfield			
Likelihood of passing Exception Test	The site is mainly at risk during the 1 in 100 and 1 in 1000 year event. The sequential approach to sites layout could potentially remove the risk to development, with the area at risk left as public open space. Development in sites 387 - Sedgeletch Site 3 would influence the risk to this site. If development occurs it could potentially change flow paths or depending on mitigation measures implemented reduce or increase flood risk to this site. Both sites should be considered together during flood risk mitigation, site layout and emergency planning. It is recommended that this site is avoided during the Sequential Test.			

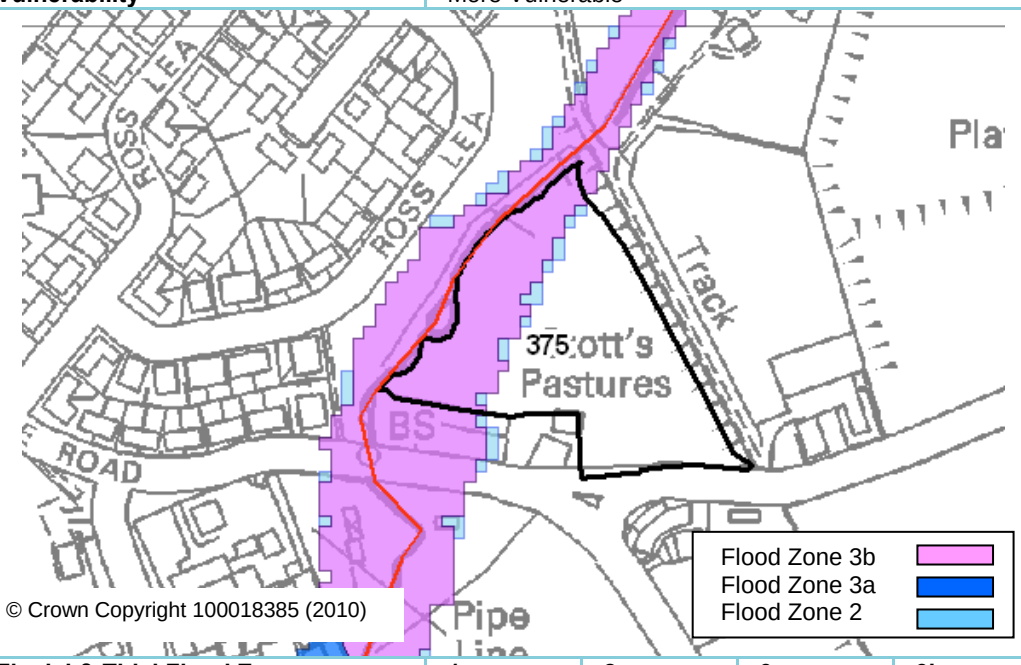
Site	387 - Sedgeletch site 3				
Area	1.23 ha				
Catchment	Lumley Park Burn				
Development Type	Residential (SHLAA)				
Vulnerability	More Vulnerable				
	 © Crown Copyright 100018385 (2010)				
Fluvial & Tidal Flood Zone Coverage	**1**	**2**	**3a**	**3b**	
	9%	52%	3%	36%	
Climate Change Sensitive	Low - Little change between 1 in 100 year modelled outline and 1 in 100 year + 20%				
Surface Water Zone Coverage	**Low**	**Medium**	**High**		
	9%	13%	34%		
NWL Drainage Area	Medium Flood Risk				
Critical Drainage Area	Houghton/Hetton CDA				
Historical Flooding	Within EA HFM				
Defended	No				
Flood Warning	No				
Brownfield/Greenfield	Greenfield				
Likelihood of passing Exception Test	Only 9% of the current developable footprint is not at flood risk. The remaining 81% is designated as functional floodplain, Flood Zone 3a and 2. Flood Zone 2 areas could potentially be developable if an FRA proves it can be safe. However, the functional floodplain should be removed from the development site. The development site has the potential to influence risk to site 386 - Sedgeletch site 2. Both sites should be considered together during flood risk mitigation, site layout and emergency planning. Potentially this site should be sacrificed for flood storage or compensational storage to allow for development on Sedgeletch site 2. It is recommended that this site is avoided during the Sequential Test.				

Site	181 - Houghton Road
Area	13.23 ha
Catchment	Lumley Park Burn
Development Type	Residential (SHLAA)
Vulnerability	More Vulnerable

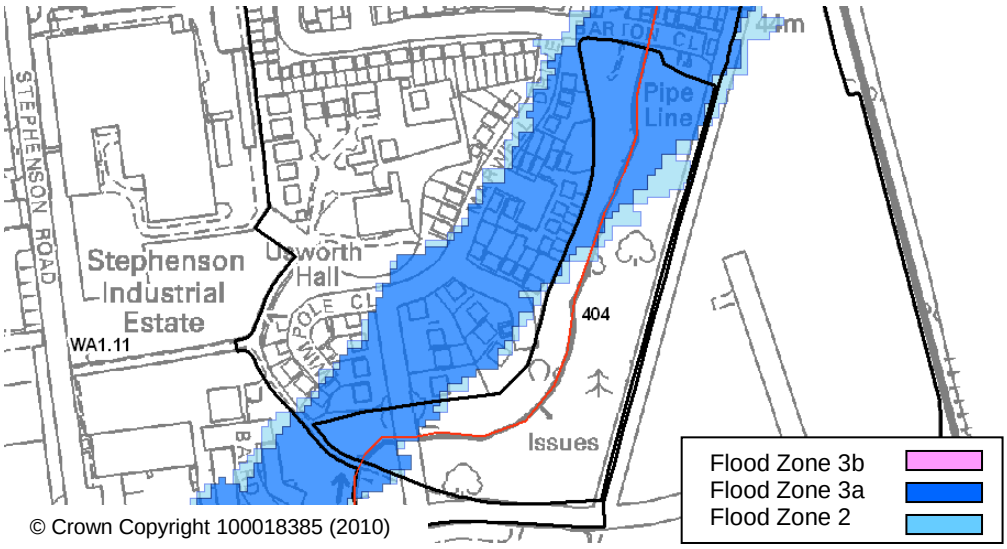


Fluvial & Tidal Flood Zone Coverage	**1**	**2**	**3a**	**3b**
	78%	2%	0%	20%
Climate Change Sensitive	Low			
Surface Water Zone Coverage	**Low**	**Medium**	**High**	
	13%	6%	0%	
NWL Drainage Area	Medium Flood Risk			
Critical Drainage Area	Houghton/Hetton CDA			
Historical Flooding	No records			
Defended	No			
Flood Warning	No			
Brownfield/Greenfield	Greenfield			
Likelihood of passing Exception Test	78% of the site is not at flood risk and is available for development. However, the site is currently situated on undeveloped land. The remaining 22% of the site at flood risk should be removed from the developable footprint, leaving open space along the river corridor to store water during times of flood. Safeguarding land along the river corridor could also tie in with green infrastructure and improved ecology. The Lumley Park Burn hydraulic model does not extend as far upstream as this reach, so as a result the Flood Zones are based on early broad scale modelling outputs. The functional floodplain is based on the Flood Zone 3 extent and any FRA should investigate the true extent further. This site could be allocated once the Sequential Test has been applied.			

Site	341 - Redburn Road			
Area	4.94 ha			
Catchment	Lumley Park Burn			
Development Type	Residential (SHLAA)			
Vulnerability	More Vulnerable			
	 © Crown Copyright 100018385 (2010)			
Fluvial & Tidal Flood Zone Coverage	**1**	**2**	**3a**	**3b**
	69%	4%	0%	27%
Climate Change Sensitive	Low			
Surface Water Zone Coverage	**Low**	**Medium**	**High**	
	9%	17%	6%	
NWL Drainage Area	Medium Flood Risk			
Critical Drainage Area	Houghton/Hetton CDA			
Historical Flooding	No records			
Defended	No			
Flood Warning	No			
Brownfield/Greenfield	Greenfield			
Likelihood of passing Exception Test	Red Burn, a small tributary to Lumley Park Burn runs along the eastern boundary of the site and currently poses risk to the development. The Lumley Park Burn hydraulic model does not extend along Red Burn, so as a result the Flood Zones are based on early broad scale modelling outputs. The functional floodplain is based on the Flood Zone 3 extent and any FRA should investigate the true extent further. If improved mapping shows that this site is within Flood Zone 3b, then only water compatible development will be permitted here. If improved mapping shows the site is within Flood Zone 3 and the entire site is required for housing, the Exception Test will need to be passed, in which a FRA must prove it is safe. 27% of the land will potentially need compensational storage. Modelling work could show a reduction in fluvial risk when comparing to the current outlines. However there are potentially other sources of flooding to consider as it lies within a CDA. It is recommended that this site is avoided during the Sequential Test.			

