URS

North Tyneside Surface Water Management Plan

December 2012

Prepared for:
North Tyneside Council

UNITED KINGDOM & IRELAND

REVISION SCHEDULE					
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ACRONYMS AND ABBREVIATIONS

Abbreviation	Description
AAP	Area Action Plan
AMP	Asset Management Plan
AStSWF	Area Susceptible to Surface Water Flooding
BGS	British Geological Survey
CDA	Critical Drainage Area
CIRIA	Construction Industry Research and Information Association
CFMP	Catchment Flood Management Plan
CLG	Government Department for Communities and Local Government
Defra	Department for Environment, Flood and Rural Affairs
DEM	Digital Elevation Model
EA	Environment Agency
FWMA	Flood and Water Management Act (2010)
IUD	Integrated Urban Drainage
LDF	Local Development Framework
LiDAR	Light Detection and Ranging
LPA	Local Planning Authority
LLFA	Lead Local Flood Authority
LRF	Local Resilience Forum
MCA	Multi Criteria Analysis
N&NTSMP2	Northumberland and North Tyneside Shoreline Management Plan 2
NPPF	National Planning Policy Framework
NTC	North Tyneside Council
NWL	Northumbrian Water Limited
OFWAT	Water Services Regulation Authority
PPS25	Planning and Policy Statement 25: Development and Flood Risk
RBMP	River Basin Management Plan
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan

GLOSSARY

Term	Definition
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
Asset Management Plan	A plan for managing water and sewerage company infrastructure and other assets in order to deliver an agreed standard of service.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Civil Contingencies Act	This Act delivers a single framework for civil protection in the UK. As part of the Act, Local Resilience Forums must put into place emergency plans for a range of circumstances.
Critical Drainage Area	Areas of significant flood risk, characterised by the amount of surface runoff that drains into the area, the topography and hydraulic conditions of the pathway (e.g. sewer, river system), and the receptors (people, properties and infrastructure) that may be affected.
Culvert	A channel or pipe that carries water below the level of the ground.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
Flood Defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection.
Floods and Water Management Act	Part of the Government's response to the Pitt Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Local Resilience Forum	A multi-agency forum, bringing together all organisations that have a duty to cooperate under the Civil Contingencies Act, and those involved in responding to emergencies. They prepare emergency plans in a co-ordinated manner.
Partner	A person or organisation with responsibility for decisions or actions that need to be taken.
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial Flooding	Flooding from water flowing over the surface of the ground; often occurs when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with additional flow.
Rate Support Grant	Funding mechanism from CLG to Local Authorities which provides funding for all Local Authority responsibilities.
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Sewer Flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Stakeholder	A person / organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
Sustainable Drainage Systems	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.

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1 INTRODUCTION

1.1 Background

In January 2011, URS Infrastructure and Environment UK Limited (URS) was commissioned to undertake a Surface Water Management Plan (SWMP) and Water Cycle Study (WCS) for North Tyneside Council (NTC).

The SWMP and WCS along with the Preliminary Flood Risk Assessment (PFRA, 2011) and the Strategic Flood Risk Assessment (SFRA, 2010) for North Tyneside will form part of the flood risk management strategies as required by the Flood and Water Management Act 2010 (FWMA) to be produced by the Council who are a newly designated Lead Local Flood Authority (LLFA) under the FWMA.

1.2 What is a Surface Water Management Plan?

A SWMP is a framework to help understand the causes of surface water flooding and agree a preferred strategy for the management of surface water flood risk. In this context surface water flooding describes flooding from sewers, drains, groundwater, and runoff from land, ordinary watercourses and ditches that occurs as a result of heavy rainfall.

This SWMP study covers North Tyneside and has been undertaken in consultation with local flood risk management partners who are responsible for surface water management and key stakeholders, these include:

Partners

- North Tyneside Council,
- Northumbrian Water,
- Environment Agency.

Key Stakeholders

- Network Rail and NEXUS,
- Tyne and Wear Fire and Rescue Services,
- Neighbouring Councils,
- Local Resilience Forum.

The Partners are working together to understand the causes and effects of surface water flooding so that they can agree the most cost effective way of managing surface water flood risk for the long term.

1.3 Linking and Integrating Surface Water Management

This document also establishes a starting point for a long-term action plan to manage surface water and will influence future capital investment, maintenance, public engagement and understanding, land-use planning, emergency planning and future developments. Surface water management is often key to many of these initiatives and strategies and so it is important that a consistent, integrated and sustainable approach to surface water management is adopted across North Tyneside.

Contributing to this aim, the North Tyneside SWMP will identify existing areas of open space and green infrastructure that could help to alleviate and manage surface water and flood risk across North Tyneside. Outputs from the SWMP and local flood risk management processes should link closely with NTC's Green Infrastructure Strategy[1] to identify areas where new open spaces and green infrastructure could benefit both flood risk management and improve access, biodiversity and recreation across North Tyneside. Green Infrastructure (GI) can be defined as "networks of multifunctional green space which sit within and contribute to the high quality natural and built environment". Entec produced the Green Infrastructure Strategy for North Tyneside in February 2011.

Whilst the main body of work has an emphasis on biodiversity and regeneration opportunities, NTC have identified that there are also opportunities to link to other functions, in particular, the potential to reduce flood risk by "making space for water" and to assist with sustainable flood risk management in the future. Green Infrastructure, together with sustainable surface water management, also has the potential to help the Borough achieve the 'good ecological status' requirements of the European Union Water Framework Directive (EU WFD).

1.4 SWMP Methodology

The methodology for this SWMP has been based on the Defra SWMP Technical Guidance[2], published in March 2010. The guidance document identifies four clear phases in undertaking a SWMP study (as illustrated in Figure 1-1):

- Phase 1 - Preparation,
- Phase 2 - Risk Assessment,
- Phase 3 - Options,
- Phase 4 - Implementation and Review.

[1] Entec, (February 2011); North Tyneside Council - Green Infrastructure Study.
[2] DEFRA, (March 2010); Surface Water Management Plan Technical Guidance. Available online at http://www.defra.gov.uk/publications/files/pb13546-swmp-guidance-100319.pdf

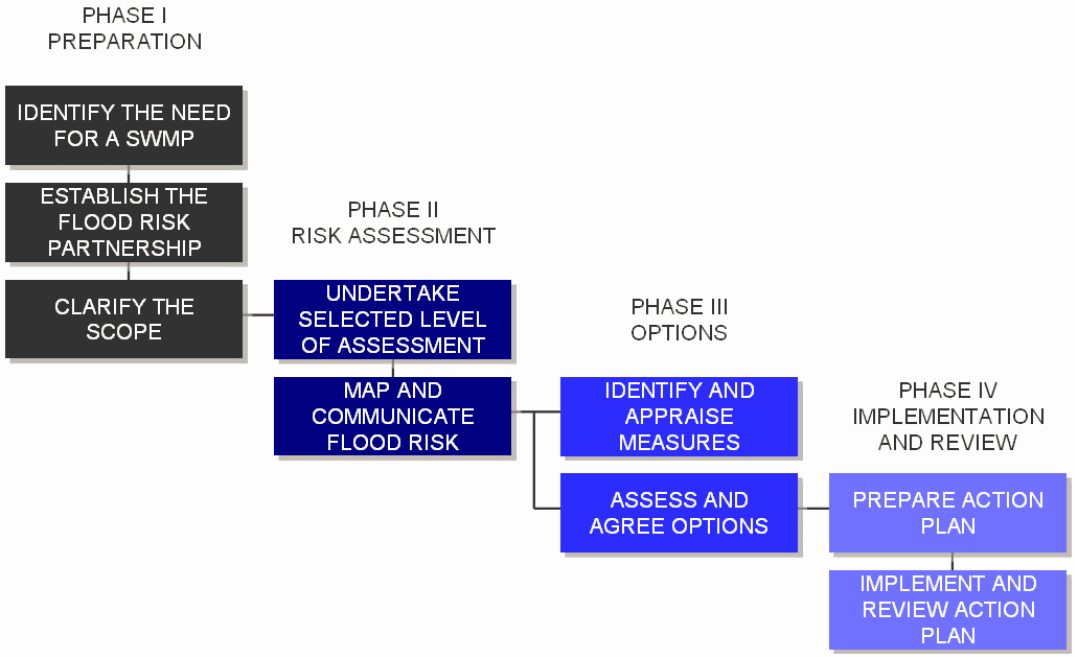


Figure 1-1: Phases of the SWMP

1.5 Scope of the SWMP

1.5.1 *Phase I – Preparation*

The main focus of Phase I of the NTC SWMP is to identify and quantify the local flood risks within North Tyneside, review the existing flood risk partnerships and set the scope for the later phases of the SWMP. As such, Phase I should:

- Identify the specific needs for a SWMP in North Tyneside and determine the local project drivers,
- Build upon the established Flood Groups to continue to develop a joint understanding of flood risk within North Tyneside and overcome the division of responsibility in urban drainage,
- Collate existing information regarding flood risk from all sources,
- Determine an appropriate level of assessment for the North Tyneside SWMP.

1.5.2 *Phase II – Risk Assessment*

The aim of Phase II of the NTC SWMP is to identify and quantify the risks of flooding from surface water, ordinary watercourses and groundwater. The process is a hierarchical one and includes the following objectives:

- Undertake suitable modelling approach to enable an intermediate assessment of surface water flood risk in North Tyneside,
- Quantify the risks from surface water flooding through the identification of overland flow paths and areas of surface water ponding leading to an assessment of properties and infrastructure at risk,
- Map the results of the pluvial modelling,

- Communicate flood risks to relevant bodies within the local flood risk partnership,
- Provide recommendations for detailed risk assessment if appropriate.

1.5.3 *Phase III – Options*

Where Phase II has identified significant risks (through the strategic to detailed stages), mitigation options need to be assessed to alleviate flooding. The important aspect of Phase III is that potential intervention measures are identified to be taken forward in consultation with local partners and key stakeholders to identify where collaborative working or joint funding may help to identify a preferred options and eventually implementation. Phase III includes:

- Providing initial identification of potential options for surface water management in North Tyneside,
- Advising on 'early actions' or practical solutions that can be implemented,
- Advising on the potential for Integrated Drainage Strategies for strategic development sites,
- Advising on potential funding options for delivery of identified schemes (i.e. community levies, developer contributions).

1.5.4 *Phase IV – Implementation and Review*

Once a preferred option or set of preferred options have been identified by NTC, these should feed into the draft Action Plan developed as part of Phase IV of the SWMP. This will in turn inform the Local Flood Risk Management Strategy (LFRMS) for North Tyneside.

The draft Action Plan forms the basis of an implementation plan that coordinates actions from different stakeholders, assigns responsibilities and maintenance activities and identifies sources of funding for each option. Importantly, Phase IV also sets out the success criteria under which mitigation schemes can be monitored and measured against and highlights the process by which this will occur. It is anticipated that this process will be reviewed and repeated during the design life of the scheme and also that the SWMP as a whole is reviewed periodically. Phase IV includes:

- Providing focus towards the implementation and management of the recommendations determined in Phase I, Phase II and Phase III of the study,
- Preparation of the draft Action Plan.

1.6 Linkages with Other Plans

It is important that the SWMP is not viewed as an isolated document, but one that connects with other strategic and local plans. Figure 1-2 shows URS's interpretation of the drivers behind the North Tyneside SWMP, the evidence base and how the SWMP supports the delivery of other key spatial planning and investment processes.

In addition, the SWMP also forms part of the emerging Local Flood Risk Management Strategy portfolio for North Tyneside.

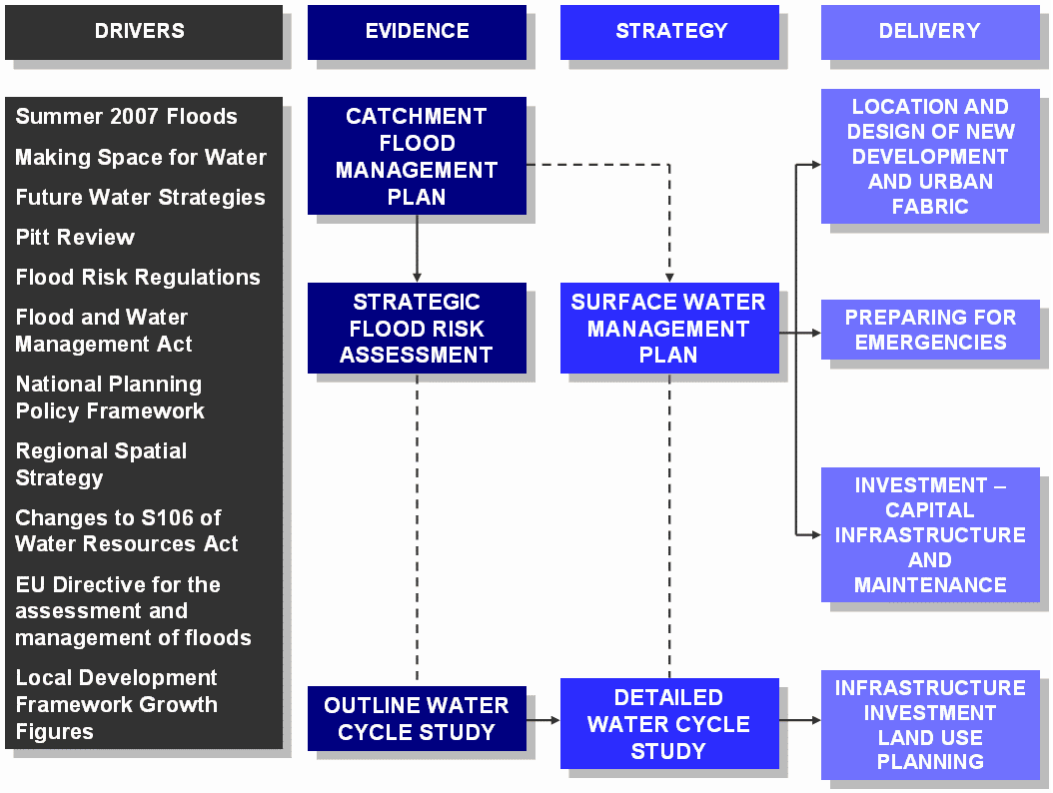
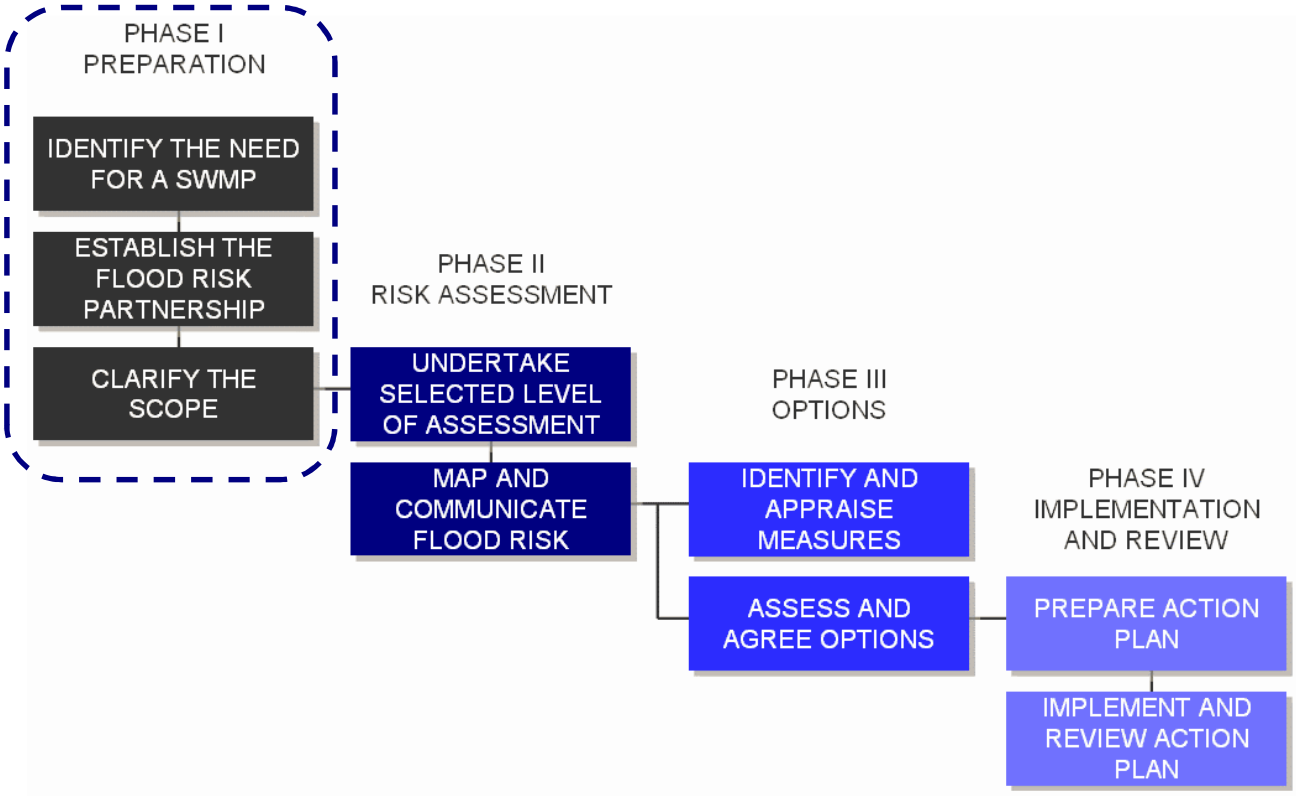