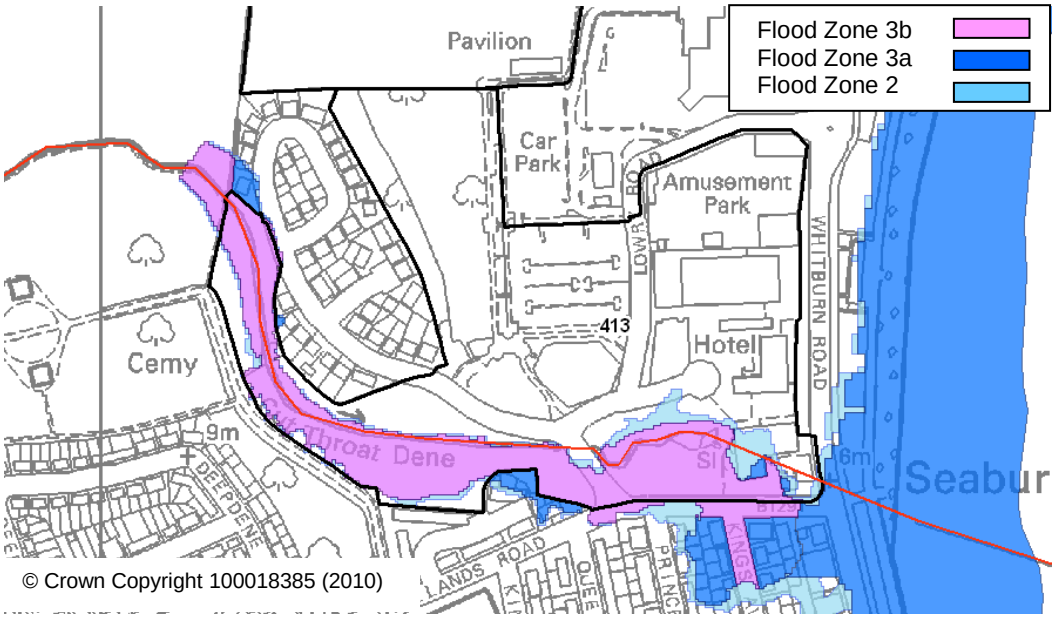
Site	375 - Stott's Pasture			
Area	1.08 ha			
Catchment	Lumley Park Burn			
Development Type	Residential (SHLAA)			
Vulnerability	More Vulnerable			
				
Fluvial & Tidal Flood Zone Coverage	**1**	**2**	**3a**	**3b**
	65%	3%	0%	32%
Climate Change Sensitive	Low			
Surface Water Zone Coverage	**Low**	**Medium**	**High**	
	2%	10%	9%	
NWL Drainage Area	Medium Flood Risk			
Critical Drainage Area	Herrington CDA			
Historical Flooding	No records			
Defended	No			
Flood Warning	No			
Brownfield/Greenfield	Greenfield			
Likelihood of passing Exception Test	The site is located on Herrington Burn, a tributary to Lumley Park Burn. The watercourse does not have a hydraulic model, so as a result the Flood Zones are based on early broad scale modelling outputs. The functional floodplain is based on the Flood Zone 3 extent and any FRA should investigate the true extent further. 32% of the site is currently within Flood Zone 3b, which should be removed from the development footprint. If the total developable footprint is required for housing, the Exception Test will need to be passed, in which a FRA must prove it is safe. In this instance a detailed hydraulic model will be required. Compensational storage will be required on site if flood storage is lost due to development. It is recommended that this site is avoided during the Sequential Test.			

Site	404 - Site west of Waterloo Road
Area	3.04 ha
Catchment	River Don
Development Type	Residential (SHLAA)
Vulnerability	More Vulnerable

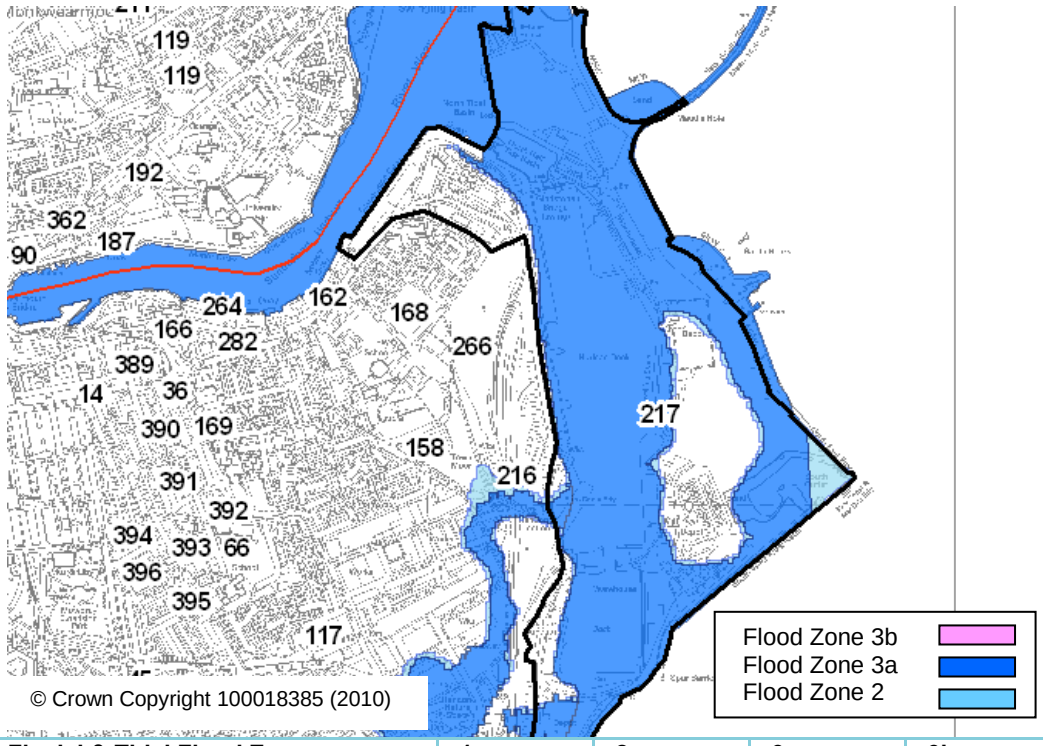


Fluvial & Tidal Flood Zone Coverage	**1**	**2**	**3a**	**3b**
	62%	5%	31%	2%
Climate Change Sensitive	Low			
Surface Water Zone Coverage	**Low**	**Medium**	**High**	
	5%	23%	13%	
NWL Drainage Area	Medium Flood Risk			
Critical Drainage Area	No			
Historical Flooding	No records			
Defended	No			
Flood Warning	No			
Brownfield/Greenfield	Greenfield			
Likelihood of passing Exception Test	The site is currently heavily vegetated surrounding Usworth Burn, a tributary to the River Don. The watercourse does not have a hydraulic model, so as a result the Flood Zones are based on early broad scale modelling outputs. Fluvial risk is unknown due to the significant error and misalignment in the current Flood Zones. The watercourse will have to be modelled to gain an understanding of the current risk to the development and surrounding properties as part of a FRA. It is recommended that this site is avoided during the Sequential Test.			

Site	413 - Seaburn Amusements
Area	9.24 ha
Catchment	Cut Throat Dene
Development Type	Residential (SHLAA)
Vulnerability	More Vulnerable



Fluvial & Tidal Flood Zone Coverage	**1**	**2**	**3a**	**3b**
	75%	3%	0%	21%
Climate Change Sensitive	Tidal levels will increase by 0.94m by 2100			
Surface Water Zone Coverage	**Low**	**Medium**	**High**	
	9%	19%	13%	
NWL Drainage Area	High Flood Risk			
Critical Drainage Area	Seaburn and Roker CDA			
Historical Flooding	No records			
Defended	Yes - Coastal defences			
Flood Warning	No			
Brownfield/Greenfield	Brownfield			
Likelihood of passing Exception Test	The site is a risk from both tidal and fluvial flooding along Cut Throat Dene. However, the site is protected directly from tidal flooding by coastal defences. The watercourse does not have a hydraulic model, so as a result the Flood Zones are based on early broad scale modelling outputs. Cut Throat Dene could potentially be sensitive to climate change due to the influence of tidal locking in the future. The current river corridor should be left as open space flood storage during an event. Development will have to link in with the future flood risk management strategy for the coastal defences along this stretch of the coast.			

Site	217 - The Port			
Area	88.94 ha			
Catchment	Coastal Streams			
Development Type	Residential (SHLAA)			
Vulnerability	More Vulnerable			
	 © Crown Copyright 100018385 (2010)			
Fluvial & Tidal Flood Zone Coverage	**1**	**2**	**3a**	**3b**
	26%	3%	71%	0%
Climate Change Sensitive	Tidal levels will increase by 0.94m by 2100			
Surface Water Zone Coverage	**Low**	**Medium**	**High**	
	9%	22%	0%	
NWL Drainage Area	Low/No Flood Risk			
Critical Drainage Area	No			
Historical Flooding	No records			
Defended	Yes			
Flood Warning	No			
Brownfield/Greenfield	Brownfield			
Likelihood of passing Exception Test	According to the analysis above, only 26% of the site is not at risk from flooding from the sea. However, the developable footprint includes the actual Port itself. Currently the site is in commercial and industrial usage. The site is currently defended by coastal defences. Development will have to link in with the future flood risk management strategy for the coastal defences along this stretch of the coast. The Wear CFMP policy states that the tidal floodplain should not see an increase in development and when the opportunity arises to set back developments from the tidal floodplain. However, due to the type of development planned on an industrial port it is unlikely that this is a realistic option. Any housing development should take account of this policy.			

5 Recommendations for Further Work

5.1 Introduction

SFRAs are more than a repository planning tool, and can provide a much broader and inclusive vehicle for integrated, strategic and local Flood Risk Management (FRM) assessment and delivery. Since publication of the Pitt Review, it is apparent that SFRAs can provide the centre for data, information and consideration for all flood risk issues relating to flooding from all sources at a local level; and provide the linkage between CFMPs, SMPs, RFRAs, SWMPs and appropriate sustainable land uses over a number of planning cycles.

In order to achieve this Sunderland City Council should take a lead role in FRM and continue the work of this Level 1 SFRA and increase the understanding and information available on flood risk issues. There are a number of future plans and studies which could provide this comprehensive understanding and acknowledgement of flood risk from all sources. These are outlined below with recommendations and how they will fulfil forthcoming LDF needs or those within the EU Flood Directive and recent Flood Risk Regulations 2009.

5.2 Level 2 Strategic Flood Risk Assessment

This Level 1 SFRA has provided the evidence base for Sunderland City Council to apply the Sequential Test as set out in PPS25. Whilst the suite of Flood Risk Maps provided will help inform the decision making process and go some way in informing the likelihood of passing the Exception Test, they do not provide the local understanding and the level of detail required to assess whether or not the Exception Test could be passed.

The aim of a Level 2 SFRA is to produce this greater understanding of the flood mechanisms and residual risks, concentrate on specific locations, and to provide the data needed to understand the likelihood that sites will pass part c) of the Exception Test – whether the development will be safe. Overall, it assesses whether or not sites at flood risk are deliverable in terms of Flood Risk Management (FRM) and that the full implications of allocating or including these areas in the strategy are understood.