Figure 1-2: 'Where SWMPs Fit-In'

PHASE I: PREPARATION



2 PHASE I SCOPE

2.1 Identify the need for an SWMP

The principal output from a SWMP is essentially a plan which outlines the preferred strategy for the coordinated management of surface water flood risk within a given area[3], in this instance North Tyneside. In the context of the SWMP, surface water flooding incorporates flooding from sewers, drains, groundwater, and runoff from land, ordinary watercourses and ditches occurring all as a result of heavy rainfall.

The SWMP Technical Guidance issued by Defra in March 2010 emphasises that SWMPs may not be required in all locations. Studies should be prioritised in areas considered to be at greatest risk of surface water flooding or where partnership working is essential to both understand and subsequently address surface water flooding issues.

This section provides an overview of the rationale behind the preparation of a SWMP for North Tyneside including:

- The history of surface water flooding,
- The complexity of flooding mechanisms in North Tyneside due to drainage system interactions,
- The fragmented responsibilities with respect to asset management,
- Proposed future urbanisation and redevelopment,
- The impacts of existing and emerging policy and legislation.

Evidence of the need for a SWMP for NTC is presented in the following sections.

2.2 Study Area

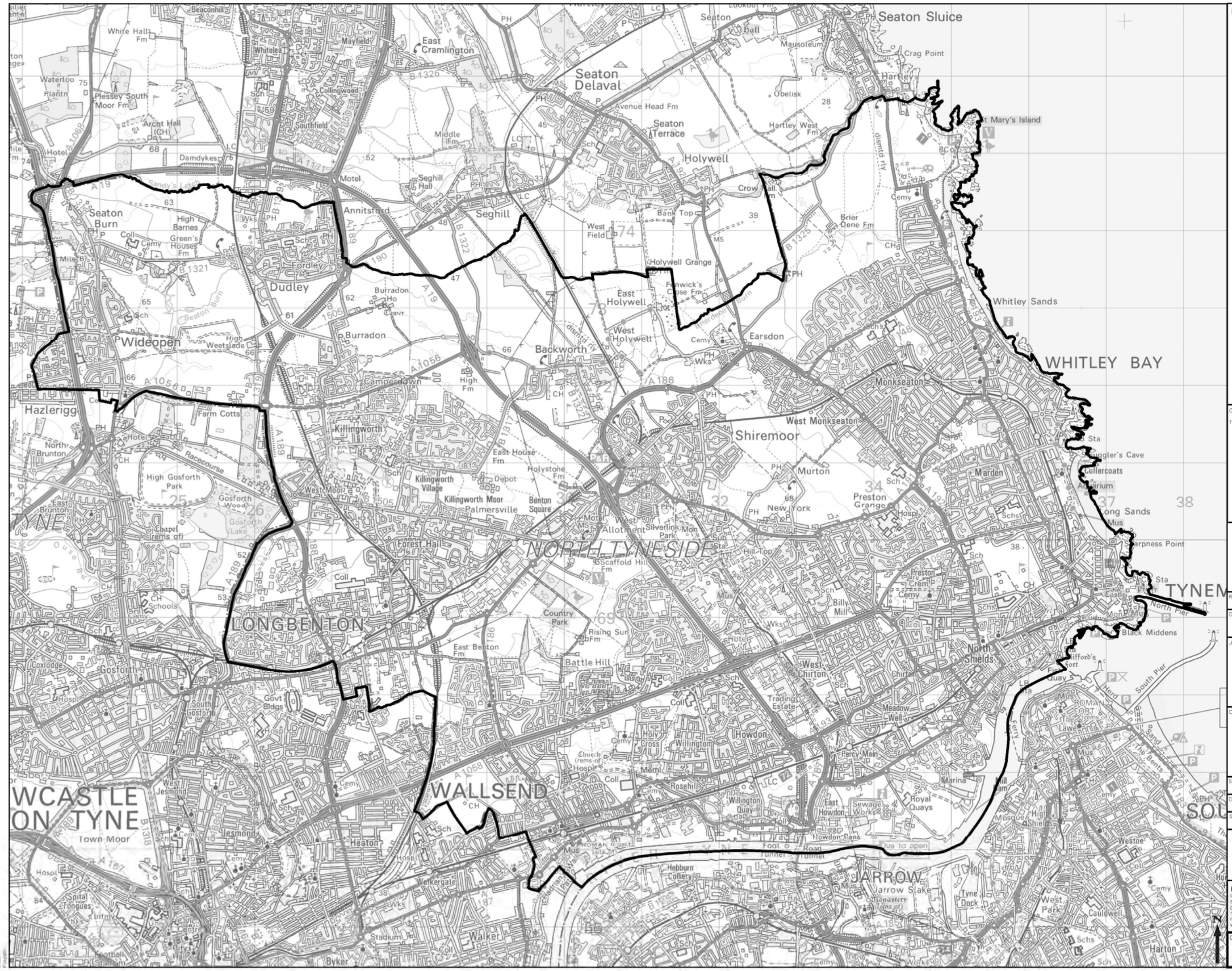
North Tyneside is located in the north east of England within the conurbation of Tyne and Wear covering an area of approximately 85km^2. North Tyneside is bordered to the south by the River Tyne and to the east by the North Sea. Newcastle City Council forms the western boundary and the former district of Blyth Valley forms the northern boundary, which is now part of the administrative area of Northumberland County Council. A map of the study area is shown in Figure 2-1.

2.2.1 *Topography and Hydrology*

The topography of North Tyneside has been assessed from LiDAR data. In general there is a spine of high ground through the centre of North Tyneside, running on a north west to south east orientation. Shiremoor (at circa 73 mAOD), West Allotment Country Park (at circa 90 mAOD), Killingworth (at circa 85 mAOD), High Weetslade (at circa 86 mAOD) and Wideopen (at circa 72 mAOD) fall within the area of high ground. Ground levels fall towards the coast to the east, through Monkseaton and Marden, to the banks of the River Tyne (to the south) through West Chirton and Howdon, into Longbenton Letch (to the west) through Longbenton and into the Brierdene Burn Valley (to the north) through Backworth.

This topography results in relatively steep slopes falling from the central plateau within North Tyneside, which often form flow-paths for surface runoff, and subsequently pluvial flooding (or ponding) at lower elevations, or locations where there are obstructions to the flow-paths as demonstrated in June 2012.

[3] Defra, (2010); Surface Water Management Plan Technical Guidance. Available at www.defra.co.uk



NOTES

Study Area

Revision Details	By / Check	Date	Suffix

Drawing Status: FINAL

Job Title: NORTH TYNESIDE SURFACE WATER MANAGEMENT PLAN

Drawing Title: STUDY AREA

Scale at A3: 1:45,000

Drawn	Approved
AW	MT

Stage 1 Check	Stage 2 Check	Orginated	Date

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Drawing Number: Figure 2-1

Rev: -

Figure 2-2 shows the key watercourses within North Tyneside:

- Brierdene Burn,
- Forest Hall Letch,
- Longbenton Letch,
- Redburn Dene,
- River Tyne,
- Sandy's Letch,
- Seaton Burn,
- Wallsend Burn,
- Willington Gut.

The tidally-influenced River Tyne originates outside of the administrative area of North Tyneside and is classed as Main River. The River Tyne borders the south of North Tyneside flowing in an easterly direction out into the North Sea. A number of the River Tyne's tributaries flow through North Tyneside including Willington Gut, Wallsend Burn and Redburn Dene.

North Tyneside falls within the Ouseburn catchment, one of the Tyne's major tributaries. Forest Hall Letch and Longbenton Letch (located within North Tyneside) drain into the Ouseburn to the west of the North Tyneside boundary. Seaton Burn enters North Tyneside underneath the A1 flowing through Dudley where Sandy's Letch converges from the north forming part of the northern boundary of the Borough. Brierdene Burn originates southwest of Backworth flowing under the A19 through rural areas before being joined by numerous small drains flowing though Whitley Bay Golf Course and out into the North Sea.

2.2.2 *Soils and Geology*

According to British Geological Survey (BGS)[4] mapping the bedrock geology in the study area is underlain by mudstones, sandstones and siltstones, with pockets of middle and upper and lower Pennine coal measures. The Pennine Lower Coal Measures Formation can be found in the north east of the study area, and the Pennine Upper Coal Measures Formation in the south west. The Pennine Middle Coal Measures Formation dominates the rest of the surface bedrock, covering over three quarters of the administrative area. These formations are all classified as secondary aquifers[5] by the EA. In the south west of the study area, the Coal Measures are overlain by the Yellow Sands Formation (fine, medium grained sandstone), and in other areas there are also pockets of Rockey and Raisby Dolomite rock Formations. The Rockey and Raisby Dolomite Formations and the Yellow Sands Formation have all been classified as principal aquifers[6] by the EA.

The majority of the study area is overlain by superficial deposits of till, diamicton and beach deposits along the coastal strip. There is also alluvium along the banks of the Tyne Estuary. Beach deposits have a very high to high permeability, the till deposits are generally expected to behave as aquitards[7] and permeabilities and can range from high to low to localised variations in sand and gravel horizons. Alluvium is classified as a secondary aquifer of which varies for high to very low permeability. More information on the geology of North Tyneside and the susceptibility to groundwater flooding can be found in Chapter 9.

[4] http://www.bgs.ac.uk/opengeoscience/home.html. Accessed in September 2011.
[5] Secondary aquifer (A)' - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
[6] Principal aquifer' - Layers that have high permeability. They may support water supply and/or river base flow on a strategic scale.
[7] Aquitard - A bed of low permeability adjacent to an aquifer.

LEGEND

Study Area

Main River

Ordinary Watercourse

Revision Details	By / Check	Date	Suffix

Drawing Status: FINAL

Job Title: NORTH TYNESIDE SURFACE WATER MANAGEMENT PLAN

Drawing Title: KEY WATERCOURSES

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2.2.3 *Land Use*

North Tyneside is one of five metropolitan boroughs within Tyne and Wear and had a total population in 2001 of approximately 192,000. The main urban areas within North Tyneside are Wallsend (located on the left bank of the River Tyne), Whitley Bay (located on the coastline of the North Sea) and North Shields (located on the left bank of the River Tyne at the tidal mouth). Four other large settlements also exist within North Tyneside and these are Longbenton, Wideopen, Forest Hall and Killingworth. The northern fringe of the Borough consists of open countryside and is classified as Green Belt.

The urban nature of the southern section of North Tyneside has resulted in a number of watercourses being culveted, straightened and retained by hard engineered structures. These waterbodies are designated as Heavily Modified Waterbodies (HMWB) under the Water Framework Directive (WFD).

North Tyneside is served by several strategic transport links including the A19 southwards via the Tyne Tunnel and access to the north-west via the A1. A good system of internal roads exists and the A1058 links the Borough with Newcastle City to the west. Newcastle Airport is located to the north-west of the Borough and a suburban electric rail 'metro' system loops through the borough linking the main towns and the coastal area with Newcastle and other Tyneside districts.

The study area falls within the Northumbria River Basin District (RBD), agreed as part of the European Directiveand NWL is the water utility company that serves North Tyneside.

2.3 Forthcoming Urbanisation and Redevelopment

2.3.1 *Core Strategy Status*

Following consideration of responses to the Core Strategy (CS) Preferred Options and to further consultation on Growth Options, a submission Draft of the Core Strategy will be presented to a meeting of the Council's Cabinet to commence the process of consideration by the full Council. At present the Council is reviewing the content of the CS and its timetable in light of the changes to Government policy as indicated in the National Planning Policy Framework (NPPF), and of updated evidence on the many issues that it will cover. Following consideration by the NTC of the CS it will be subject to a further period of statutory consultation and then submitted to the Government after which a public enquiry will be held concerning both the content of the Plan and process followed. Adoption is likely to happen in late 2013 or early 2014.

Ten key housing sites have been identified, which are located broadly along the metro line from Longbenton to Shiremoor, with additional sites in Killingworth and potential AAP development sites in Wallsend, North Shields and along the coast.

The focus for new jobs will be at 8 key employment sites in the broad areas of Wideopen, Longbenton, The North Bank and West Chirton.

2.3.2 *Residential Development*

The CS Preferred Options indicates that approximately 10,375 new dwellings are being delivered through the period up to 2028. In addition to this up to 180 ha of employment area is to be delivered during the same planning period.

Through supporting studies, including the Strategic Housing Land Availability Assessment (SHLAA) and employment land assessments NTC has identified numerous strategic housing and employment sites. These sites have been assessed against key criteria, and those meeting minimum criteria have been chosen as key housing sites or key

employment sites. The Preferred Options document identifies 10 key housing sites and 8 key employment sites. In addition to this, the key urban areas of Wallsend and North Shields will undergo significant development and have their own AAPs to consider potential development options there in more detail.

The main locations for development within North Tyneside, as identified in the Core Strategy Preferred Options are listed in Table 2-1 and shown in Figure 2-3.

TABLE 2-1 : MAXIMUM POTENTIAL HOUSING IN NORTH TYNESIDE

Number	Development Area	Dwellings
1	Station Road East	650
2	Station Road West	560
3	East Benton Farm	50
4	West Chirton South	420
5	Whitehouse Farm	367
6	Scaffold Hill	450
7	Annitsford Farm	400
8	Shiremoor West (South)	370
9	Shiremoor West (North)	260
10a	Wellfield	210
11	Wallsend	500
12	North Shields	430
13	Coast	270
14	Urban Fringe*	121
15	Urban Area (remainder of Borough)**	2,094
16	Existing Planning Permissions	3,223
Total Dwellings		**10,375**

** Due to the location of development in the Urban Fringe area the proposed residential figures have been split equally between Annitsford Farm and Shiremoor.*

*** Development in the remainder of North Tyneside is likely to be allocated across the North Tyneside on a site by site basis.*

Figure 2-3: Key Development in North Tyneside
Source: North Tyneside Council Preferred Options, June 2010

2.3.3 *Employment Development*

Employment growth within North Tyneside is focused at eight (8) key employment sites which will act as a catalyst for the rejuvenation of the Borough as a whole:

- Tyne Tunnel Trading Estate,
- West Chirton (Middle) Industrial Estate,
- Balliol Business Park East,
- North Bank Area,
- Esso,
- Gosforth Business Park and Balliol West,
- Weetslade,
- Proctor and Gamble.

3 ESTABLISH A PARTNERSHIP

Following the flooding in July 2007, the Government commissioned Sir Michael Pitt to undertake an independent review into the causes and management of flood risk in the areas affected.

In his review, Sir Michael Pitt stated that:

> *"the role of local authorities should be enhanced so that they take on responsibility for leading the coordination of flood risk management in their areas".*

The Flood and Water Management Act 2010 (FWMA) is designed to put into place the changes recommended by Sir Michael Pitt in his review and aims to reduce the risk and impact of flooding; improve a LPA's ability to manage the risk of flooding; improve water quality; and reduce pollution.

The Flood Risk Regulations came into force in December 2009 and are a set of regulations which translate the EU Floods Directive into law for England and Wales. The Regulations bring the EA, County Councils and Unitary Authorities together with partners such as water companies to manage flood risk from all sources and to reduce the consequences of flooding on human health, economic activity, cultural heritage and the environment.

Sir Michael Pitt's review of the Summer 2007 floods[8], the subsequent FWMA and the Flood Risk Regulations 2009, emphasise the need for LPAs to embrace a leadership role for local flood risk management, ensuring that flood risk from all sources, including flooding from surface water, groundwater and small watercourses, is identified and managed as part of locally agreed work programmes. Under this legislation all upper tier local authorities are therefore designated Lead Local Flood Authorities (LLFA), and have been allocated a number of key responsibilities with respect to local flood risk management.

As a LLFA, NTC is therefore responsible for leading local flood risk management across North Tyneside and for working in partnership with other neighbouring authorities. In accordance with these recommendations and the requirements, NTC has begun the process of preparing a SWMP for North Tyneside.

As stated in the North Tyneside PFRA, much of the local knowledge and technical expertise necessary for NTC to fulfil their duties as LLFA lies with NTC and other partner organisations. It is therefore crucial that NTC work alongside these groups and organisations as they undertake their responsibilities to ensure effective and consistent management of local flood risk throughout their planning cycles.

3.1 Fragmented Responsibilities

In areas of multiple sources of flood risk and complicated interactions between different sources of flooding, there are likely to be multiple water or drainage regulators, owners and maintainers and because of this the responsibilities for flood and water management were fragmented prior to the FWMA. In North Tyneside there are numerous partners with responsibility for decisions regarding drainage assets and areas at risk of flooding including NTC, the EA, NWL, Network Rail, Nexus and other Riparian owners.

It is essential that all relevant partners with responsibility for making decisions and taking actions are involved in plans for flood risk management from the outset. The purpose of the SWMP for North Tyneside is to strengthen the partnership between these organisations and

[8] Pitt Review, Learning Lessons from the 2007 Floods (June 2008)

ensure inclusivity through all phases of this study and future flood risk management in the Borough.

3.2 Stakeholder Engagement

For the purpose of the SWMP a stakeholder is defined as anyone affected by, or interested in the surface water problem or proposed solution. Stakeholders are often individual homeowners but they can include organisations, the public and communities. Different stakeholders should be engaged with to provide a rounded view of the problem and proposed solution.

A significant proportion of the local knowledge and technical expertise necessary for NTC to fulfil its duties as a LLFA lies with partner organisations. As part of the preparation of a Local Flood Risk Management Strategy (LFRMS) for North Tyneside (which includes the SWMP within the portfolio of documents), stakeholders from the following organisations and authorities should continue to be engaged:

- Environment Agency,
- Northumbrian Water,
- Neighbouring Council's,
- Network Rail,
- Nexus,
- Northumbria Police,
- Tyne & Wear Fire and Rescue,
- Highways Agency,
- Natural England,
- Ports Authority,
- Developers,
- Land Owners,
- Elected Members,
- Critical Services (NHS etc.).

It is important that NTC liaise with stakeholders as an on-going process as they have often experienced flooding first hand and can provide invaluable information. Also, to ensure the smooth running and effective implementation of potential mitigation measures (especially those which may lead to local disruption e.g. road works) stakeholder engagement is required from the start.

The SWMP process supports liaison with local stakeholders throughout the process however, it also highlights the importance of managing their expectations.

The following engagement priorities are suggested to be taken forward by NTC:

- Engage with stakeholders to raise the profile of flood risk – potentially through a leaflet drop,
- Provide a single point of contact at the Council for surface water drainage problems to be reported to – this role is currently fulfilled by the Highways and Drainage Engineer,
- Provide a newsletter/leaflet to promote schemes that NTC have completed, supported or funded in order to reduce existing and/or future flood risk,
- Formally engage with local stakeholders via public meetings at the options stage. This should include details of options, as well as information on how homeowners can protect themselves against flooding,

- Hold an open evening when different partners attend including the EA, NWL, Network Rail, Nexus and other members/departments from NTC to describe what actions each organisation are taking and answer questions from the public.

NTC are committed to working collaboratively and in partnership with key stakeholders, neighbouring authorities and across council services to ensure that flood risk management in the area is properly coordinated and is carried out in a sustainable and efficient manner.

3.3 Existing Flood Risk Collaboration

3.3.1 *Tyne and Wear Flood Board*

At a sub-regional level, the Tyne and Wear Flood Board (TWFB) work together on the development of policy for managing flood risk at a sub-regional level. Members of the TWFB include the following unitary authorities:

- Gateshead Council,
- Newcastle Council,
- North Tyneside Council,
- South Tyneside Council,
- Sunderland Council.

In addition to the unitary authorities, the TWFB also includes representation from the EA and NWL. The TWFB rely on individual flood groups to inform them with sub-regional flood risks to help make decisions and refine regional flood risk policy.

3.3.2 *North Tyneside Flooding Task and Finish Group*

NTC have created a Flooding Task and Finish Group which is responsible for the Local Flood Risk Management across North Tyneside, to assist with fulfilling their duties as a LLFA under the FWMA.

In order for the key findings of the SWMP to be taken forward and for Local Flood Risk Management to be successful across North Tyneside, it is essential that relevant partners and stakeholders, who share the responsibility for necessary decisions and actions, work collaboratively as part of the Task and Finish Group to further enhance their understanding of existing and future surface water flood risk across North Tyneside.

In accordance with the Flooding Task and Finish terms of reference:

> *"The Group will, following its deliberations and discussions, come forward with a plan of action for the Council, its partners and the community to ensure that North Tyneside is effectively prepared for flooding, be even more proactive when it hits and able to respond post-flooding.*
>
> *Through having all the relevant organisations around the table, it is hoped the outcomes will deliver real actions that will increase the resistance of North Tyneside to the increasingly frequent extreme weather seen of late".*

Members of the Flooding Task and Finish Group include:

- Elected Mayor,
- North Tyneside Councillors,
- North Tyneside Officers,

- Local MP Representative,
- NEXUS,
- Northumbria Police,
- Tyne & Wear Fire and Rescue,
- Northumbria Water,
- Environment Agency.

3.4 Communicate Risk

3.4.1 *Professional Stakeholders*

There are various professional stakeholders who are interested in increasing their knowledge of risks from surface water flooding. It is essential that the North Tyneside Flooding Task and Finish Group actively engages with these groups, where appropriate, to share the findings of this report. This will ensure that emerging plans and policies are informed by the latest understanding of local flood risk across North Tyneside.

It is recommended that NTC make the intermediate pluvial modelling mapped outputs available on their website for professional stakeholders and members of the public to access and view, along with appropriate explanations.

3.4.2 *Local Resilience Forums*

In line with the SWMP Technical Guidance it is strongly recommended that the information provided in the SWMP is issued to the Local Resilience Forum. Surface water flood maps and knowledge of historic flood events should be used to update Incident Management Plans and Community Risk Registers for the area. In addition, maps showing the depth of pluvial flooding during a range of return period rainfall events can be used to inform operations undertaken by emergency response teams especially near public buildings and major routes throughout North Tyneside.

3.5 Benefits of Collaborative Working

Under the FWMA, NTC are designated as a LLFA and this requires NTC to work alongside local partners and key stakeholders on local flood risk management across North Tyneside.

A number of benefits will arise from the collaborative working between members of the North Tyneside Flooding Task and Finish Group, including:

- Greater understanding of urban drainage by a range of organisations,
- A shared understanding of flood risk between NTC, EA and NWL,
- Efficiency savings for 'essential stakeholders and partners' though achieving outcomes,
- Appraisal of surface water drainage options,
- Greater certainty for developers concerning appropriate drainage,
- Quicker, more consistent decisions on development and infrastructure provision,
- Overall reduction in flood risk in North Tyneside, primarily driven through the latter SWMP phases (Phase III and Phase IV) – dependent upon available funding.

4 CLARIFYING THE SCOPE FOR THE SWMP

According to the SWMP Guidance documents[9], the aims and objectives of a SWMP should be set out at an early stage to ensure that key partners have a stake in the scope of the SWMP.

4.1 Aims and Objectives

The primary aim of the study is to produce a SWMP tailored to the local needs of NTC and their professional partners. The SWMP in combination with the WCS and other relevant documents such as the SFRA and PFRA will enable the comprehensive planning, phasing, delivery and management of water, sewerage, flooding and drainage infrastructure in North Tyneside by the relevant utility companies, agencies and authorities whilst not adversely affecting the environment.

The primary aims of the SWMP are to:

- Provide a comprehensive picture of all forms of flood risk in North Tyneside,
- Understand the mechanisms behind surface water flooding so that NTC can identify areas of high risk in the future,
- Gain a deeper understanding and overview of the sewerage and drainage network,
- Have a good understanding of the impact of the proposed development in North Tyneside,
- Allow NTC to develop their competencies as a LLFA,
- Allow NTC to build a strong working relationship with partners and stakeholders.

The objectives of the SWMP are to:

- Develop a robust understanding of surface water flood risk in and around the study area, taking into account the challenges of climate change, population and demographic change and increasing development in and around North Tyneside,
- Identify, define and prioritise CDA's, including further definition of existing Local Flood Risk Hotspots and mapping new areas of potential flood risk,
- Make holistic and multi-functional recommendations for surface water management which improve emergency and land use planning, and enable better flood risk and drainage infrastructure investments,
- The SWMP will need to link in closely with other initiatives currently ongoing within the Borough relating to the impact of major development and investigations into green infrastructure provision,
- Establish and consolidate partnerships between key stakeholders to facilitate a collaborative culture of data and skills sharing and resource learning and exchange. This will enable closer coordination to utilise cross boundary working opportunities,

[9] DEFRA, (2010); Surface Water Management Plan Technical Guidance

- Undertake engagement with stakeholders to raise awareness of surface water flooding, identify flood risks and assets, and agree mitigation measures and actions,
- Deliver outputs to enable a real change on the ground rather than just reports and models, whereby partners and stakeholders take ownership of their flood risk and commit to delivery and maintenance of the recommended mitigation measures and actions.

4.2 Data Review

One of the key components of a shared understanding of flood risk is the sharing of flood risk data between and across organisations.

Data has been collated, recorded and analysed by URS. Data collected has been recorded in a project data register which documents the source of the data and its completeness. In line with the SWMP technical guidance, the quality of the data has been scored using the following classifications:

1. No known deficiencies - not possible to improve in the near future,
2. Known deficiencies – best replaced as soon as new data are available,
3. Assumed – based on experience and judgement,
4. Grossly assumed – an educated guess.

4.3 Identify Availability of Information

4.3.1 *Environment Agency Plans*

Tyne River Basin Management Plan

The River Basin Management Plan (RBMP) for the Tyne River Basin District addresses the pressures facing the water environment in the district and the actions required to protect and improve the water environment. This plan has been developed in consultation with a wide range of organisations and individuals and is the first of a series of six-year planning cycles. The first cycle will end in 2015 when, following further planning and consultation, this plan will be updated and reissued.

Wansbeck and Blyth Catchment Flood Management Plan

The Wansbeck and Blyth Catchment Flood Management Plan (CFMP) was published in December 2009 and sets out policies for the sustainable management of flood risk across the whole catchment over the long-term (50 to 100 years) taking climate change into account. The Plan emphasises the role of the floodplain as an important asset for the management of flood risk, the crucial opportunities provided by new development and regeneration to manage risk, and the need to re-create river corridors so that rivers can flow and flood more naturally.

This Plan will be periodically reviewed, approximately five years from when it was published, to ensure that it continues to reflect any changes in the catchment.