The scope of a Level 2 SFRA is provided in PPS25 and its Practice Guide. It should include the detailed nature of the flood hazard within a flood zone including:

- Flood probability
- Flood Depth
- Flood Velocity

The Level 2 SFRA should also provide information on flood defences including their location, SoP, condition and an assessment of defences breaching and overtopping.

On review of flood risk information provided in this Level 1 SFRA, it is apparent that tidal flooding along the River Wear is not as significant as first assessed during the SFRA produced in 2007. Fatfield is the only area at risk from tidal and fluvial flooding along the Wear. However, Sunderland City Council has not identified any future development sites within this area.

Lumley Park Burn and its tributaries provide the greatest known risk of fluvial flooding in Sunderland. The level of risk is well documented with a recent hydraulic model of the watercourse available. Along the watercourse Sunderland City Council have proposed a number of developments sites. Some areas also benefit from fluvial flood defences, which protect certain areas to a 1 in 200 year standard. The residual risks along Lumley Park Burn should be investigated further during a Level 2 SFRA if these sites are not avoided during the Sequential Test.

Sunderland is also at risk from tidal flooding along the coast. Whilst urban areas are protected by coastal defence assets there is still a potential for residual risks i.e.

overtopping of defences during extreme events. A large development along the Port area just south of the mouth of the wear has been proposed by Sunderland City Council with nearly 70% within Flood Zone 3. If this site is not avoided during the Sequential Test it should be assessed further during a Level 2 SFRA.

Level 2 SFRA Recommendation

A Level 2 SFRA will only be required if Sunderland City Council want to allocate those development sites identified at risk which remain after the Sequential Test has been applied. This mainly relates to those sites along Lumley Park Burn and the Port. If required the Level 2 SFRA should be carried out to inform the preparation of the Allocation DPD.

The Port area has also been identified as a Strategic Site within the Sunderland City Council Core Strategy and therefore a Level 2 SFRA should be prepared to support the Sustainability Appraisal of the Core Strategy.

If a Level 2 SFRA is carried out to support the allocation of development sites in high risk areas, Sunderland City Council should also consider investigating surface water and sewer risk in greater detail within the scope of the work with guidance from the Environment Agency and Northumbrian Water.

If these sites are avoided during the Sequential Test a Level 2 SFRA will not be required.

5.3 Surface Water Management Plans and Water Cycle Studies

The 'Pitt Review', 'PPS25', the 'Making Space for Water - Integrated Urban Drainage' pilots, the 'Draft Flood and Water Management Bill' and draft Surface Water Management Plan (SWMP) guidance recognise the need for clearer roles and responsibilities for different sources of flood risk, with the current legislative framework leading to a fragmented and piecemeal approach for managing urban flood risk. A local leadership role for local flood risk issues has emerged whereby local authorities will need to have in place a strategy to manage these risks, of which a SWMP is an integral part.

SWMPs are developed by a partnership between a Local Authority, Water Company and the Environment Agency. They provide an opportunity to:

- Develop a framework for joint working and data sharing (which is a fundamental part of flood risk management under the draft Flood and Water Management Bill),
- Collate a central geographic database of drainage assets and flood risk issues,
- Assess the likelihood of surface water flooding through various modelling approaches,
- Assess the risk of surface water flooding to people, properties and the environment,
- Communicate this risk to local communities,
- Assess the costs and benefits of various flood risk reduction measures,
- Provide a drainage strategy for areas of significant development if appropriate, and
- Provide a framework for implementation and monitoring of the surface water strategy for a given area.

Water Cycle Studies (WCS) may also need to be carried out along side any SWMP. However, a WCS may not always be required if scoping shows no significant issues. Whilst the SWMP would address surface water management, WCS address the remaining issues of the capacity in water supply, waste water infrastructure and water in the environment to ensure that new development can be supplied with the required water services it needs in a sustainable way.

Both SWMPs and WCSs should be aimed at those regions with significant flood risk issues that are expecting growth as they can provide the evidence in introducing more onerous drainage standards for new or redevelopment sites.

SFRAs provide the opportunity for local authorities to assess the level of risk associated with multiple sources of flooding and their interactions by identifying Critical Drainage Areas (CDAs). CDAs are identified using historical flood records, hydraulic river models, surface water flooding maps and any information on the local sewer network, its capacity and risk to flooding received from the local water company and are the first stop in the production of SWMPs.

Recommendations would then be made for the future provision of SWMPs and WCSs in these high risk locations or areas with the aim of reducing risk to both current and future development.

SWMP Recommendation

Using the information collected in this Level 1 SFRA, CDAs have been identified in Sunderland within the drainage areas of Barnes Burn, Hendon Burn, Houghton/Hetton, Herrington, Seaburn/Roker and Washington Central.

It would usually be recommended that SWMP are carried out covering these areas. WCS would normally be undertaken over a large geographical area. Due to the overall low level of risk and lack of large scale development pressures in or upstream of these areas they are not need immediately.

However, looking towards the medium term, SWMPs could prove beneficial in the CDAs of Barnes Burn and Hendon Burn as a means of coordinating any urban flood risk study recommended below in Section 5.4. Houghton/Hetton and Washington Central CDAs could also benefit from a SWMP in the future if large scale development is planned.

It is recommended that those development sites (greater than 0.5ha) proposed in any of the CDAs should carry out Flood Risk Assessment and/or Drainage Impact Assessments as part of their planning application procedure to assess flood risk from all sources, their interactions and the standard of the current drainage/sewer network in which they are going to connect to. Additional safeguarding in these critical areas can ensure surface water from development is managed carefully.

Integrated drainage solutions should be prepared for larger sites or areas. Where major flow paths have been identified these should be considered in the master planning of the site and the sequential placement of development. SUDs techniques should be identified within the development at the earliest possible stage.

5.4 Flood Risk Study

According to the current Environment Agency Flood Zones and historical information collected Barnes and Hendon Burn provide a risk of fluvial flooding to current properties through Sunderland. However, both non-main watercourses are currently un-modelled and as such it has been difficult to assess the actual level of risk during this Level 1 SFRA.

Currently the Environment Agency Flood Zones are still based on the early broad scale modelling outputs and are likely to be inaccurate in both scale and extent. Flood risk is also difficult to predict due to the nature of the catchment.

Firstly, the contributing catchment of the watercourse is heavily urbanised and any inflows are likely to rely on urban surface water drainage system rather than natural runoff. This type of contributing catchment will significantly alter the volume, speed and location at which water enters the burn. Secondly, both watercourses have a number of critical

culverts which are know to block and cause flooding. The watercourses also discharge into the sea and the River Wear, meaning it is susceptible to tidal locking and the backing up and flooding of fluvial flow.

Sunderland City Council's Local Area Agreement NI189 has also identified the need to undertake a flood risk mapping study of urban watercourses through Sunderland (see Volume I Section 3.6.3). If this study is to be carried out as part of Sunderland City Council meeting their NI189 targets, it should be completed within the timetables specified in the document.

Flood Risk Study Recommendation

In order to assess the level of risk associated with Barnes and Hendon Burn, a detailed flood risk mapping study should be carried out. This should be carried out by Sunderland City Council, the Environment Agency and NWL in order to improve local knowledge and support further flood risk management.

This modelling work is likely to require significant input and cooperation from all flood risk stakeholders and could benefit from being part of a SWMP (as mentioned above in Section 5.3) to aid to coordination of the study.

Modelling could be carried out during the evidence preparation of a Preliminary Flood Risk Assessment (PFRA) identified in the Flood Risk Regulations (2009) and the future Floods and Water Management Bill (see Volume I Sections 3.2.1 and 3.2.2). This work could also be carried out towards Sunderland City Council meeting their NI189 actions (see Volume I Section 3.6.3).

Depending on the mechanism used to carry out this study, a range of timetables are likely to apply. However, as the preparations for PFRA are set to start in March 2010, it is more likely that this study would benefit from being part of a SWMP in the medium term.

5.5 Green Infrastructure Strategy

The Green Infrastructure (GI) of Sunderland is part of the City area's life support system. It is a planned and managed network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and rural fringe. In general GI consists of:

- Open Spaces – parks, woodlands, nature reserves, lakes, etc
- Linkages – River corridors and canals, pathways and cycle routes and greenways
- Networks of "urban green" – private gardens, street trees, verges and green roofs.

The identification and planning of GI is critical to sustainable growth. It merits forward planning and investment as much as other socio-economic priorities such as health, transport, education and economic development.

GI is also central to climate change action and is recurring theme in planning policy statements, regional spatial strategy and the sub-regional action plan.

GI is recognised as having multiple benefits: environmental (biodiversity), social (health and well being) and economic (attractive places to live have higher value and attract more investment). With regards to flood risk, green spaces can be used to manage storm flows and free up water storage capacity in existing infrastructure to reduce risk of damage to urban property, particularly in city centres and vulnerable urban regeneration areas. In general it allows space for SUDs and promotes sustainable vegetation cover, which stores water, increasing surface roughness and improves permeability of soils. GI can also improve accessibility to waterways and improve water quality, supporting regeneration and improving opportunity for leisure, economic activity and biodiversity.

When considering the potential of GI to contribute to water management, it must also be understood that GI is a holistic approach with potential to provide many benefits. It is equally the case that water management benefits should not be sought without consideration for other issues such as biodiversity, or amenity and play value of landscapes.

Green Infrastructure Recommendation

The evidence base provided in this SFRA should be used to enhance Sunderland City Council's Green Infrastructure Framework. River corridors identified as functional floodplain or land identified in the Areas Susceptible to Surface Water Flooding Map are an excellent linkage of GI and can provide storage during a flood event.

Areas identified at flood risk within the urban environment or defined flow routes within proposed CDAs should be incorporated in the City's GI strategy, by opening up land to create flow paths or flood storage areas that can help protect current and future property.

5.6 Summary

The above section has recommended a number of further studies within Sunderland which could provide Sunderland City Council with more detailed flood risk information within their area. This enhanced level of detail would help inform the application of the Sequential and Exception Tests and go some way in outlining key FRM policy and mitigation approaches in reducing and controlling flood risk.