The CFMP Policy Unit for Blyth and Coastal Streams

Part of North Tyneside is currently covered within the Blyth and Coastal Streams (Sub-Area 4) Policy Unit of the Wansbeck and Blyth CFMP. The vision and the preferred approach for the Blyth and Coastal Streams (Sub-Area 4) Policy Unit is:

> *"Policy Option 3 is our approach in this sub-area. The measures presently in place to manage flood risks appear to be adequate in most places as actual flooding reports are rare. The scale of the economic damages from flooding justifies the present levels of maintenance and flood warning service provided. As a result of climate change, the risk to people and property is expected to increase in some areas. Our approach will not prevent the risk but will enable us to prepare for the future. We will continue to carry out regular inspection and clearance of the river channels to allow unrestricted flows in the rivers. Additional work will be carried out to better understand the actual risk of flooding in the area and the policy reviewed at that time".*

The key messages from the Blyth and Coastal Streams (Sub-Area 4) Policy Unit are:

- *"The area consists of large urban areas. There are only a few isolated areas at risk of flooding,*
- *Seaton Burn is the main area at risk of flooding within this sub-area,*
- *There is limited history of flooding in the area and so further work is required to better understand the actual risk in the area,*
- *Improving flood awareness and resilience needs to be improved to manage the risk of flooding".*

<u>Tyne Catchment Flood Management Plan</u>

The Tyne CFMP was published in December 2009 and sets out policies for the sustainable management of flood risk across the whole catchment over the long-term (50 to 100 years) taking climate change into account. The Plan emphasises the role of the floodplain as an important asset for the management of flood risk, the crucial opportunities provided by new development and regeneration to manage risk, and the need to re-create river corridors so that rivers can flow and flood more naturally.

This Plan will be periodically reviewed, approximately five years from when it was published, to ensure that it continues to reflect any changes in the catchment. The review consultation for the CFMP was completed on the 7th November 2011.

The CFMP Policy Unit for the Lower Tyne

Most of North Tyneside is currently covered within the Lower Tyne (Sub-Area 6) Policy Unit of the Tyne CFMP. The Lower Tyne unit is currently being split into two to be known as the 'Lower Tyne' and the 'Ouseburn'. According to the Environment Agency LLFAs have been consulted and the revised CFMP is likely to be implemented in early 2012/13.

The vision and the preferred approach for the Lower Tyne (Sub-Area 6) Policy Unit is:

"A Policy Option 4 approach is justified in the sub areas as there is a predicted increase in risk in the future. While there are no specific flood defences the channel is modified in urban areas and has a large capacity, therefore flooding of the extent suggested by computer models is unlikely to occur. We will do more to ensure that the risk of flooding does not increase in the future. This policy choice is relevant to the likely future urban development and redevelopment in the area".

The key messages from the Lower Tyne (Sub-Area 6) Policy Unit are:

- *"The risk of flooding is potentially high in this area, due to the urban nature of the land and its high regional economic importance. The combination of risk from river and tidal flooding is important to understanding and managing risk,*
- *There is little natural floodplain, due to the urban environment and the modified channel; no formal flood defence assets are present,*
- *Flood risk could increase in the future and therefore there is a need to carry out more detailed studies to identify suitable flood risk management actions".*

NWL have confirmed that it is proposed to change the policy option for the Lower Tyne (Sub-Area 6) Policy Unit from Policy Option 4 to Policy Option 5. Due regard to this should be taken, once the proposed change is implemented.

Northumberland and North Tyneside Shoreline Management Plan 2

North Tyneside is covered within the Northumberland and North Tyneside Shoreline Management Plan 2 (N&NTSMP2).

The objectives set out in the N&NTSMP2 are:

- *"To provide an understanding of the coast, its behaviour and its values,*
- *To define, in general terms, the risks to people and the developed, natural and historic environment within the SMP2 area over the next century,*
- *To appraise different policy approaches and identify the preferred policies for managing those risks or creating opportunity for sustainable management,*
- *To examine the consequences of implementing the preferred policies in terms of the objectives for management,*
- *To set out procedures for monitoring the effectiveness of the SMP policies,*
- *To inform others so that future land use and development of the shoreline can take due account of the risks and preferred SMP2 policies,*
- *To comply with international and national nature conservation legislation and biodiversity obligations".*

The study area was divided into six Policy Development Zones (PDZs) to allow the development of specific policies. North Tyneside falls within PDZ6, which covers Seaton Sluice to the River Tyne.

The main focus of the policies for PDZ6 were identified as:

- *"Maintain protection to property and infrastructure against erosion and sea flooding,*
- *Allow the natural development of undefended sections of frontage".*

With the key challenges identified as:

- *"Maintaining largely Victorian era defences along North Tyneside,*
- *Managing the transition between defended and undefended sections of coast".*

4.3.2 *North Tyneside Plans*

Core Strategy

As previously noted, the emerging CS presents the spatial vision, strategic objectives and policies for growth in North Tyneside up to 2027, including locations for proposed new residential and non-residential development.

As plans progress within each of the areas allocated for growth and regeneration, the findings of the SWMP should be considered and implemented as appropriate.

Strategic Flood Risk Assessment

NTC completed a Level 1 SFRA in July 2010, which forms part of the evidence base for the LDF. The SWMP will build upon the findings of the Level 1 SFRA with respect to surface water flood risk. A review of the initial Critical Drainage Areas (CDAs) identified in the Level 1 SFRA has been undertaken as part of the SWMP.

From reviewing the Level 1 SFRA, it was noted that a Level 2 SFRA is not required for North Tyneside.

Multi-Agency Flood Plan

It is assumed that findings from the SWMP will inform the preparation of the Multi-Agency Flood Plan for North Tyneside. This however should be planned by Emergency Planners from NTC.

Preliminary Flood Risk Assessment

In June 2011 NTC published a draft Preliminary Assessment Report (PAR) for their PFRA. The PAR is a high level screening assessment for identifying key flood risk areas within NTC. This involves collating past flood events and assessing future flood risk based on a variety of local flood risk sources. The identified key flood risk areas are further investigated within this SWMP. The PFRA supports the SWMP, the SFRA and the WCS forming local flood risk management strategies.

4.3.3 *Northumbrian Water Plans*

As a partner in the delivery of Local Flood Risk Management across North Tyneside and during the preparation of the SWMP, NWL has provided hydraulic sewer flooding data and GIS data.

During the development of any future Local Flood Risk Management Strategy (LFRMS) for North Tyneside, additional documents that would be useful include the following:

- Drainage Area Plans,
- Hydraulic Model Outputs,
- Asset Management and Investment Plans.

4.3.4 *Data Summary*

A summary of the key datasets available for use for the SWMP are identified in Table 4-1.

TABLE 4-1: RELEVANT AVAILABLE SOURCES OF INFORMATION

Source	Dataset	Description
Environment Agency	Areas Susceptible to Surface Water Flooding	The first generation national mapping, which outlines areas of risk from surface water flooding across the country with three susceptibility bandings (less, intermediate and more susceptible).
	Flood Map for Surface Water	The updated (second generation) national surface water flood mapping which was released at the end of 2010. This dataset includes two flood probabilities (1 in 30 and a 1 in 200 chance of occurring) and two depth bandings (greater than 0.1m and greater than 0.3m).
	Flood Map	Shows the extent of flooding from rivers with a catchment of more than 3km^2 and flooding from the sea.
	Areas Susceptible to Groundwater Flooding	Coarse scale national mapping showing areas which are susceptible to groundwater flooding.
	Historic Flood Map	Attributed spatial flood extent data for flooding from all sources.

TABLE 4-1: RELEVANT AVAILABLE SOURCES OF INFORMATION (CONTIUNED)

Source	Dataset	Description
	Tyne Catchment Flood Management Plan	CFMPs consider all types of inland flooding from rivers, groundwater, surface water and tidal flooding and are used to plan and agree the most effective way to manage flood risk in the future.
North Tyneside Council	Strategic Flood Risk Assessment	SFRAs contain useful information on historic flooding, including local sources of flooding from surface water, groundwater, ordinary watercourses and canals.
	Historical flooding records	Historical records of flooding from surface water, groundwater and ordinary watercourses.
	Core Strategy	Details of the emerging Core Strategy, including Preferred Options.
Northumbrian Water	Records of Areas at Risk of Hydraulic Flooding	National Grid references of areas at risk of hydraulic flooding.
	Summary of Recent and Programmed Capital Works Schemes	A brief overview of recent and planned alleviation schemes.

4.4 Data Limitations

NTC and their key stakeholders are aware of many of the limitations that existing datasets present. As part of their duties under the FWMA, as LLFA, NTC are required to record flooding incidents and maintain an asset register that will improve the quantity, quality and consistency of future flood risk datasets.

4.5 Level of Assessment Adopted for SWMP

SWMPs can function at different geographical scales and therefore necessarily at differing scales of detail. Table 4-2 defines the potential levels of assessment within a SWMP.

TABLE 4-2: SWMP STUDY: LEVELS OF ASSESSMENT (DEFRA 2010)		
Level of Assessment	**Scale**	**Outputs**
Strategic Assessment	Sub-Regional (Tyne & Wear)	• Broad understanding of locations that are more vulnerable to surface water flooding, • Prioritised list for further assessment, • Outline maps to inform spatial and emergency planning.
Intermediate Assessment	Borough/District (North Tyneside)	• Identify flood hotspots which might require further analysis through detailed assessment, • Identify immediate mitigation measures which can be implemented, • Inform spatial and emergency planning.
Detailed Assessment	Flooding Hotspots	• Detailed assessment of cause and consequences of flooding, • Use to understand the mechanisms and test mitigation measures, through modelling of surface and sub-surface drainage systems.

4.5.1 ***Intermediate Assessment***

As shown in Table 4-2 the intermediate assessment is applicable across a large town, city or Borough/district. In the light of the scattered nature of surface water flooding across North Tyneside, it is appropriate to adopt this level of assessment to further quantify the risks.

The purpose of this intermediate assessment will be to further identify those parts of North Tyneside that are likely to be at greater risk of surface water flooding and require more detailed assessment.

The outputs from this intermediate assessment should be used to update spatial and emergency planning and to identify potential mitigation measures including quick win measures which can be implemented to reduce surface water flooding. These may include improved maintenance and clearance of blockages.

4.5.2 ***Detailed Assessment***

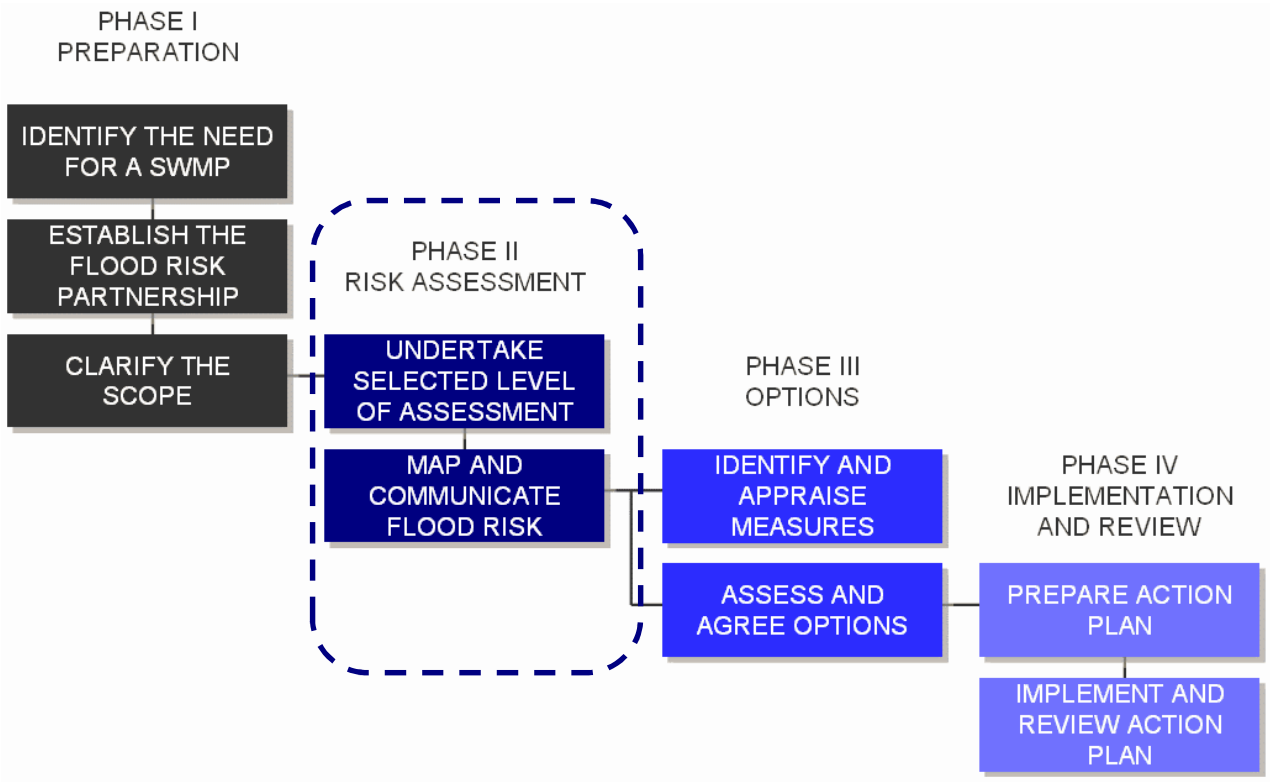
As stated in Table 4-2, detailed assessments focus on known flooding hotspots – typically identified through modelling undertaken as part of the intermediate assessment. Once a more detailed model has been developed, there is potential to determine, with a greater level of certainty, the mechanisms contributing towards the identified flooding. This can then form the basis of option testing for potential mitigation measures.

For North Tyneside, the modelling undertaken as part of the intermediate assessment will contribute to determining the scale and extent of any future detailed assessment(s).

4.6 Chosen Level of Assessment

North Tyneside are preparing a SWMP for their entire administrative area and therefore this SWMP provides a second level 'Intermediate Assessment'.

PHASE II: RISK ASSESSMENT



5 PHASE II SCOPE

5.1 Aims and Objectives

The purpose of a Phase II 'Risk Assessment' is for key stakeholders (in this case NTC, NWL and the EA) to further develop their understanding of the surface water flood risk in North Tyneside and to subsequently communicate this risk to relevant parties. The specific objectives of the Phase II SWMP for North Tyneside are to:

- Undertake suitable modelling to enable an intermediate assessment of surface water flood risk in North Tyneside,
- Quantify risks from surface water flooding through the identification of flow paths and areas of surface water ponding leading to an assessment of areas at risk,
- Quantify the risks from other sources of flooding within North Tyneside,
- Map the results of the pluvial modelling and other flooding data-sets such as historical flooding,
- Communicate flood risks to relevant bodies within the local flood risk partnership,
- Identify critical drainage areas for further consideration during the Phase III Options Assessment,
- Provide recommendations for detailed risk assessment if appropriate.

In order to achieve these objectives, the following elements of work have been undertaken:

- Review of existing data identified and collated in Phase I,
- Hydrological site investigations,
- Direct rainfall pluvial modelling,
- Review of data relating to the existing sewer system from NWL,
- A district-wide groundwater assessment.

A detailed review and assessment of the different sources of flooding to North Tyneside is provided in the following chapters, which consider each of the following sources of surface water flooding in turn:

- Surface runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or a watercourse, or cannot enter it because the network is full to capacity, thus causing flooding (known as pluvial flooding),
- Sewer flooding[10] which occurs when the capacity of the underground public sewer network system is exceeded, resulting in flooding inside and outside of buildings. This could occur as a result of the normal discharge of sewers and

[10] Consideration of sewer flooding in 'dry weather' resulting from blockage, collapse or pumping station mechanical failure is excluded from SWMPs as this if for the sole concern of the sewage undertaker.

drains through outfalls being impeded by high water levels in receiving waters[11] or as a result blockages for example,

- Flooding from small open channels and culverted urban watercourses[12] which receive most of their flow from inside the urban area and perform an urban drainage function,
- Overland flows which could result from groundwater sources.

[11] Interactions with larger watercourses can be an important mechanism in controlling surface water flooding.
[12] These watercourses will frequently be ordinary watercourses (within the responsibility of local authorities) but may also be designated Main River (with responsibility of the Environment Agency).

6 SURFACE WATER FLOODING

6.1 Overview

Surface water flooding also known as pluvial flooding or flash flooding, occurs when high intensity rainfall generates runoff which flows over the surface of the ground and ponds in low lying areas. It often occurs when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with the additional flow (Figure 6-1).

Figure 6-1: Pluvial Runoff within an Urban Water System
Source: URS (Defra Urban Blue Corridors Study, 2010)

No single organisation has overall responsibility for pluvial flooding with different aspects of the drainage system falling to either the relevant highways authority, NWL and land owners.

According to national research undertaken by Defra[13], there are up to 3,260 properties at risk of surface water flooding within North Tyneside. Wallsend, Long Benton/Killingworth and North Shields are the most at risk settlements in North Tyneside, with as many as 810, 760 and 710 properties estimated to be respectively at risk. In total six further settlements within North Tyneside are considered to be at risk of surface water flooding (Table 6-1).

[13] Defra, (2009): National Rank Order of Settlements Susceptible to Surface Water Flooding,

TABLE 6-1: SETTLEMENTS AT RISK OF SURFACE WATER FLOODING		
National Ranking	**Settlement**	**Estimated Properties**
387	Wallsend	810
413	Long Benton / Killingworth	760
433	North Shields	710
543	Whitley Bay	510
999	Dudley	200
1197	Tynemouth	140
1403	Wideopen	100
2469	Shiremoor	20
3398	Backworth	<10
Total		**Up to 3,260**
Source: Defra, 2009		

Surface water flooding and overland flow typically arises from intense rainfall, often of short duration, that fails to infiltrate the surface or enter drainage systems and as a result travels over the ground surface and can result in local flooding. Local topography and built form can have a strong influence on the direction and depth of flow.

NTC hold records of pluvial flooding, with recent notable flooding in 2005, 2007, 2008, 2009 and 2012 and NTC have provided GIS layers showing areas affected by flooding and these are shown on Figure 6-2 and in Table 6-2.

Furthermore the Level 1 SFRA states that there is a high risk of surface water flooding in North Tyneside. The also confirms that there is a high risk of surface water flooding in North Tyneside and provides a summary of existing and available data on surface wate.

The SFRA stated that the EA provided data for the following major flood incidences which impacted North Tyneside including:

- 30th June 2007 – Properties flooded in Wheatfield Grove on low lying ground along the line of culvert and surface water drains. Flooding also in Hailsham Avenue,
- 6th September 2008 – Flooding at the A189 Roundabout,
- 10th July 2008 – Flooding of fields in Earsdon due to poor drainage to Wellfield Beck,
- NTC also provided data showing that properties flooded in 2005 (598 properties), 2007 (74 properties) and 2008 (171 properties).

In addition to the flooding noted in the SFRA, significant flooding occurred across most of North Tyneside on 28th June 2012 and the areas affected are shown in Figure 6-2 and Table 6-2.

NOTES

Study Area

Flood Events (NTC)

- 2005
- 2007
- 2008
- 2009
- 2010
- 2012

Revision Details	By / Check	Date	Suffix

Drawing Status: FINAL

Job Title: NORTH TYNESIDE SURFACE WATER MANAGEMENT PLAN

Drawing Title: HISTORICAL FLOODING COUNCIL RECORDS

Scale at A3: 1:45,000

Drawn:	Approved:
AW	MT

Stage 1 Check	Stage 2 Check	Originated:	Date:

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Drawing Number: Figure 6-2

Rev: -

TABLE 6-2: FLOODING HISTORY IN NORTH TYNESIDE	
Location of Flooding	**Year**
Wallsend	2005, 2012
Battlehill	2005, 2012
Backworth	2005, 2012
Whitley Bay	2005, 2007, 2012
Earsden	2005, 2008, 2012
A189 roundabout	2008
West Monkseaton	2005, 2008, 2009, 2010, 2012
Dudley	2005, 2007, 2009
Wideopen	2005, 2007, 2009
Camperdown	2009
Killingworth	2005, 2007, 2008, 2009, 2012
Shiremoor	2005, 2007, 2008, 2009, 2012
Silverlink	2007, 2009
North Shields	2005, 2007, 2008, 2009, 2012
Percy Main	2005, 2009, 2012
Longbenton	2005, 2007, 2008, 2009, 2012
Willington	2005
Murton	2005
West Chirton	2005, 2012
Source: North Tyneside Council (Spreadsheet and GIS) Datasets	

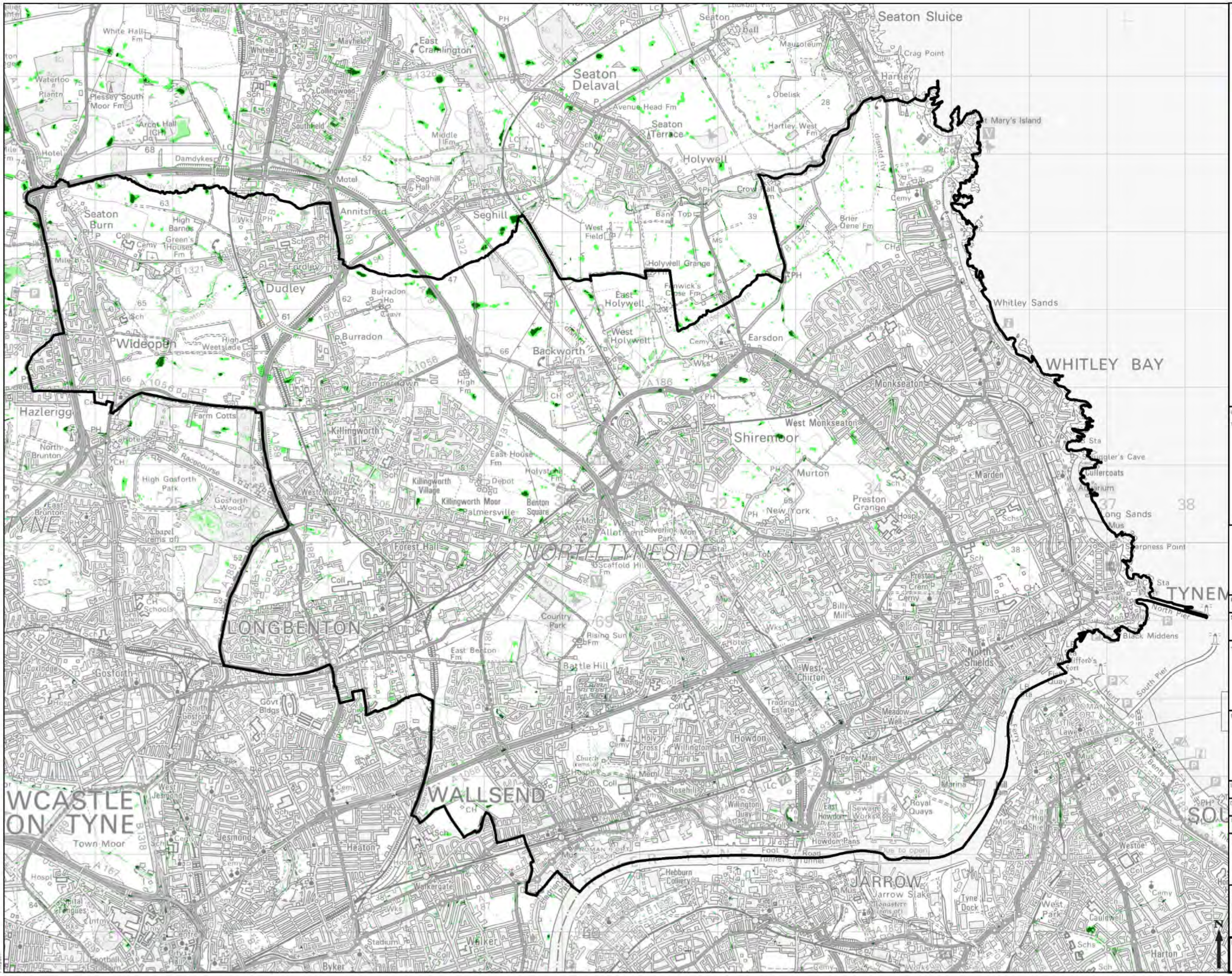
6.2 Pluvial Modelling

In order to continue developing an understanding of the causes and consequences of surface water flooding in North Tyneside, intermediate level hydraulic modelling has been undertaken for a range of rainfall event profiles. This hydraulic modelling has been designed to provide additional information where local knowledge is lacking and forms a basis for future detailed assessments in areas identified as high risk.

6.2.1 *National Pluvial Modelling*

The EA has undertaken pluvial modelling at a national scale and produced mapping identifying those areas susceptible to surface water flooding. The mapping relevant to North Tyneside is shown in Figure 6-3 (FMfSW, 30yr) and Figure 6-4 (FMfSW, 200yr). The primary purpose of these maps are to assist LPAs with emergency planning procedures and it should be noted that this national mapping has the following limitations:

- Mapping does not show the interface between the surface water network, sewer systems and watercourses, although does include an allowance for losses (sewer/infiltration),
- Mapping does not show susceptibility of individual properties to surface water flooding,
- Mapping has significant limitations for use in flat catchments.



LEGEND

- Study Area
- Shallow Flooding
- Deep Flooding

Copyright

To be confirmed by NTC, EA and NWL

Revision Details | By | Check | Date | Suffix

Drawing Status: FINAL

Job Title: NORTH TYNESIDE SURFACE WATER MANAGEMENT PLAN

Drawing Title: FLOOD MAP FOR SURFACE WATER 1 IN 30 YEAR

Scale at A3	1:45,000
Drawn: AW	Approved: MT
Stage 1 Check	Stage 2 Check
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Drawing Number: **Figure 6-3** Rev: -

LEGEND

- Study Area
- Shallow Flooding
- Deep Flooding

Revision Details	By / Check	Date	Suffix

Drawing Status: FINAL

Job Title: NORTH TYNESIDE SURFACE WATER MANAGEMENT PLAN

Drawing Title: FLOOD MAP FOR SURFACE WATER 1 IN 200 YEAR

Scale at A3: 1:45,000

Drawn	Approved
AW	MT

Stage 1 Check	Stage 2 Check	Orginated	Date

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Drawing Number: Figure 6-4

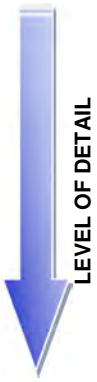
Rev: -

This mapping provides national coverage and is intended for use by the Local Resilience Forums solely to inform emergency planning and should not be used for spatial planning decisions. In addition, the EA strongly recommend that local knowledge is applied to assess the suitability of the mapping as an indicator of surface water flooding before emergency planners make decisions based upon it.

In the light of these recommendations, this mapping has been used purely as an initial high-level overview of pluvial flood risk across North Tyneside which is being reviewed in conjunction with local knowledge of pluvial flooding incidents to form a platform for the intermediate risk assessment.

6.2.2 *Pluvial Hydrology*

A Direct Rainfall approach (Figure 6-5) using TUFLOW software has been selected whereby rainfall events of known probability are applied directly to the ground surface and resultant flows are routed overland to provide an indication of potential flow path directions and velocities and determine areas where surface water may pond. A full methodology of the hydraulic modelling undertaken is included in Appendix A.



Rolling Ball	Surface water flow routes are identified by topographic analysis, most commonly in a GIS package.
Direct Rainfall	Rainfall is applied directly to a surface and is routed overland to predict surface water flooding.
Drainage Systems	Based around models of the underground drainage systems.
Integrated Approach	Representing both direct rainfall and drainage systems in an integrated manner, or linking different models together dynamically.

Figure 6-5: Levels of Pluvial Modelling
Source: SWMP Technical Guidance March, 2010

Rainfall events with the following return periods have been modelled:

- 1 in 30 year event,
- 1 in 50 year event,
- 1 in 75 year event,
- 1 in 100 year plus climate change event,
- 1 in 200 year event.

The events have been run for the calculated North Tyneside wide critical storm duration of 6 hours.

6.2.3 *Pluvial Model Outputs*

Model output in the form of ASCII grids which were then converted into GIS MapInfo TAB files have been created for all scenarios and are in a format ready for transfer to NTC for upload onto their in-house GIS system.

As part of this study, a map has been prepared covering the areas of interest within North Tyneside for the 1 in 75 year event and this mapping is included in Figure 6-6.

It is anticipated that this map should be used for facilitating the engagement of stakeholders on surface water flooding issues, to further inform spatial planning process, to inform future capital investment decisions, to inform emergency planning functions carried out by Local Resilience Forums and to identify whether critical infrastructure is at risk from surface water flooding.

However, the limitations of this modelling should be considered when using the information. The key points are that the intermediate modelling assumes that no water either enters the underground drainage network or infiltrates into the soil surface, therefore the results are conservative. In addition, the modelling does not take into account any capacity issues of the local drainage network such as surcharging of manholes which may lead to backing up and further pooling of surface water in identified critical drainage areas.