Table 5-1: Summary of Recommended Studies

Study	Trigger	Scope	Timetable
Level 2 SFRA	Sites at high risk of flooding remain after Sunderland City Council has applied the Sequential Test Specifically, if Sunderland City Council is to allocate those housing development sites along Lumley Park Burn and the Port If more vulnerable sites at high risk (Flood Zone 3a/3b) are avoided during the Sequential Test, this study will not be required	The Level 2 SFRA should focus on those sites which require the Exceptions Test Specific tasks may include assessing the residual risks (breaching & overtopping) associated with the two defences along Lumley Park Burn and coastal defences at the Port Fluvial depths, velocities and hazards should be investigated to identify the likelihood of sites remaining safe if allocated and developed	This study should be carried out once Sunderland City Council has applied the Sequential Test in line with the LDF process This study may be needed to inform preparation of the Allocations DPD and Core Strategy of Strategic Sites
SWMP and WCS	Large scale development in Houghton/Hetton and Washington Central CDAs Flood risk study along Barnes and Hendon Burn	SWMP guidance available Requires significant input from the Environment Agency and NWL	Likely to be medium term – low priority
Barnes & Hendon Burn Flood Risk Study	Future development sites are proposed along either watercourse And/or	Flood risk mapping study would involve detailed surveying, production of a 1D or 1D-2D hydraulic model of the watercourse and urban drainage system and creation	This study should be carried out once the action is triggered If carried out as

Study	Trigger	Scope	Timetable
	Sunderland City Council want to improve the level and detail of flood risk information in line with SWMP, NI189 or Flood Risk Regulations 2009	of flood extents for a range of return periods Study should look at drainage and culvert capacities, the effects of tidal locking and climate change	part of SWMPs, NI189 or Flood Risk Regulations 2009, each mechanism will have their own timetables However, as this study has a low priority it is unlikely to match within any study in the next year. It is more likely to benefit from being included with any SWMP in the medium term

Appendices

A . Digital Data Register

Digital Data Register can be found on the Sunderland City Council Level 1 SFRA Digital Deliverables CD - Appendix A Folder

B . Historical Flood Incident Register

Historical Flood Incident Register can be found on the Sunderland City Council Level 1 SFRA Digital Deliverables CD - Appendix B Folder

C . Coastal Defence Survey

Condition grade taken from Environment Agency NFCDD (2010)

Recommended action and priority* scoring taken from NECAG (2009) Coast Protection Assets and Coastal Slope Condition Analysis report

** The priority level encompasses the asset condition, residual life and weighting of the asset in addition to the nature, scale and cost of remedial work required. A guide to each of the priority levels is provided below:*

Priority	Description
Low	Low Routine maintenance or local repairs
Medium	More significant survey and/or extensive maintenance work
High	Urgent investigation and/or extensive repair works. Potential replacement of asset elements or asset as a whole

NFCDD Defence Asset Reference	Location	Asset Type	Condition Grade	Recommended Action (2008)	Priority*
121AB901B0602C01	The Bents	Wall	unknown	No action	-
121AB901B0603C01	Whitburn Sands	Wall	2-3	Remove vegetation & infill cracks	Low
121AB901B0603C02	Whitburn Sands	Wall	2-3	Replace missing mortar at masonry/concrete joint	Low
121AB901B0603C03	Whitburn Sands	Wall	3	Repoint. Replace missing mortar at masonry/concrete joint	Low
121AB901B0604C01	Whitburn Sands	Wall	2	Repoint masonry wall	Low
121AB901B0604C02	Parson's Rocks	Splash Wall	3	No action	-
121AB901B0605C01	Roker	Wall	2	Infill cracks/replace cracked masonry blocks. Repoint masonry wall	Low
121AB901B0605C02	Roker	Wall	1	Infill cracks in upper concrete wall	Low
121AB901B0702C01	Roker	Splash Wall	2	Infill cracks in concrete wall	Low
121AB901B0702C02	Roker	Splash Wall	2	No action	
121AB901B0702C03	North Pier	Undefended Frontage	3	No action	-
121AB901B0702C04	Roker Pier	Breakwater	2	Minor repointing. Repairs to surface	Medium
121AB901B0702C05	Roker	Wall	1	Minor repointing to masonry wall	Low
121AB901B0703C01	New South Pier	Breakwater	2	No action	-

NFCDD Defence Asset Reference	Location	Asset Type	Condition Grade	Recommended Action (2008)	Priority*
121AB901B0703C02	Port of Sunderland	Wall	2	Infill cracks in concrete. Patch repairs to spalling of surface. Make good tie in with revetment to north	Low
121AB901B0703C03	Port of Sunderland	Armour	1-2	No action	-
121AB901B0801C01	Port of Sunderland	Wall	5	No action – concrete groyne has collapsed	Low
121AB901B0801C02	South Rocks	Armour	3	No action	-
121AB901B0801C03	New South Pier	Wall	2	No action	-
121AB901B0801C04	North East Pier	Apron	4	Full survey of structure. Large scale remedial works or replacement	High
121AB901B0801C05	Port of Sunderland	Undefended Frontage	3	Provide rock armour to undefended frontage	Medium
121AB901B0801C06	Port of Sunderland	Revetment	3	Increase volume of armour or redistribute around exposed walls/ piles	Medium
121AB901B0801C07	Port of Sunderland	Breakwater	4	Large scale remedial work to/replacement of derelict breakwater	High
121AB901B0801C08	Port of Sunderland South Outlet	Revetment	3	No action	-
121AB901B0802C01	Hendon	Splash Wall	2	Replace missing concrete crest wall section	Medium
121AB901B0802C02	Port of Sunderland	Splash Wall	2	Infill cracks and patch repairs to concrete surface damage around drainage holes and construction joints	Low
121AB901B0802C03	Port of Sunderland	Bank	3-4	Patch repairs to concrete seawall. Add rock armour revetment or similar to protect concrete seawall at Hendon Foreshore Barrier	High
121AB901B0802C04	Spur Barrier	Splash Wall	2	Replace sealant in construction joints and infill cracks in concrete	Low
121AB901B0802C05	South West Breakwater	Apron	3	Full survey of structure. Local repair works to north face and upper level of south face	Medium
121AB901B0802C06	Port of Sunderland South Outlet	Revetment	3	No action	-
121AB901B0802C07	Port of Sunderland South Outlet	Revetment	2	No action	-
121AB901B0803C01	Ryhope	Undefended Frontage	1	No action	-
121AB901B0803C02	Hendon Promenade	Breakwater	2-3	Full survey of structure. Remedial work to remove failed seaward end of breakwater and make good exposed structure. Replace sealant in construction joints	Medium
121AB901B0804C02	Pincushion	Undefended Frontage	1	No action	-
121AB901B0804C03	Salterfen Rocks	Cliff / Scarp	1	No action	-

D . Sequential Test Spreadsheet (extract)

A full copy of the Sequential Test Spreadsheet can be found on the Sunderland City Council Level 1 SFRA Digital Deliverables CD - Appendix D Folder

Site ID	Name	Type	Area (ha)	Flood Zone 1		Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
				Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
1	High Dubmire (phase 2) Mulberry Park	SHLAA	3.37	3.37	100	0.00	0	0.00	0	0.00	0
2	Lyons Garage, Colliery Lane	SHLAA	0.60	0.60	100	0.00	0	0.00	0	0.00	0
3	NEEB (site of), Station Road	SHLAA	7.92	7.92	100	0.00	0	0.00	0	0.00	0
5	Davenport School	SHLAA	1.40	1.40	100	0.00	0	0.00	0	0.00	0
6	Former Flighters Public House and Car Park	SHLAA	0.05	0.05	100	0.00	0	0.00	0	0.00	0
10	Chilton Moor Phase 2, Avon and Thames Crescent	SHLAA	1.45	1.45	100	0.00	0	0.00	0	0.00	0
11	Site of Windsor Crescent/ Hall Lane	SHLAA	2.81	2.81	100	0.00	0	0.00	0	0.00	0
12	Oval Guest House	SHLAA	0.10	0.10	100	0.00	0	0.00	0	0.00	0
14	Former Bristol St Motors and Coopers Bar PH	SHLAA	0.23	0.23	100	0.00	0	0.00	0	0.00	0
15	Brookfield, Ashbrooke Road	SHLAA	0.55	0.55	100	0.00	0	0.00	0	0.00	0
16	The Esplanade and Esplanade Mews	SHLAA	0.77	0.77	100	0.00	0	0.00	0	0.00	0
17	Benedict Building, Saint Georges Way	SHLAA	0.73	0.73	100	0.00	0	0.00	0	0.00	0
18	42-45 Nile Street	SHLAA	0.06	0.06	100	0.00	0	0.00	0	0.00	0
20	Warwick Garage	SHLAA	0.63	0.63	100	0.00	0	0.00	0	0.00	0
22	Saint Georges House	SHLAA	0.12	0.12	100	0.00	0	0.00	0	0.00	0
23	The Oaks, Silksworth	SHLAA	0.46	0.46	100	0.00	0	0.00	0	0.00	0
24	Site of Leonard House/Library	SHLAA	0.42	0.42	100	0.00	0	0.00	0	0.00	0
25	Site of Parkhurst Road (part)	SHLAA	3.95	3.95	100	0.00	0	0.00	0	0.00	0
28	Well Bank School	SHLAA	0.61	0.61	100	0.00	0	0.00	0	0.00	0
29	Moorway and Thorngill	SHLAA	2.93	2.93	100	0.00	0	0.00	0	0.00	0
30	Cross House Farm	SHLAA	0.21	0.21	100	0.00	0	0.00	0	0.00	0

Site ID	Name	Type	Area	Flood Zone 1		Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
31	East of Windermere Crescent	SHLAA	3.60	3.44	95	0.05	1	0.01	0	0.10	3
32	Robertson Yard, Station Road	SHLAA	0.69	0.69	100	0.00	0	0.00	0	0.00	0
33	Helen's Depot, Colliery Lane	SHLAA	1.21	1.21	100	0.00	0	0.00	0	0.00	0
34	Chilton Moor Phase 3	SHLAA	1.09	1.09	100	0.00	0	0.00	0	0.00	0
35	Over the Hill Farm, Durham Road	SHLAA	1.14	1.14	100	0.00	0	0.00	0	0.00	0
36	4-8 Villiers Street, Hendon	SHLAA	0.09	0.09	100	0.00	0	0.00	0	0.00	0
37	24-28 Stockton Road and land to rear	SHLAA	0.17	0.17	100	0.00	0	0.00	0	0.00	0
38	12-14 Gray Road	SHLAA	0.30	0.30	100	0.00	0	0.00	0	0.00	0
40	187-193 High Street West	SHLAA	0.10	0.10	100	0.00	0	0.00	0	0.00	0
42	Former Bus Depot	SHLAA	0.21	0.16	77	0.05	22	0.00	1	0.00	0
43	178-185 High Street West	SHLAA	0.14	0.14	100	0.00	0	0.00	0	0.00	0
44	The Bunker, 29 Stockton Road	SHLAA	0.06	0.06	100	0.00	0	0.00	0	0.00	0
45	Toward Road Service Station	SHLAA	0.27	0.27	100	0.00	0	0.00	0	0.00	0
46	Angram Drive	SHLAA	1.27	1.27	100	0.00	0	0.00	0	0.00	0
47	Former print Centre and Adj land Former Car Garage, Fulwell Road	SHLAA	0.21	0.21	100	0.00	0	0.00	0	0.00	0
49	Health Centre, Coleridge Road	SHLAA	0.37	0.37	100	0.00	0	0.00	0	0.00	0
50	Saint margarets Church, Hylton Castle Road	SHLAA	0.22	0.22	100	0.00	0	0.00	0	0.00	0
52	Doxford Park Phase 3	SHLAA	4.39	4.39	100	0.00	0	0.00	0	0.00	0
53	Land Rear of Thorney Close Club	SHLAA	0.42	0.42	100	0.00	0	0.00	0	0.00	0
54	Former Public House, Portsmouth Road	SHLAA	0.19	0.19	100	0.00	0	0.00	0	0.00	0
55	West of Burtree, Cambrian Way	SHLAA	0.43	0.43	100	0.00	0	0.00	0	0.00	0
56	High Usworth Infant School	SHLAA	2.92	2.92	100	0.00	0	0.00	0	0.00	0
57	George Washington Hotel, Stone Cellar Road	SHLAA	0.80	0.80	100	0.00	0	0.00	0	0.00	0
59	Site of Middle Close	SHLAA	0.30	0.30	100	0.00	0	0.00	0	0.00	0
60	19-26 Westward Place	SHLAA	0.29	0.29	100	0.00	0	0.00	0	0.00	0
61	Former Lambton Cokeworks Site	SHLAA	21.01	20.66	98	0.06	0	0.00	0	0.30	1
62	Ryhope and Cherry Knowle Hospital Sites & Wellfield Farm	SHLAA	30.32	30.32	100	0.00	0	0.00	0	0.00	0
63	Vaux brewery	SHLAA	5.86	5.86	100	0.00	0	0.00	0	0.00	0
64	Farringdon Row Phase 1	SHLAA	1.21	1.21	100	0.00	0	0.00	0	0.00	0

Site ID	Name	Type	Area	Flood Zone 1		Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
65	Southmoor Service Station	SHLAA	0.09	0.09	100	0.00	0	0.00	0	0.00	0
66	15-18 Hudson Road	SHLAA	0.07	0.07	100	0.00	0	0.00	0	0.00	0
67	R and J Smith Motors Limited, Pallion Road	SHLAA	0.17	0.17	100	0.00	0	0.00	0	0.00	0
68	8-12 Murton Street	SHLAA	0.17	0.17	100	0.00	0	0.00	0	0.00	0
69	St Georges Terrace	SHLAA	0.46	0.46	100	0.00	0	0.00	0	0.00	0
70	The Forge Site	SHLAA	3.20	3.20	100	0.00	0	0.00	0	0.00	0
71	Cape Insulation, Barmston Road	SHLAA	16.06	16.06	100	0.00	0	0.00	0	0.00	0
72	Land at Warren lea, Springwell Road	SHLAA	0.17	0.17	100	0.00	0	0.00	0	0.00	0
74	Murton Lane	SHLAA	14.08	14.08	100	0.00	0	0.00	0	0.00	0
75	Halliwell Street and Brinkburn Crescent Car Park	SHLAA	1.16	1.16	100	0.00	0	0.00	0	0.00	0
76	West of Lyons Avenue	SHLAA	1.97	1.97	100	0.00	0	0.00	0	0.00	0
77	Holmeside Triangle	SHLAA	4.13	4.13	100	0.00	0	0.00	0	0.00	0
78	Farringdon Row Phase 2-4	SHLAA	4.59	4.59	100	0.00	0	0.00	0	0.00	0
79	Hylton Lane, Town End Farm	SHLAA	2.55	2.55	100	0.00	0	0.00	0	0.00	0
80	Stadium Village	SHLAA	1.40	1.40	100	0.00	0	0.00	0	0.00	0
81	Chapelgarth site part	SHLAA	35.59	35.59	100	0.00	0	0.00	0	0.00	0
82	Clinton Place	SHLAA	3.53	3.53	100	0.00	0	0.00	0	0.00	0
83	North of Saint Lukes Road	SHLAA	6.15	6.15	100	0.00	0	0.00	0	0.00	0
84	Land at Priestman Court, Ford Estate	SHLAA	0.41	0.41	100	0.00	0	0.00	0	0.00	0
85	Groves	SHLAA	31.65	31.61	100	0.02	0	0.02	0	0.00	0
86	Easington Lane Primary School	SHLAA	1.27	1.27	100	0.00	0	0.00	0	0.00	0
87	Dubmire Primary School	SHLAA	0.30	0.30	100	0.00	0	0.00	0	0.00	0
90	Saint Peters Wharf Phase 2 and 3, Chandlers Road	SHLAA	1.53	1.53	100	0.00	0	0.00	0	0.00	0
91	Southwick Primary School	SHLAA	1.80	1.80	100	0.00	0	0.00	0	0.00	0
92	Monkwearmouth College	SHLAA	0.69	0.69	100	0.00	0	0.00	0	0.00	0
93	North Moor Lane	SHLAA	3.56	3.56	100	0.00	0	0.00	0	0.00	0
94	Grindon Hall Christian School	SHLAA	3.92	3.92	100	0.00	0	0.00	0	0.00	0
95	Thorney Close Primary School	SHLAA	0.83	0.83	100	0.00	0	0.00	0	0.00	0
96	Felstead School	SHLAA	1.90	1.90	100	0.00	0	0.00	0	0.00	0
97	Pennywell Phase 7	SHLAA	0.50	0.50	100	0.00	0	0.00	0	0.00	0

Site ID	Name	Type	Area	Flood Zone 1		Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
98	Ayton Primary School	SHLAA	1.58	1.58	100	0.00	0	0.00	0	0.00	0
99	Site of Windsor Crescent/Hall Lane	SHLAA	3.69	3.69	100	0.00	0	0.00	0	0.00	0
100	Ryhope Village	SHLAA	4.92	4.92	100	0.00	0	0.00	0	0.00	0
101	Kidderminster Road	SHLAA	5.24	5.24	100	0.00	0	0.00	0	0.00	0
102	Carley Hill School	SHLAA	4.20	4.20	100	0.00	0	0.00	0	0.00	0
103	Castletown Aviary and Allotments	SHLAA	4.31	4.31	100	0.00	0	0.00	0	0.00	0
104	Southwick Phase 1	SHLAA	12.13	12.13	100	0.00	0	0.00	0	0.00	0
105	Doxford Park phases 3b	SHLAA	23.93	23.93	100	0.00	0	0.00	0	0.00	0
106	High Ford Estate	SHLAA	12.80	12.80	100	0.00	0	0.00	0	0.00	0
107	Pennywell phases 2 to 6	SHLAA	15.85	15.85	100	0.00	0	0.00	0	0.00	0
108	1-8 Westward Place	SHLAA	0.24	0.24	100	0.00	0	0.00	0	0.00	0
109	Glebe	SHLAA	1.62	1.62	100	0.00	0	0.00	0	0.00	0
110	Starks Builders Yard, Hunter Street	SHLAA	0.52	0.52	100	0.00	0	0.00	0	0.00	0
111	Land at Neil St and the Bat Cave	SHLAA	1.61	1.61	100	0.00	0	0.00	0	0.00	0
112	Broomhill Estate Phase 1 and 2	SHLAA	3.89	3.89	100	0.00	0	0.00	0	0.00	0
113	Site of Herrington Working Mens Club	SHLAA	0.42	0.42	100	0.00	0	0.00	0	0.00	0
114	Moor House, Four Lane Ends	SHLAA	0.61	0.61	100	0.00	0	0.00	0	0.00	0
115	Holmelands	SHLAA	5.75	5.75	100	0.00	0	0.00	0	0.00	0
117	Dawson and Usher works	SHLAA	0.77	0.77	100	0.00	0	0.00	0	0.00	0
118	Belford House	SHLAA	0.78	0.78	100	0.00	0	0.00	0	0.00	0
119	Back Whickham Street	SHLAA	0.54	0.54	100	0.00	0	0.00	0	0.00	0
120	St Hilda's Church	SHLAA	0.62	0.62	100	0.00	0	0.00	0	0.00	0
122	Doxford House, Warden Law Lane	SHLAA	0.62	0.62	100	0.00	0	0.00	0	0.00	0
124	Glebe Village House	SHLAA	0.40	0.40	100	0.00	0	0.00	0	0.00	0
125	Woodlands	SHLAA	0.47	0.47	100	0.00	0	0.00	0	0.00	0
128	Black Boy Road	SHLAA	10.34	10.34	100	0.00	0	0.00	0	0.00	0
129	Hetton Moor House	SHLAA	6.49	6.49	100	0.00	0	0.00	0	0.00	0
130	Elemore Golf Club	SHLAA	3.51	3.51	100	0.00	0	0.00	0	0.00	0
131	Southern House Farm	SHLAA	1.33	0.82	62	0.03	3	0.07	5	0.40	30
134	Football pitch, Colliery Lane	SHLAA	0.78	0.78	100	0.00	0	0.00	0	0.00	0
138	North Road	SHLAA	31.77	30.87	97	0.24	1	0.00	0	0.66	2
139	South Lodge Farm	SHLAA	10.40	9.76	94	0.08	1	0.00	0	0.56	5