6.3 Pluvial Modelling Results

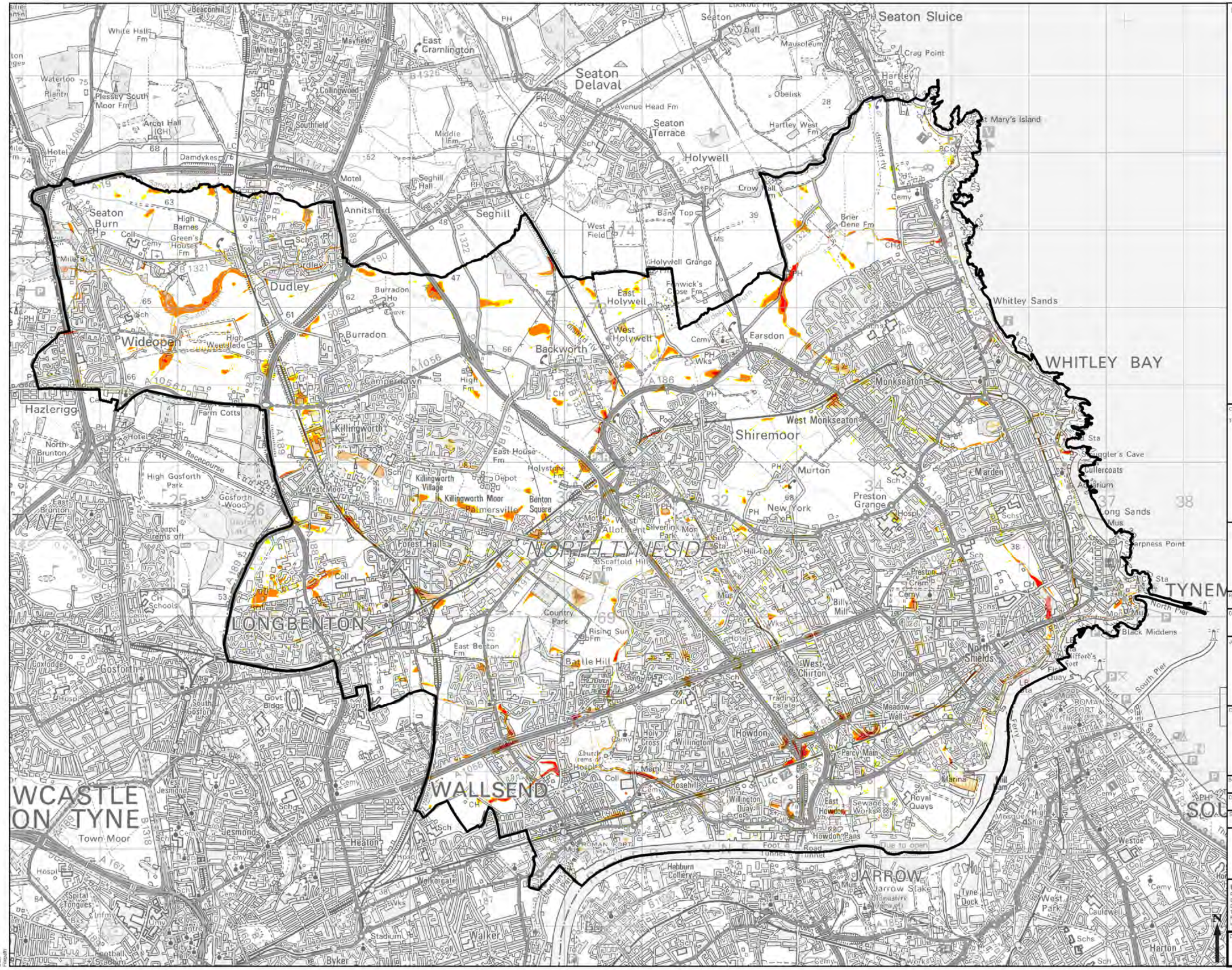
The results of the intermediate level pluvial modelling combined with site visits and review of historical flood records held by NTC, NWL and the EA indicate that pluvial flooding in North Tyneside is scattered across the study area.

The primary features within North Tyneside which contribute to surface water ponding are narrow corridors associated with topographical valleys which are either rural areas with watercourses, or are built up areas which are likely to have previously been the route of watercourses.

The secondary feature associated with flooding in North Tyneside is the presence of two railway embankments running east-west and to a lesser extent the raised sections of road network. Flooding on the upstream side of these embankments is due to undersized culverts through the embankments, or in places, where no flow routes are present.

6.3.1 *Risk to Existing Properties and Infrastructure*

In order to provide a quantitative indication of potential risks, address point data has been overlaid onto intermediate pluvial modelling results to establish the number of properties at risk within each specific area. Table 6-3 presents the approximate number of properties which may be affected in each area during a 1 in 200 year rainfall event (i.e. the worst case modelled event). These properties have been identified using a refined version of the NTC supplied address point database. Of the 2,530 properties affected, 1,636 are private residential houses, 714 are private residential flats and 180 are commercial units. There are no hospitals, schools, fire stations or other infrastructure identified as at risk.



LEGEND

Study Area

Depth Rating

- 0.30m - 0.50m
- 0.50m - 1.50m
- >1.50m

Revision Details	By	Check	Date	Suffix

Drawing Status: FINAL

Job Title: NORTH TYNESIDE SURFACE WATER MANAGEMENT PLAN

Drawing Title: PLUVIAL MODELLING RESULTS 1 IN 75 YEAR

Scale at A3: 1:45,000

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TABLE 6-3:PROPERTIES AFFECTED BY PLUVIAL FLOODING	
Electoral Ward	**Properties Affected by Pluvial Flooding (1 in 200 year with greater than 0.3m depth)**
Valley	103
Cullercoats	29
Chirton	340
Riverside	158 *(including a pre-school and a clinic)*
Howdon	56
Killingworth	172
Benton	178 *(including a pre-school)*
Longbenton	278 *(including an electrical substation)*
Wallsend	110 *(including an electrical substation)*
Tynemouth	90 *(including water supply land and buildings)*
Camperdown	52
Weetslade	109 *(including an electrical substation)*
Northumberland	185
Battle Hill	154
Preston	111
St Mary's	37
Monkseaton North	113 *(including water supply land and buildings)*
Whitely Bay	66 *(including a pre-school and a medical care home)*
Monkseaton South	119
Collingwood	70

6.3.2 *Verification of Pluvial Modelling*

Using information provided by NTC and NWL in relation to the flooding across North Tyneside on 28th June 2012, checks were made between the modelled outputs from the pluvial modelling for the 1 in 200 year event (similar to the noted event) and records of flooding.

A review of the two sets of data showed good synergy between the predicted (through pluvial modelling) areas of flooding and those that were recorded as flooding. This was particularly apparent in the following areas:

- Chicken Road area of Wallsend,
- Mead Way area of Palmersville/Forest Hall,
- Goathland Avenue area of Benton,
- Ullswater Drive area of Killingworth,
- Weyhill Avenue area of Percy Main,
- Preston Road North/North Road area of Preston,

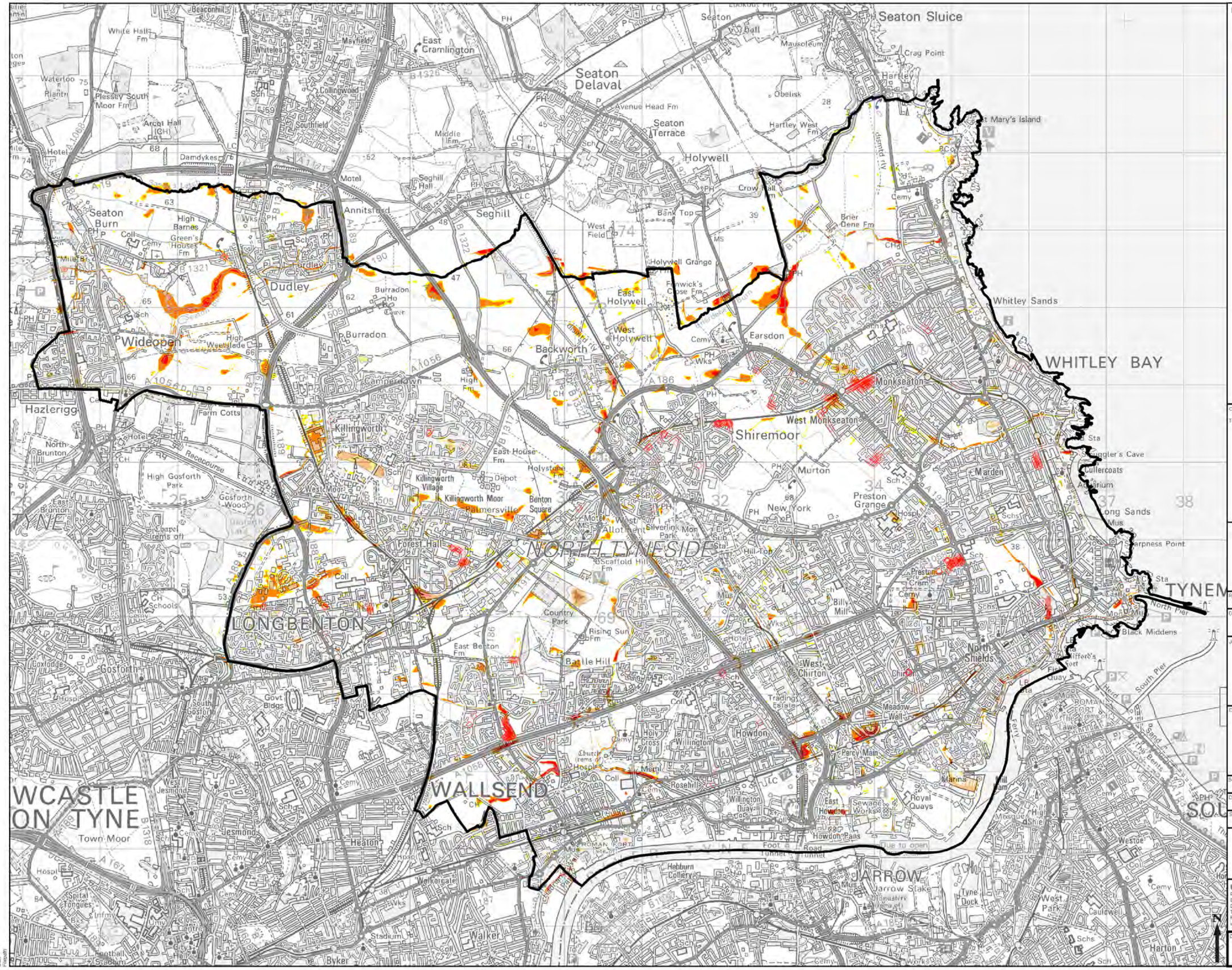
- Area around West Monkseaton Metro Station,
- Brantwood Avenue area of Whitley Bay,
- Willow Grove area of Wallsend.

Figure 6-7 provides a comparison between the predicted modelled extents during the 1 in 200 year event and the recorded instances of flooding for the June 2012 event.

6.4 Pluvial Flood Risk Summary

Based on the surface water assessment and the pluvial modelling undertaken as part of this SWMP, the following conclusions can be drawn:

- Historical records (including the June 2012 event) and predicted datasets indicate that there is a dispersed risk of surface water flooding across North Tyneside,
- A pluvial model was created for North Tyneside to assess, in more detail, the areas and the number of properties at risk of surface water flooding over a range of rainfall events,
- Results from the pluvial modelling compare well to historical flooding events across North Tyneside, with strong synergies between the modelled 1 in 200 year event and records of flooding from the June 2012 event.



LEGEND

Study Area

Depth Rating

- 0.30m - 0.50m
- 0.50m - 1.50m
- >1.50m

June 2012 Flooding

NTC Record

Revision Details	By	Check	Date	Suffix

Drawing Status: FINAL

Job Title: NORTH TYNESIDE SURFACE WATER MANAGEMENT PLAN

Drawing Title: PLUVIAL MODEL VERIFICATION 1 IN 200 YEAR/JUNE 2012

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7 SEWER FLOODING

7.1 Overview

During heavy rainfall, flooding from sewer system may occur if:

- The rainfall event exceeds the capacity of the sewer system / drainage system,
- The system and/or road gullies become blocked by debris or sediment (which can lead to serious flood incidents and exacerbate surface water flooding),
- The system surcharges due to high water levels in rivers.

Within North Tyneside, there is potential for sewer outfalls to watercourses to become submerged during high water levels. When this happens, water is unable to discharge into the watercourse and flows back along the sewer. Once storage capacity within the sewer itself is exceeded, the water will overflow.

Since the late 1970s, and with the publication of Sewers for Adoption[14] in 1980, sewer systems have typically been designed and constructed to accommodate a rainfall event with a 1 in 30 probability of occurrence in any given year (3.3%) or less. Therefore, rainfall events with a rainfall probability of greater than 3.3% AEP would be expected to result in surcharging of some of the sewer system.

While NWL is concerned about the frequency of extreme events, it is not economically viable to build sewers that could cope with every extreme event.

7.2 Responsibility

In order to clearly identify problems and solutions, it is important to first outline the responsibilities of different organisations with respect to drainage infrastructure. The responsible parties are primarily as follows:

- North Tyneside Council,
- Northumbrian Water,
- Owners of Private Drainage Systems.

As illustrated in Figure 7-1, NTC as the Highways Authority are responsible for maintaining an effective highway drainage system including kerbs, road gullies and the pipes which connect the gullies to the public sewers and soakaways. The sewerage undertaker, in this case NWL are responsible for maintaining the public sewers.

[14] The Sewers for Adoption guide was first issued in 1980 by WRc. Since then the document has become the standard for the design and construction of sewers to adoptable standards in England and Wales. It acts as a guide to assist developers in preparing their submission to a sewerage undertaker before they enter into an Adoption Agreement under Section 104 of the Water Industry Act 1991

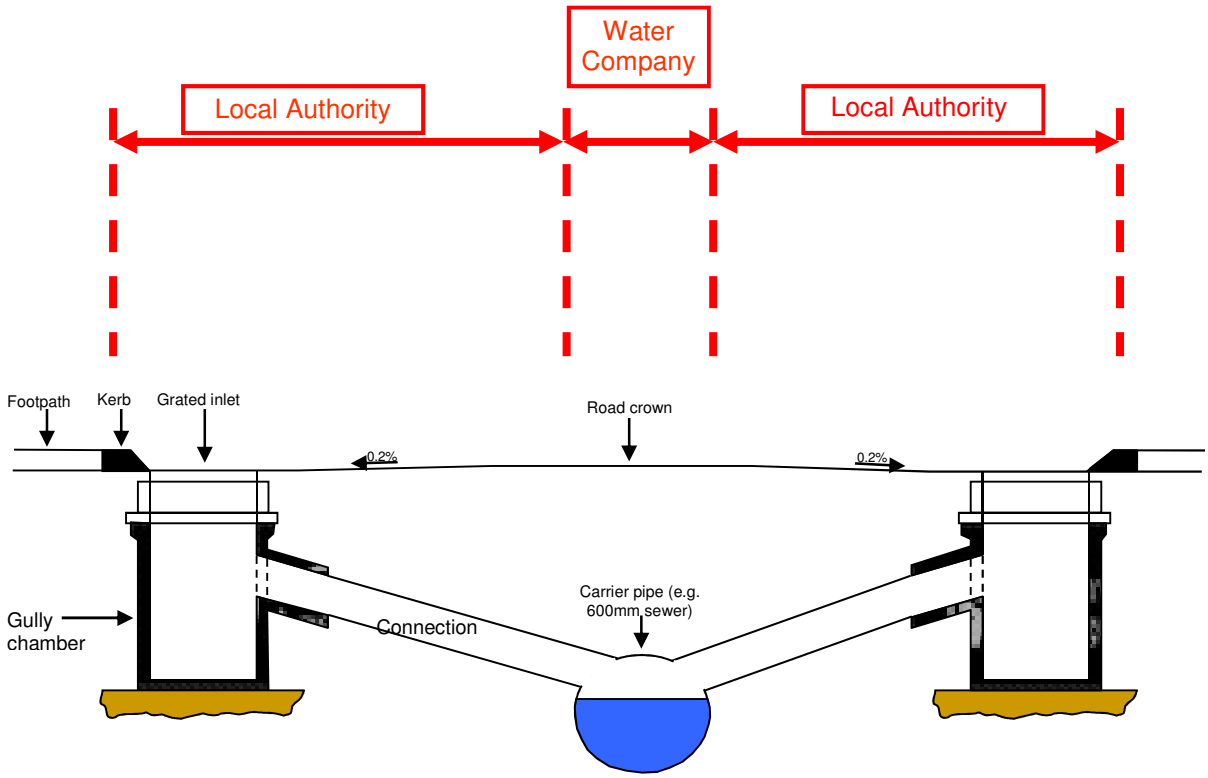


Figure 7-1: Surface Water Drainage Responsibility

7.3 Northumbrian Water Data Review

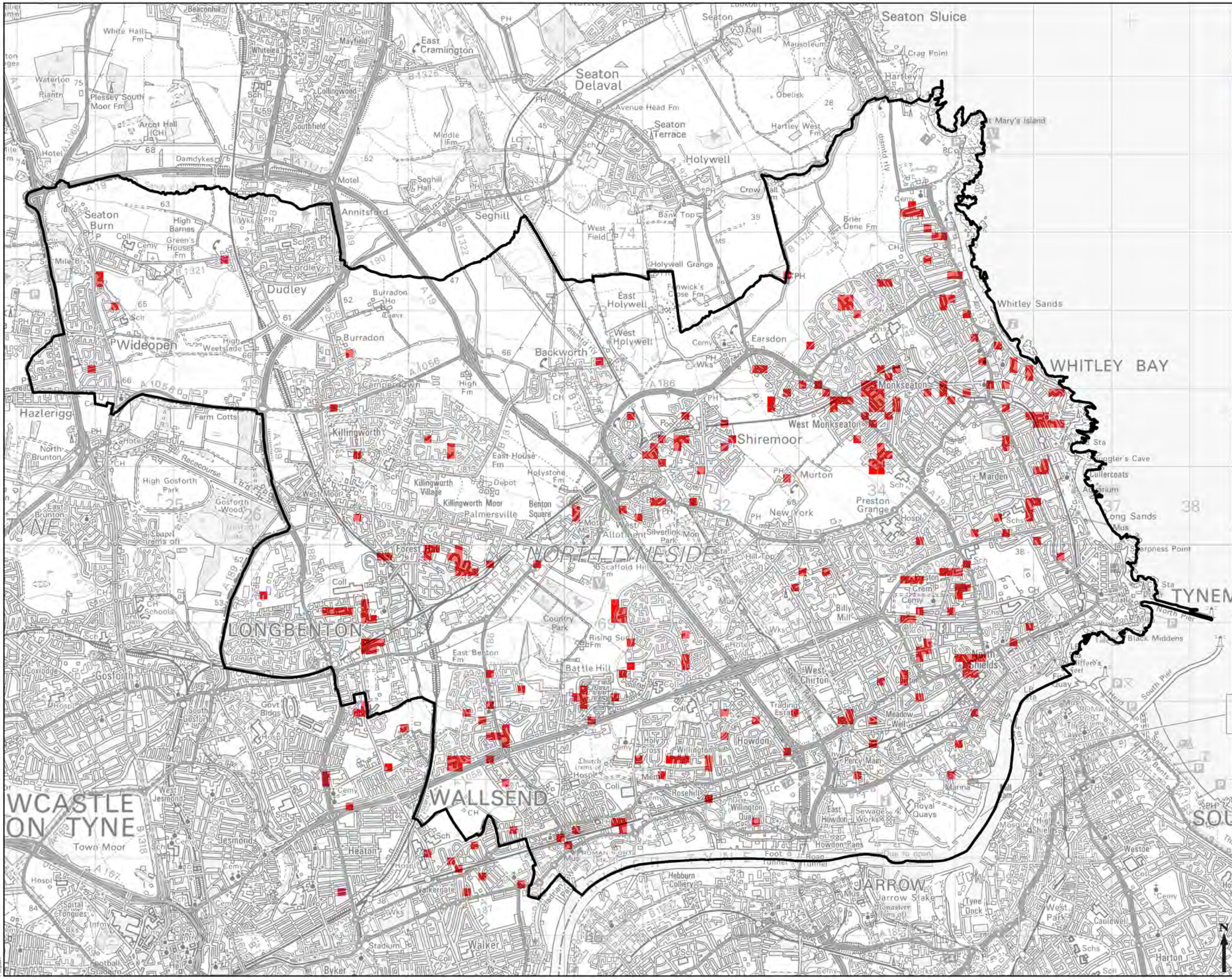
In order to fulfil statutory commitments set by OFWAT, water companies must maintain verifiable records of sewer flooding, which is achieved through their DG5 registers. Water companies are required to record flooding arising from public foul, combined or surface water sewers and identify where properties have suffered internal or external flooding. The DG5 register does not however indicate areas or properties at risk of future flooding.

DG5 registers from NWL were analysed to investigate the occurrence of sewer flooding incidents across North Tyneside.

Figure 7-2 shows the location of sewer flooding incidents (reported to NWL) within 100m grid squares in North Tyneside, including records from the June 2012 event.

NWL have classified the risk of sewer flooding in the drainage areas within North Tyneside as low, medium or high. As described in Section 1.3.3.the following areas have been classified as having locations within them being at high risk of flooding however investment is onsite, planned or complete at most of these locations:

- Benton,
- Brierdene,
- Chirton,
- Cullercoats,
- Seaton Valley,
- Tynemouth,
- Whitley Bay.



LEGEND

Study Area

Flooding Records (100m Squares)

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To be confirmed by NTC, EA and NWL

Revision Details	By	Check	Date	Suffix

Drawing Status

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Job Title

NORTH TYNESIDE SURFACE WATER MANAGEMENT PLAN

Drawing Title

RISK OF SEWER FLOODING FROM NORTHUMBRIAN WATER RECORDS

Scale at A3: 1:45,000

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Drawing Number: **Figure 7-2**   Rev: -

It is important to note that the DG5 register indicates areas that NWL are aware of, that are currently at risk of flooding as a result of insufficient hydraulic capacity in the sewer network. The flood records provided could be misleading as they may not be a complete and accurate record of flood events in the study area as some minor flooding incidents may go unreported, particularly if no property is affected by internal flooding.

Sewer flooding models provide a much more detailed and useful appreciation of the risk posed. However much of this work is not yet publicly available due to commercially sensitive issues or the Data Protection Act (1998).

In addition to the provision of initial data, data-sets were also provide by NWL in the form of 100m grid squares that recorded flooding on the network during the June 2012 event.

7.4 Sewer Network Flood Risk

NWL have provided a GIS layer of the sewer network in North Tyneside however this confirms limited information and contains no invert/gradient information. This information has been used to help delineate CDAs to be used in Phase III to inform on potential mitigation options for each location.

As part of the North Tyneside Water Cycle Study (WCS) a 'high level assessment' was undertaken for the key development areas in North Tyneside and sets out the foul flow constraints likely to occur from this new development.

Table 7-1 summarises the risk of sewer networks exceeding their capacity as a result of the number of dwellings in the proposed development areas in North Tyneside. The risk ratings are primarily based on the NWL DG5 records provided.

TABLE 7-1:SUMMARY OF RISK RATINGS FOR SEWER NETWORKS TO DEVELOPMENT AREAS

Development Area	Risk
Coast	Amber
North Shields	Amber
Wellfield	Amber/Red
West Chirton South	Amber
Annitsford Farm (including Urban Fringe development)	Green
Whitehouse Farm	Amber
Shiremoor (including Urban Fringe development)	Amber
Scaffold Hill	Amber
Station Road	Amber
East Benton Farm	Green
Wallsend	Green

Note: Levels of risk are those attributed to the sewer network by Northumbrian Water

7.5 Flood Risk from Sewers Summary

The following conclusions on sewer flooding in North Tyneside can be made:

- Historical records indicate that flooding from sewers has occurred in North Tyneside,

- Flooding in the past was largely due to volumes of water overwhelming the capacity of the sewer in certain parts of the network,
- High intensity rainfall events have also prevented water entering the network,
- Capital works are being undertaken, or are proposed to be undertaken by NWL at some of the areas at risk of flooding and therefore the risk may have been removed or reduced significantly,
- NWL have confirmed that potential issues with the capacity of Howdon WwTW, partly due to the influx of surface water and monitoring is currently being undertaken. The Tyneside Sustainable Sewerage Strategy has highlighted this problem, with a view to removing surface water where practicable,
- Until more detailed and suitable data becomes available, NTC, the EA and NWL should continue to liaise to determine how sewer flooding data can best be used to inform flood risk management in North Tyneside.

8 ORDINARY WATERCOURSE FLOODING

8.1 Overview

Ordinary watercourse flooding includes flooding from small open channels and culverted urban watercourses. These small channels often receive most of their flow from inside the urban area and perform an urban drainage function.

The EA has responsibility over flooding from designated statutory Main Rivers, however the responsibility for maintenance of small open channels and culverted urban watercourses which are not designated as 'main river' falls to riparian owners who own land on either bank (this may include NTC). In accordance with the FWMA, NTC have certain powers and responsibilities to allow them to perform an overarching supervisory role with regards to flood risk management of ordinary watercourses.

Historically, the risk of flooding from ordinary watercourses has been poorly understood. Many urban ordinary watercourses are heavily engineered with artificial channel geometries, numerous structures (such as weirs and sluice gates) and long culverted reaches. In addition, there is often a complex interaction with the local sewer networks with many drains discharging into the ordinary watercourses. For these reasons, the potential future flood risks are also generally poorly understood for ordinary watercourses.

The EA has responsibility over flooding from designated Main Rivers and flooding from this source has been further assessed as part of the previously completed Level 1 SFRA for North Tyneside.

As part of this study and through consultation with NTC and the EA, it has been confirmed that the following are designated as ordinary watercourses and as such fall under the responsibility of NTC for maintenance and management:

- Brierdene Burn,
- Redburn Dene,
- Sandy's Letch,
- Wallsend Burn,
- Wallsend Dene,
- Willington Gut.

8.2 Culverted Watercourses.

Some (GIS) information has been provided by NTC in relation to major culverted watercourses within the study area. Using the information provided, ordnance survey mapping, the identified ordinary watercourses and NWL asset network data, an attempt has been made to identify the presence of culverted watercourses across North Tyneside. A site visit was undertaken in August 2011 following this review to observe a number of key culverts and inform their inclusion in the pluvial model.

As limited information is available (i.e. the presence and location), assumptions have been made with regards to the structural details of the culverted watercourses (i.e. their size, gradient and integrity) to allow key culverts to be included within the pluvial modelling. A review of initial pluvial model outputs was undertaken to determine where ponding may have been occurring as a consequence of a culvert not being represented in the model. Where this was the case, a suitable allowance for a (1D) culvert was made

within the hydraulic model, using prevailing upstream and downstream ground levels from LiDAR data for the invert levels and OS mapping and aerial photography to determine the approximate route of the culvert.

9 GROUNDWATER FLOODING

9.1 Background

Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from abnormal springs. This tends to occur after much longer periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is likely to be at shallow depth. Groundwater flooding is known to occur in areas underlain by principal aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels.

Groundwater flooding tends to occur sporadically in both location and time, and tends to last longer than fluvial, pluvial or sewer flooding. When groundwater flooding occurs, basements and tunnels can flood, buried services may be damaged, and storm sewers may become ineffective, exacerbating the risk of surface water flooding. Groundwater flooding can also lead to the inundation of farmland, roads, commercial, residential and amenity areas.

The Groundwater Flooding Susceptibility Report is included in Appendix B and this includes details of the Boroughs geology. The following sections summarise the hydrogeology of North Tyneside and the high level assessment of groundwater flooding.

9.2 Hydrogeology

9.2.1 *Bedrock Hydrogeology*

The Roker and Raisby Dolomite Formations outcropping at surface to the North of Marden, have been classified as a principal aquifer by the EA and permit groundwater flow. The deposits are of limited lateral extent, but localised groundwater lenses may be present which may be in continuity with the underlying Coal Measures. The Yellow Sands Formation found in the area of Forest Hall, has been classified as a principal aquifer by the EA and therefore permit groundwater flow and the possibility of perched groundwater. However, where the Formation is overlain by Glacial Till (variable clay, sand and gravel) the clay content may impede Groundwater flow. These deposits are of interest to the current study.

The, Pennine Upper Coal Measures Formation, Pennine Middle Coal Measures Formation (sandstone), Middle Coal Measures Formation (Mudstone, Siltstone and Sandstone) and Lower Coal Measures are all classified as secondary aquifers (A) by the EA, with groundwater levels possibly existing within the sandstone horizons. Only the Pennine Middle Coal Measures Formation (sandstone) and Middle Coal Measures Formation (Mudstone, Siltstone and Sandstone) are found present at surface in the areas of Earsdon,Billy Mill, Burradon, Killingworth Village, Scaffold Hill and south of Benton Square. These units are of interest to the current study.

9.2.2 *Superficial Hydrogeology*

Blown Sand is found to the east coast of the North Tyneside Study area, at Long Sands and Whitley Sands. It is classified by the EA as a secondary aquifer (A). The BGS permeability shows it to be high permeability and so it's likely to store water, though its ability will vary depending on its thickness and horizontal extent. It's possible that perched groundwater may exist when found to be overlaying clay horizons of the Coal Measures.

The Beach Sand Deposits, composed of lose sand, are identified by the EA as a Secondary Aquifer (A), with a very high to high permeability. Groundwater will flow through these deposits and could be stored, though they are not laterally extensive. Alluvium along some of the brooks and tributaries to the north west of the Borough area is

classified as secondary aquifer (A) by the EA and the BGS permeability data set suggests a high to very low permeability. It is likely that the ability of the deposits to store water will vary locally depending on the extent and thickness of the sand and gravel horizons.