Site ID	Name	Type	Area	Flood Zone 1		Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
140	Hazard Lane	SHLAA	4.10	4.06	99	0.00	0	0.00	0	0.03	1
141	Lyons Avenue	SHLAA	0.65	0.65	100	0.00	0	0.00	0	0.00	0
142	Former Chilton Moor Cricket Club	SHLAA	1.29	1.29	100	0.00	0	0.00	0	0.00	0
143	Lyons Cottages	SHLAA	0.61	0.61	100	0.00	0	0.00	0	0.00	0
144	Coaley lane	SHLAA	9.29	9.29	100	0.00	0	0.00	0	0.00	0
145	Burdon Road and Burdon Lane	SHLAA	7.37	7.37	100	0.00	0	0.00	0	0.00	0
146	Easington Lane Primary School	SHLAA	1.68	1.68	100	0.00	0	0.00	0	0.00	0
147	Greenway House	SHLAA	1.24	1.24	100	0.00	0	0.00	0	0.00	0
149	Aster Terrace	SHLAA	1.58	1.58	100	0.00	0	0.00	0	0.00	0
150	Land Adjacent Newbottle Primary School	SHLAA	0.41	0.41	100	0.00	0	0.00	0	0.00	0
152	Burdon Village	SHLAA	3.76	3.76	100	0.00	0	0.00	0	0.00	0
154	Seaburn Camp	SHLAA	11.86	11.86	100	0.00	0	0.00	0	0.00	0
156	Ex North Block	SHLAA	1.25	1.25	100	0.00	0	0.00	0	0.00	0
157	Crowtree Leisure Centre	SHLAA	1.13	1.13	100	0.00	0	0.00	0	0.00	0
158	Former Orphanage/ East CA	SHLAA	0.61	0.61	100	0.00	0	0.00	0	0.00	0
159	Land Adjacent to The Sportsmans Arms	SHLAA	0.29	0.29	100	0.00	0	0.00	0	0.00	0
160	East of Silksworth Lane	SHLAA	0.69	0.69	100	0.00	0	0.00	0	0.00	0
161	Dovedale Road	SHLAA	0.38	0.38	100	0.00	0	0.00	0	0.00	0
162	High Street East	SHLAA	0.28	0.28	100	0.00	0	0.00	0	0.00	0
163	Amberley Street and Harrogate Street	SHLAA	3.48	3.48	100	0.00	0	0.00	0	0.00	0
166	Numbers Garth and Former School	SHLAA	0.60	0.60	100	0.00	0	0.00	0	0.00	0
168	Burleigh Garth	SHLAA	1.02	1.02	100	0.00	0	0.00	0	0.00	0
169	Covent Garden	SHLAA	0.30	0.30	100	0.00	0	0.00	0	0.00	0
171	Former Pallion Station Site	SHLAA	0.40	0.40	100	0.00	0	0.00	0	0.00	0
172	Forest Estate	SHLAA	4.15	4.15	100	0.00	0	0.00	0	0.00	0
174	Houghton Colliery	SHLAA	4.44	4.44	100	0.00	0	0.00	0	0.00	0
175	Fulwell Quarry East	SHLAA	4.94	4.94	100	0.00	0	0.00	0	0.00	0
176	Sunniside	SHLAA	0.42	0.42	100	0.00	0	0.00	0	0.00	0
177	Former Usworth Comprehensive School Site A	SHLAA	7.48	7.48	100	0.00	0	0.00	0	0.00	0
178	Downs Pit Lane	SHLAA	2.64	2.64	100	0.00	0	0.00	0	0.00	0
181	Houghton Road	SHLAA	13.23	10.26	78	0.34	3	0.00	0	2.63	20

Site ID	Name	Type	Area	Flood Zone 1		Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
183	Ashburn House	SHLAA	1.08	1.08	100	0.00	0	0.00	0	0.00	0
185	Wearmouth Hall site, Chester Road	SHLAA	0.38	0.38	100	0.00	0	0.00	0	0.00	0
186	Precinct	SHLAA	1.40	1.40	100	0.00	0	0.00	0	0.00	0
187	Bonnersfield	SHLAA	1.03	1.03	100	0.00	0	0.00	0	0.00	0
188	Clanny House	SHLAA	2.44	2.44	100	0.00	0	0.00	0	0.00	0
189	Forster Building	SHLAA	0.57	0.57	100	0.00	0	0.00	0	0.00	0
190	Technology Park	SHLAA	0.67	0.67	100	0.00	0	0.00	0	0.00	0
191	Priestman Building	SHLAA	0.27	0.27	100	0.00	0	0.00	0	0.00	0
192	Manor Quay and Wearbank House	SHLAA	0.25	0.25	100	0.00	0	0.00	0	0.00	0
193	SIG Combibloc Limited	SHLAA	4.83	4.83	100	0.00	0	0.00	0	0.00	0
194	Lambton Lane	SHLAA	9.28	8.13	88	0.72	8	0.05	1	0.39	4
197	Eppleton Primary School	SHLAA	5.56	5.56	100	0.00	0	0.00	0	0.00	0
198	All Saints House	SHLAA	0.46	0.46	100	0.00	0	0.00	0	0.00	0
211	36 to 38 Roker Avenue	SHLAA	0.28	0.28	100	0.00	0	0.00	0	0.00	0
214	Redcar Road	SHLAA	0.89	0.89	100	0.00	0	0.00	0	0.00	0
216	Hendon Sidings	SHLAA	29.99	28.44	95	0.54	2	1.01	3	0.00	0
217	The Port	SHLAA	88.94	23.18	26	3.06	3	62.71	71	0.00	0
218	Littlewoods Home Shopping Group	SHLAA	0.93	0.93	100	0.00	0	0.00	0	0.00	0
221	Hind Street/Hope Street/Silksworth Row Site	SHLAA	0.85	0.85	100	0.00	0	0.00	0	0.00	0
222	Waterworks Road	SHLAA	0.37	0.37	100	0.00	0	0.00	0	0.00	0
223	Johnson Street	SHLAA	0.29	0.29	100	0.00	0	0.00	0	0.00	0
224	Deptford works, Pallion New Road	SHLAA	6.36	6.36	100	0.00	0	0.00	0	0.00	0
225	Former Shipyard	SHLAA	11.92	11.61	97	0.03	0	0.28	2	0.00	0
230	Rutland Street	SHLAA	0.42	0.42	100	0.00	0	0.00	0	0.00	0
235	Manor House, Station Road	SHLAA	1.45	1.45	100	0.00	0	0.00	0	0.00	0
236	Garage, Cox Green Road	SHLAA	0.48	0.48	100	0.00	0	0.00	0	0.00	0
237	Fulwell Junior School, Sea Road	SHLAA	1.01	1.01	100	0.00	0	0.00	0	0.00	0
238	Portobello Lane, Roker Avenue	SHLAA	0.52	0.52	100	0.00	0	0.00	0	0.00	0
240	West Quay, Crown Road	SHLAA	1.83	1.83	100	0.00	0	0.00	0	0.00	0
241	Ridley Street	SHLAA	0.25	0.25	100	0.00	0	0.00	0	0.00	0
242	Ridley Street off Emsworth Road	SHLAA	0.35	0.35	100	0.00	0	0.00	0	0.00	0
243	Earlston Street	SHLAA	0.50	0.50	100	0.00	0	0.00	0	0.00	0

Site ID	Name	Type	Area	Flood Zone 1		Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
248	Emmerson House	SHLAA	4.44	4.44	100	0.00	0	0.00	0	0.00	0
249	Galleries Car Park adj to Asda	SHLAA	1.20	1.20	100	0.00	0	0.00	0	0.00	0
250	B & Q Warehouse (former), Armstrong Road	SHLAA	0.73	0.73	100	0.00	0	0.00	0	0.00	0
252	Hastings Court	SHLAA	0.75	0.75	100	0.00	0	0.00	0	0.00	0
254	Fulwell Reservoir	SHLAA	0.72	0.72	100	0.00	0	0.00	0	0.00	0
255	South Ryhope	SHLAA	46.82	45.81	98	0.07	0	0.00	0	0.94	2
258	Albany Park	SHLAA	17.24	17.24	100	0.00	0	0.00	0	0.00	0
263	Springwell Road	SHLAA	2.15	2.15	100	0.00	0	0.00	0	0.00	0
264	Scotia Quay	SHLAA	0.21	0.21	100	0.00	0	0.00	0	0.00	0
265	Beacon Drive	SHLAA	0.19	0.19	100	0.00	0	0.00	0	0.00	0
266	Hendon Sidings	SHLAA	5.26	5.15	98	0.07	1	0.04	1	0.00	0
267	Elstob House Farm	SHLAA	31.94	31.47	99	0.23	1	0.24	1	0.00	0
269	Blue House fields	SHLAA	7.53	7.53	100	0.00	0	0.00	0	0.00	0
270	Mount Lodge	SHLAA	4.77	4.77	100	0.00	0	0.00	0	0.00	0
272	North Farm, Warden Law Site 1	SHLAA	22.05	22.05	100	0.00	0	0.00	0	0.00	0
273	North Farm, Warden Law Site 2	SHLAA	6.22	6.22	100	0.00	0	0.00	0	0.00	0
274	North Farm, Warden Law Site 3	SHLAA	7.16	7.16	100	0.00	0	0.00	0	0.00	0
275	North Farm, Warden Law Site 4	SHLAA	10.91	10.91	100	0.00	0	0.00	0	0.00	0
276	North Hylton between north bound carrigeway of A19 and the A1290	SHLAA	22.20	22.20	100	0.00	0	0.00	0	0.00	0
277	Burdon Road and Burdon Lane Site 6	SHLAA	40.07	40.07	100	0.00	0	0.00	0	0.00	0
278	Burdon Road and Burdon Lane Site 3	SHLAA	30.63	30.63	100	0.00	0	0.00	0	0.00	0
279	Bede Centre and surrounding land	SHLAA	9.01	9.01	100	0.00	0	0.00	0	0.00	0
280	Shiney Row Centre	SHLAA	4.20	4.20	100	0.00	0	0.00	0	0.00	0
282	High Street East	SHLAA	0.34	0.34	100	0.00	0	0.00	0	0.00	0
286	Woodbine Terrace/Ditchburn Terrace	SHLAA	1.75	1.74	99	0.00	0	0.01	0	0.00	0
287	Wilden Road	SHLAA	4.93	4.93	100	0.00	0	0.00	0	0.00	0
288	East of Pattinson Road	SHLAA	2.13	2.13	100	0.00	0	0.00	0	0.00	0
291	Dagmar Public House	SHLAA	0.62	0.62	100	0.00	0	0.00	0	0.00	0
292	Lisburn Terrace Site 2	SHLAA	10.79	10.79	100	0.00	0	0.00	0	0.00	0
293	Low Moorsley	SHLAA	5.38	5.38	100	0.00	0	0.00	0	0.00	0
294	Paper Mill, Commercial Road	SHLAA	5.25	5.25	100	0.00	0	0.00	0	0.00	0

Site ID	Name	Type	Area	Flood Zone 1		Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
296	Allotment Site	SHLAA	1.43	1.43	100	0.00	0	0.00	0	0.00	0
297	Former Arriva Depot	SHLAA	1.57	1.57	100	0.00	0	0.00	0	0.00	0
298	Usworth House Farm	SHLAA	26.91	26.91	100	0.00	0	0.00	0	0.00	0
299	Peareth Hall Farm	SHLAA	2.83	2.83	100	0.00	0	0.00	0	0.00	0
300	Springwell trust meeting house	SHLAA	0.89	0.89	100	0.00	0	0.00	0	0.00	0
301	Ferryboat Lane	SHLAA	0.55	0.55	100	0.00	0	0.00	0	0.00	0
302	Hylton bank	SHLAA	0.82	0.82	100	0.00	0	0.00	0	0.00	0
305	High Dubmire	SHLAA	0.73	0.73	100	0.00	0	0.00	0	0.00	0
307	Ford and Hylton Social Club	SHLAA	0.30	0.30	100	0.00	0	0.00	0	0.00	0
318	Moor Burn House	SHLAA	0.55	0.55	100	0.00	0	0.00	0	0.00	0
324	Durham Road and Tudor Grove	SHLAA	2.40	2.40	100	0.00	0	0.00	0	0.00	0
328	Princess Gardens	SHLAA	0.35	0.35	100	0.00	0	0.00	0	0.00	0
329	Highfield Hotel	SHLAA	0.44	0.44	100	0.00	0	0.00	0	0.00	0
330	Philadelphia Complex Site 3	SHLAA	18.58	18.58	100	0.00	0	0.00	0	0.00	0
332	Philadelphia Nursing Home	SHLAA	0.88	0.88	100	0.00	0	0.00	0	0.00	0
333	Fletcher Terrace	SHLAA	0.36	0.36	100	0.00	0	0.00	0	0.00	0
334	Holycross Home	SHLAA	1.17	1.17	100	0.00	0	0.00	0	0.00	0
335	1-4 Thornhill Park	SHLAA	0.33	0.33	100	0.00	0	0.00	0	0.00	0
339	Land at Gillas lane	SHLAA	3.35	3.35	100	0.00	0	0.00	0	0.00	0
340	Front Street	SHLAA	2.67	1.87	70	0.60	22	0.05	2	0.16	6
341	Redburn Road	SHLAA	4.94	3.40	69	0.20	4	0.01	0	1.32	27
342	Mill Hill	SHLAA	11.22	11.22	100	0.00	0	0.00	0	0.00	0
343	Grasswell	SHLAA	30.20	30.20	100	0.00	0	0.00	0	0.00	0
344	Ewe Hill	SHLAA	1.39	1.39	100	0.00	0	0.00	0	0.00	0
347	Ryhope Road	SHLAA	4.81	4.81	100	0.00	0	0.00	0	0.00	0
348	Ryhope Road	SHLAA	16.39	16.39	100	0.00	0	0.00	0	0.00	0
349	Philadelphia Junction	SHLAA	5.78	5.78	100	0.00	0	0.00	0	0.00	0
353	Usworth House Farm	SHLAA	14.75	14.75	100	0.00	0	0.00	0	0.00	0
354	Warren Lea	SHLAA	0.82	0.82	100	0.00	0	0.00	0	0.00	0
355	Rushford Phase 2	SHLAA	7.42	7.42	100	0.00	0	0.00	0	0.00	0
356	Burdon Road/ Hall Farm Road	SHLAA	9.74	9.74	100	0.00	0	0.00	0	0.00	0

Site ID	Name	Type	Area	Flood Zone 1		Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
359	Former Usworth Comprehensive School Site B	SHLAA	3.91	3.91	100	0.00	0	0.00	0	0.00	0
362	Bonner's Field Industrial Estate	SHLAA	0.32	0.32	100	0.00	0	0.00	0	0.00	0
364	Pattinson Road	SHLAA	6.30	6.30	100	0.00	0	0.00	0	0.00	0
365	Newbottle Site 2	SHLAA	3.67	3.67	100	0.00	0	0.00	0	0.00	0
366	Hastings Hill Farm	SHLAA	0.34	0.34	100	0.00	0	0.00	0	0.00	0
367	Coaley Lane	SHLAA	5.19	5.19	100	0.00	0	0.00	0	0.00	0
369	Units 1-22 Swan (North) Industrial Estate	SHLAA	0.53	0.53	100	0.00	0	0.00	0	0.00	0
370	23 Eddison Road (works depot)	SHLAA	0.32	0.32	100	0.00	0	0.00	0	0.00	0
372	Houghton Police Station	SHLAA	0.62	0.62	100	0.00	0	0.00	0	0.00	0
373	Gillbridge Police Station	SHLAA	0.50	0.50	100	0.00	0	0.00	0	0.00	0
374	Farringdon Police Station	SHLAA	0.59	0.59	100	0.00	0	0.00	0	0.00	0
375	Stott's Pasture	SHLAA	1.08	0.70	65	0.03	3	0.00	0	0.34	32
376	Chilton Gardens	SHLAA	1.31	1.31	100	0.00	0	0.00	0	0.00	0
377	High Dubmire	SHLAA	1.19	1.19	100	0.00	0	0.00	0	0.00	0
378	North of Coaley Lane	SHLAA	15.52	15.52	100	0.00	0	0.00	0	0.00	0
380	Grangetown Autos	SHLAA	0.52	0.52	100	0.00	0	0.00	0	0.00	0
381	Newbottle Site 1	SHLAA	53.80	53.80	100	0.00	0	0.00	0	0.00	0
382	Dairy Lane, Site 1	SHLAA	0.79	0.79	100	0.00	0	0.00	0	0.00	0
383	Dairy Lane, Site 2	SHLAA	4.70	1.84	39	0.81	17	1.40	30	0.64	14
384	Hunters Lodge	SHLAA	0.98	0.98	100	0.00	0	0.00	0	0.00	0
385	Sedgeletch Site 1	SHLAA	16.16	13.86	86	2.22	14	0.01	0	0.07	0
386	Sedgeletch Site 2	SHLAA	9.10	6.19	68	1.34	15	1.52	17	0.06	1
387	Sedgeletch Site 3	SHLAA	1.23	0.11	9	0.64	52	0.03	3	0.45	36
388	Ennerdale Street	SHLAA	0.98	0.98	100	0.00	0	0.00	0	0.00	0
389	North East Sector	SHLAA	1.70	1.70	100	0.00	0	0.00	0	0.00	0
390	Central Area	SHLAA	1.71	1.71	100	0.00	0	0.00	0	0.00	0
391	Nile Street (South)	SHLAA	1.28	1.28	100	0.00	0	0.00	0	0.00	0
392	Tavistock Gateway	SHLAA	0.85	0.85	100	0.00	0	0.00	0	0.00	0
393	Hudson Road	SHLAA	1.74	1.74	100	0.00	0	0.00	0	0.00	0
394	Borough Road	SHLAA	0.57	0.57	100	0.00	0	0.00	0	0.00	0
395	Tatham Street Car Park	SHLAA	0.31	0.31	100	0.00	0	0.00	0	0.00	0

Site ID	Name	Type	Area	Flood Zone 1		Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
396	Tavistock Place	SHLAA	1.28	1.28	100	0.00	0	0.00	0	0.00	0
398	Givens Street	SHLAA	1.42	1.42	100	0.00	0	0.00	0	0.00	0
399	West of Portland School	SHLAA	0.35	0.35	100	0.00	0	0.00	0	0.00	0
401	East of Sulgrave Road	SHLAA	11.97	11.97	100	0.00	0	0.00	0	0.00	0
402	Crowther Industrial Estate	SHLAA	8.15	8.15	100	0.00	0	0.00	0	0.00	0
404	West of Waterloo Road	SHLAA	3.04	1.88	62	0.16	5	1.00	33	0.00	0
405	Green Belt Land at Golf Course	SHLAA	18.75	18.75	100	0.00	0	0.00	0	0.00	0
406	Bentall Business Park	SHLAA	4.41	4.41	100	0.00	0	0.00	0	0.00	0
407	Milton Place	SHLAA	11.76	11.76	100	0.00	0	0.00	0	0.00	0
408	North and Rear of Windsor Terrace	SHLAA	1.77	1.77	100	0.00	0	0.00	0	0.00	0
409	Dubmire Industrial Estate	SHLAA	11.26	7.80	69	2.92	26	0.25	2	0.29	3
410	Blind Lane	SHLAA	0.71	0.71	100	0.00	0	0.00	0	0.00	0
411	Snippersgate	SHLAA	0.40	0.40	100	0.00	0	0.00	0	0.00	0
412	Monkwearmouth Hospital	SHLAA	3.46	3.46	100	0.00	0	0.00	0	0.00	0
413	Seaburn Amusements	SHLAA	9.24	6.96	75	0.32	3	0.03	0	1.93	21
WA_1.1	Existing Industry Boundary	Existing Industry Boundary	2.26	2.26	100	0.00	0	0.00	0	0.00	0
WA_1.2	Existing Industry Boundary	Existing Industry Boundary	1.33	1.33	100	0.00	0	0.00	0	0.00	0
WA_1.3	Existing Industry Boundary	Existing Industry Boundary	9.75	9.75	100	0.00	0	0.00	0	0.00	0
WA_1.4	Existing Industry Boundary	Existing Industry Boundary	42.19	42.19	100	0.00	0	0.00	0	0.00	0
WA_1.5	Existing Industry Boundary	Existing Industry Boundary	42.58	42.58	100	0.00	0	0.00	0	0.00	0
WA_1.6	Existing Industry Boundary	Existing Industry Boundary	13.22	13.22	100	0.00	0	0.00	0	0.00	0
WA_1.7	Existing Industry Boundary	Existing Industry Boundary	19.79	19.62	100	0.00	0	0.00	0	0.00	0
WA_1.7	Existing Industry Boundary	Existing Industry Boundary	15.90	14.96	100	0.00	0	0.00	0	0.00	0
WA_1.8	Existing Industry Boundary	Existing Industry Boundary	0.28	0.28	100	0.00	0	0.00	0	0.00	0
WA_1.8	Existing Industry Boundary	Existing Industry Boundary	11.97	11.97	100	0.00	0	0.00	0	0.00	0
WA_1.8	Existing Industry Boundary	Existing Industry Boundary	16.98	16.98	100	0.00	0	0.00	0	0.00	0
WA_1.9	Existing Industry Boundary	Existing Industry Boundary	2.69	2.69	100	0.00	0	0.00	0	0.00	0
WA_1.10	Existing Industry Boundary	Existing Industry Boundary	343.05	343.05	100	0.00	0	0.00	0	0.00	0
WA_1.11	Existing Industry Boundary	Existing Industry Boundary	50.68	50.68	100	0.00	0	0.00	0	0.00	0
WA_1.12	Existing Industry Boundary	Existing Industry Boundary	38.38	38.38	100	0.00	0	0.00	0	0.00	0
WA_1.13	Existing Industry Boundary	Existing Industry Boundary	6.86	6.86	100	0.00	0	0.00	0	0.00	0

Site ID	Name	Type	Area	Flood Zone 1		Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
WA_1.13	Existing Industry Boundary	Existing Industry Boundary	17.39	17.39	100	0.00	0	0.00	0	0.00	0
WA_1.14	Existing Industry Boundary	Existing Industry Boundary	24.82	24.82	99	0.11	1	0.06	0	0.00	0
WA_1.14	Existing Industry Boundary	Existing Industry Boundary	41.88	41.88	94	0.19	1	0.75	5	0.00	0
WA_1.15	Existing Industry Boundary	Existing Industry Boundary	11.15	11.15	100	0.00	0	0.00	0	0.00	0
HA_1.1	Existing Industry Boundary	Existing Industry Boundary	5.78	5.78	100	0.00	0	0.00	0	0.00	0
HA_1.2	Existing Industry Boundary	Existing Industry Boundary	28.13	28.13	100	0.00	0	0.00	0	0.00	0
HA_1.3	Existing Industry Boundary	Existing Industry Boundary	1.19	1.19	99	0.01	0	0.07	1	0.00	0
HA_1.4	Existing Industry Boundary	Existing Industry Boundary	2.52	2.52	100	0.00	0	0.01	0	0.00	0
HA_1.5	Existing Industry Boundary	Existing Industry Boundary	5.34	5.26	100	0.00	0	0.00	0	0.00	0
HA_1.6	Existing Industry Boundary	Existing Industry Boundary	4.58	4.58	100	0.00	0	0.00	0	0.00	0
HA_1.7	Existing Industry Boundary	Existing Industry Boundary	7.58	7.58	100	0.00	0	0.00	0	0.00	0
HA_1.8	Existing Industry Boundary	Existing Industry Boundary	14.08	14.08	99	0.00	0	0.00	0	0.00	0
HA_1.9	Existing Industry Boundary	Existing Industry Boundary	2.32	2.32	98	0.11	0	0.01	0	0.27	1
HA_1.10	Existing Industry Boundary	Existing Industry Boundary	1.07	1.07	100	0.00	0	0.00	0	0.00	0
HA_1.10	Existing Industry Boundary	Existing Industry Boundary	22.58	22.20	100	0.00	0	0.00	0	0.00	0
HA_2.1	New Sites for Business and Industrial Uses	Existing Industry Boundary	15.65	14.64	94	0.95	6	0.02	0	0.04	0
HA_2.2	New Sites for Business and Industrial Uses	Existing Industry Boundary	23.50	23.50	100	0.00	0	0.00	0	0.00	0
HA_2.2	New Sites for Business and Industrial Uses	Existing Industry Boundary	13.17	11.52	87	1.62	12	0.01	0	0.02	0
HA_2.3	New Sites for Business and Industrial Uses	Existing Industry Boundary	2.85	2.85	100	0.00	0	0.00	0	0.00	0
HA_2.3	New Sites for Business and Industrial Uses	Existing Industry Boundary	4.44	4.44	100	0.00	0	0.00	0	0.00	0
NA_1.1	Existing Industry Boundary	Existing Industry Boundary	32.18	32.18	100	0.00	0	0.00	0	0.00	0
NA_1.2	Existing Industry Boundary	Existing Industry Boundary	13.59	13.59	100	0.00	0	0.00	0	0.00	0
NA_1.2	Existing Industry Boundary	Existing Industry Boundary	6.33	6.33	100	0.00	0	0.00	0	0.00	0
NA_1.3	Existing Industry Boundary	Existing Industry Boundary	47.73	47.41	99	0.05	0	0.27	1	0.00	0
NA_1.3	Existing Industry Boundary	Existing Industry Boundary	21.71	21.71	100	0.00	0	0.00	0	0.00	0
NA_1.4	Existing Industry Boundary	Existing Industry Boundary	5.55	5.55	100	0.00	0	0.00	0	0.00	0
NA_1.5	Existing Industry Boundary	Existing Industry Boundary	16.42	16.42	100	0.00	0	0.00	0	0.00	0
NA_1.5	Existing Industry Boundary	Existing Industry Boundary	7.52	7.52	100	0.00	0	0.00	0	0.00	0
NA_2.1	Recycled Employment Site	Existing Industry Boundary	32.68	32.65	100	0.00	0	0.03	0	0.00	0
NA_2.1	Recycled Employment Site	Existing Industry Boundary	4.11	4.11	100	0.00	0	0.00	0	0.00	0
NA_2.2	Recycled Employment Site	Existing Industry Boundary	0.94	0.45	48	0.09	9	0.41	43	0.00	0
NA_3	Former Wearmouth Colliery Site	Existing Industry Boundary	87.85	22.89	26	3.04	3	61.92	70	0.00	0

Site ID	Name	Type	Area	Flood Zone 1		Flood Zone 2		Flood Zone 3a		Flood Zone 3b	
NA_3	Former Wearmouth Colliery Site	Existing Industry Boundary	48.92	41.80	85	0.93	2	6.19	13	0.00	0
SA_1.1	Existing Industry Boundary	Existing Industry Boundary	0.50	0.47	94	0.00	0	0.03	6	0.00	0
SA_1.1	Existing Industry Boundary	Existing Industry Boundary	1.93	1.93	100	0.00	0	0.00	0	0.00	0
SA_1.2	Existing Industry Boundary	Existing Industry Boundary	24.04	24.04	100	0.00	0	0.00	0	0.00	0
SA_1.2	Existing Industry Boundary	Existing Industry Boundary	49.00	49.00	100	0.00	0	0.00	0	0.00	0
SA_1.3	Existing Industry Boundary	New Business Industrial Site	0.49	0.49	100	0.00	0	0.00	0	0.00	0
SA_1.4	Existing Industry Boundary	New Business Industrial Site	12.28	12.28	100	0.00	0	0.00	0	0.00	0
SA_1.5	Existing Industry Boundary	New Business Industrial Site	15.61	15.61	100	0.00	0	0.00	0	0.00	0
SA_1.6	Existing Industry Boundary	New Business Industrial Site	3.65	3.65	100	0.00	0	0.00	0	0.00	0
SA_1.6	Existing Industry Boundary	New Business Industrial Site	3.57	3.57	100	0.00	0	0.00	0	0.00	0
SA_1.7	Existing Industry Boundary	New Business Industrial Site	0.67	0.67	100	0.00	0	0.00	0	0.00	0
SA_1.8	Existing Industry Boundary	New Business Industrial Site	2.61	2.60	100	0.00	0	0.00	0	0.01	0
SA_1.9	Existing Industry Boundary	New Business Industrial Site	2.00	2.00	100	0.00	0	0.00	0	0.00	0
SA_2	Existing Industry Boundary	New Business Industrial Site	0.68	0.68	100	0.00	0	0.00	0	0.00	0
SA_3	Existing Industry Boundary	New Business Industrial Site	2.98	2.33	78	0.59	20	0.02	1	0.05	2
SA_4.1	New Employment Site	New Business Industrial Site	5.68	4.76	84	0.36	6	0.56	10	0.00	0
SA_4.2	New Employment Site	New Business Industrial Site	7.92	7.92	100	0.00	0	0.00	0	0.00	0
SA_4.3	New Employment Site	New Business Industrial Site	0.30	0.30	100	0.00	0	0.00	0	0.00	0
SA_4.4	New Employment Site	New Business Industrial Site	20.46	20.46	100	0.00	0	0.00	0	0.00	0
WA_2	New Sites for Business and Industrial Uses	New Business Industrial Site	0.53	0.53	100	0.00	0	0.00	0	0.00	0

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