Glacial Till deposits are generally expected to behave as aquitards, although sand and gravel horizons may locally form a secondary aquifer depending on their lateral extent and thickness. Till deposits are not classified by the EA as an aquifer, although the BGS suggest that permeabilities can range from high to low and this is due to the localise variability of sand and gravel horizons. As a consequence perched groundwater lenses could form, though they could be laterally limited. In the areas marked as artificial ground, it is likely that the superficial deposits have been.

9.3 Groundwater Flooding Susceptibility

The report in Appendix B identifies six possible groundwater flooding mechanisms in the area based on the data review and conceptual understanding of the Borough:

- Roker and Raisby Dolomite Formation outcrop in the east of the study area, near Whitley Bay where superficial deposits are absent,
- Superficial aquifers in hydraulic continuity with open water courses,
- Superficial aquifers not in hydraulic continuity with surface water courses,
- Impermeable (silt and clay) areas down slope of superficial aquifers in various locations,
- Superficial aquifers along the coastline,
- Artificial ground in various locations but particularly in south.

The BGS has produced a data set showing areas susceptible to groundwater flooding on the basis of geological and hydrogeological conditions large areas of the North Tyneside study area are shown to have a very high and high susceptibility to groundwater flooding particularly where ground elevations are low. The main areas identified are, Shiremoor, Weston Chitron, Backworth and Longbenton, though susceptibility is not just confined to those areas. The BGS data set suggests this susceptibility is mostly associated with the superficial deposits (Glacial Till) as opposed to bedrock geology (largely Pennine Middle Coal Formation).

The BGS Groundwater Flooding Susceptibility map indicates that there is a very high / high susceptibility to bedrock groundwater flooding where the Roker Formation and Raisby Formation outcrop to the North of Marsden and where superficial deposits are absent. In general, based on the available data it is thought that the approximate areas identified by the BGS as being susceptible to groundwater flooding are as expected. However, it is possible that the various categories from ‘very high’ to ‘moderate’ may not be accurate given the poor availability of groundwater level data to the BGS; the EA does not monitor superficial or bedrock groundwater levels within the study area.

10 CRITICAL DRAINAGE AREAS

10.1 Overview

Initially eleven flooding hotspots across North Tyneside were identified using pluvial model outputs for the 1 in 75 year event, as this is the general threshold for insurance purposes. The spatial distribution of the flooding hotspots and their associated CDAs. NTC are the 'lead' authority in terms of managing flood risk within these identified CDAs, though it may be necessary to work in partnership with other stakeholders (i.e. the EA and NWL) to manage flood risk within several of the CDAs.

The remainder of this chapter provides a description of each CDA including details of the flooding mechanisms and interaction between flooding locations within the CDA.

10.2 Risk to Existing Residential Properties

In order to determine the CDA's for North Tyneside, as part of the Phase I SWMP and Phase II SWMP, a series of data-sets have been collected and reviewed. The data-sets include:

- CDA's identified in the SFRA,
- EA Areas Susceptible to Surface Water Flooding Maps,
- EA Flood Map for Surface Water,
- EA Areas Susceptible to Groundwater Flooding Maps,
- EA Flood Zone Maps,
- EA flooding records,
- NTC flooding records,
- NWL areas at risk of hydraulic flooding records,
- Outputs from pluvial modelling for North Tyneside,
- Groundwater Flood Risk Assessment.

In February 2011, a project start-up meeting was held with NTC to discuss sources of data and information available for the SWMP study and to provide an initial overview of the history of flooding throughout North Tyneside.

As part of the Level 1 SFRA for North Tyneside, three main CDAs were identified:

- Benton,
- Brierdene,
- Whitley Bay.

These were primarily based upon the EA's AStSWF Maps and 'Drainage Areas at Risk' on the NWL network, however the NWL 'Drainage Areas at Risk' data has since been revised, reducing the level of risk in these areas.

The Level 1 SFRA recommended that a SWMP should be undertaken with particular reference to the Killingworth and Longbenton area where there is significant interaction between a number of sources.

The EA refers to a CDA as an area within Flood Zone 1 which has 'critical drainage issues'. Within the SWMP community, there is a 'working definition' of a CDA as a:

"discrete geographic area (usually within an urban setting) where there may be multiple and interlinked sources of flood risk and where severe weather is known to cause flooding of these areas thereby affecting people, property or local infrastructure".

The initial CDA have been determined as part of this SWMP using the methodology detailed in Section 10.3.

10.3 Determining Hotspots and Critical Drainage Areas

The methodology for determining the CDA is based upon the catchment delineation of flooding hotspots identified from the pluvial modelling and using the NTC database properties showing flooding during the 1 in 75 year event have been identified.

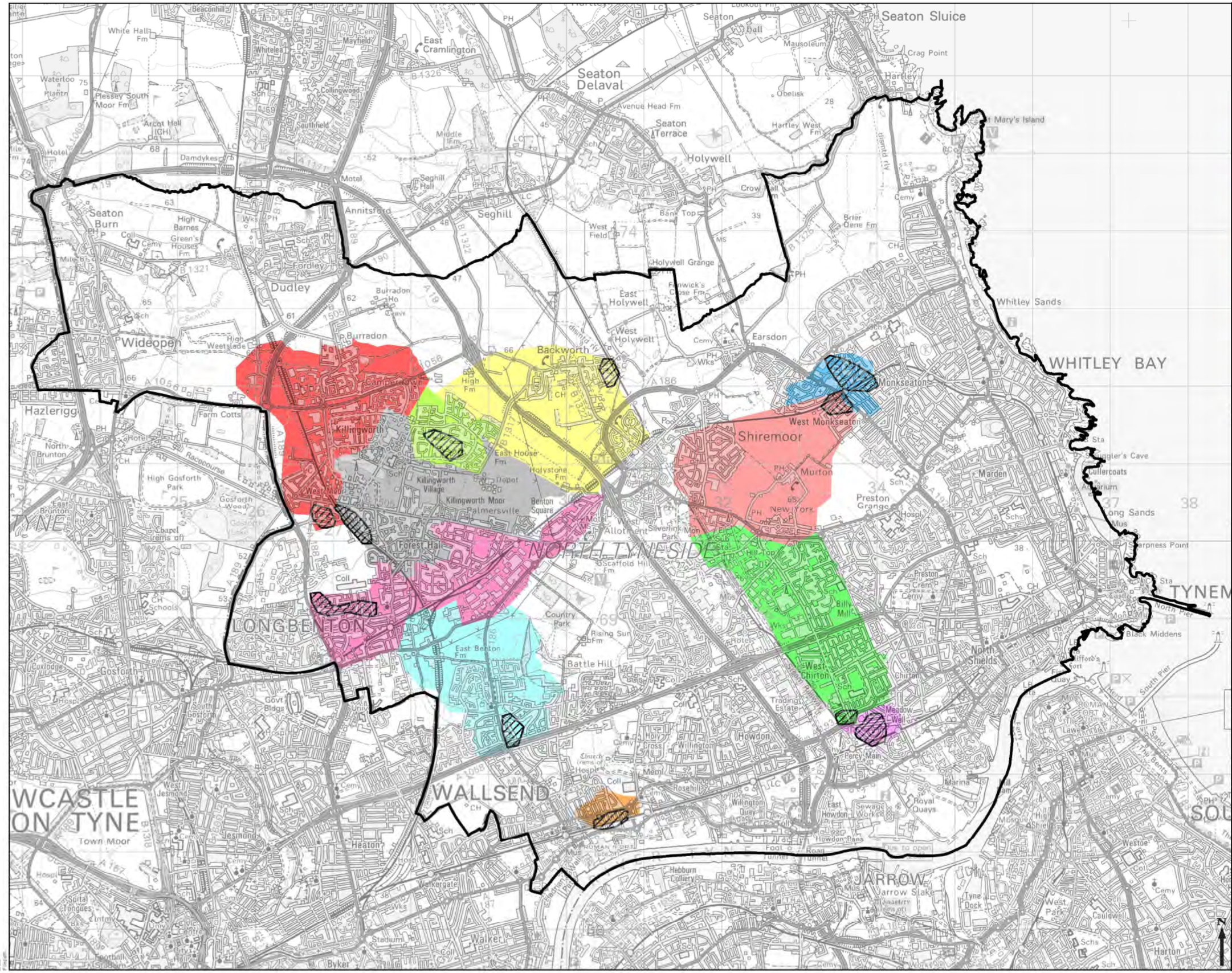
During the 1 in 75 year event (the threshold for insurance purposes), there are a number of property clusters of properties across North Tyneside affected by flooding, with the maximum number of properties affected in one cluster being one-hundred and thirty-five (135) properties.

The identified clusters of properties have been screened to remove isolated clusters of less than twenty (20) properties, during the 1 in 75 year event to provide a focus towards the highest risk areas across North Tyneside. These remaining clusters have been screen against EA Flood Zones and the results of the pluvial modelling for the 1 in 200 year event.

The top eleven (11) clusters, identified as flooding hotspots have been taken forward and their contributing catchment (i.e. the CDA) has been determined.

Details of each of the hotspots and associated CDAs are summarised in Table 10-1 and shown in Figure 10-1.

TABLE 10-1: FLOODING HOTSPOTS AND FLOODING HISTORY										
ID	Number of Properties Affected	Groundwater Risk	Sewer Risk	Historical Flooding					
	1 in 75 year			2005	2007	2008	2009	2010	2012
Backworth	22	High	Amber	✓					
Killingworth	45	Very Low	Amber						✓
Longbenton	48	Very High	Amber		✓	✓			✓
Monkseaton	77	Very High	Amber						✓
Percy Main North	103	Very High	Green	✓					✓
Percy Main South	135	Very High	Green						✓
Wallsend North	54	Very High	Green	✓					✓
Wallsend South	76	None	Green	✓					✓
West Monkseaton	61	Very High	Amber	✓		✓	✓	✓	✓
West Moor East	96	Very High	Amber						
West Moor West	46	Very High	Amber						



LEGEND

- Study Area
- Flooding Hotspot

Critical Drainage Areas

- West Monkseaton
- Percy Main North
- Percy Main South
- Monkseaton
- Wallsend South
- Wallsend North
- Longbenton
- West Moor West
- Backworth
- West Moor East
- Killingworth

Revision Details	By / Check	Date	Suffix

Drawing Status: FINAL

Job Title:

NORTH TYNESIDE SURFACE WATER MANAGEMENT PLAN

Drawing Title:

FLOODING HOTSPOTS AND ASSOCIATED CRITICAL DRAINAGE AREAS

Scale at A3: 1:45,000

Drawn:	Approved:
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Drawing Number: Figure 10-1

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10.3.1 *Backworth CDA and Flooding Hotspot*

Modelling has shown that there is a risk of pluvial flooding in the Backworth area. A total of 22 properties and 54 properties have been identified as being potentially at risk of flooding during the modelled 1 in 75 year and 1 in 200 year events respectively.

Surface water flowing from the upper catchment ponds behind the railway embankment to the eastern extent of Backworth, resulting in flooding of a number of properties (Figure 10-2). There is a 1m diameter culvert underneath the road embankment which allows Brierdene Burn to drain east; this pathway is included in the model however does not have capacity for the extreme event.

Figure 10-2: Surface Water Flooding in Backworth

The upstream catchment includes the village of Backworth and the green area which comprises the headwaters of Brierdene Burn and has an approximate area of 3.1km^2.

10.3.2 *Killingworth CDA and Flooding Hotspot*

Modelling has shown that there is a discrete area at risk of pluvial flooding in the Killingworth area. A total of 45 properties and 55 properties have been identified as being potentially at risk of flooding during the modelled 1 in 75 year and 1 in 200 year events respectively.

There is a relatively small contributing catchment (approximately 0.8km^2) to the area of identified flooding in Killingworth, resulting in flooding of a number of properties (Figure 10-3).

Figure 10-3: Surface Water Flooding in Killingworth

10.3.3 *Longbenton CDA and Flooding Hotspot*

Modelling has shown that there are a number of areas at risk of pluvial flooding in the Longbenton area. A total of 48 properties and 66 properties have been identified as being potentially at risk of flooding during the modelled 1 in 75 year and 1 in 200 year events respectively.

The contributing catchment (approximately 2.9km^2) is a narrow ribbon in Longbenton and to the west, which results in flooding of a number of properties (Figure 10-4).

Figure 10-4: Surface Water Flooding in Longbenton

NWL have confirmed that they have invested £4.8 million to upgrade the sewerage network in Longbenton. This work began on 10th January 2011 and took a year to complete. A total of 1,800 metres of new sewer pipe was constructed at Ashleigh Grove, Benton Lane, Clydedale Avenue, Goathland Avenue, Hailsham Avenue, in fields next to Longbenton Community College and in land between Ongar Way and Quorum Business Park. Another 270 metres of sewer pipe was upsized at Avondale Avenue, Cambridge Avenue and Station Road.

Additionally an underground storm water storage tank was built in land between Ongar Way and Quorum Business Park, this tank has a capacity of ten and a half million litres.

10.3.4 *Monkseaton CDA and Flooding Hotspot*

Modelling has shown that there is an area at risk of pluvial flooding in the Monkseaton area. A total of 77 properties and 93 properties have been identified as being potentially at risk of flooding during the modelled 1 in 75 year and 1 in 200 year events respectively and these appear to be attributed to the former route of a watercourse (Figure 10-5).

Figure 10-5: Surface Water Flooding in Monkseaton

There is a relatively discrete contributing catchment (approximately 0.6km^2) draining to the area of identified flooding in Monkseaton.

10.3.5 ***Percy Main North CDA and Flooding Hotspot***

Modelling has shown that there is an area at risk of pluvial flooding in the Percy Main North area. A total of 103 properties and 108 properties have been identified as being potentially at risk of flooding during the modelled 1 in 75 year and 1 in 200 year events respectively (Figure 10-6).

Figure 10-6: Surface Water Flooding in Percy Main North

The contributing catchment to the Percy Main North area is approximately 2.9km^2, extending to the north covering the West Chirton development area, Billy Mill and the southern fringe of New York. The broad northern boundary of the CDA is the A191 to the south of Shiremoor.

10.3.6 *Percy Main South CDA and Flooding Hotspot*

Modelling has shown that there is an area at risk of pluvial flooding in the Percy Main North area. A total of 135 properties and 192 properties have been identified as being potentially at risk of flooding during the modelled 1 in 75 year and 1 in 200 year events respectively (Figure 10-7).

Figure 10-7: Surface Water Flooding in Percy Main North

Outputs from the pluvial modelling show that flooding behind the railway embankment (Figure 10-7) within the Percy Main South CDA is situated immediately downstream of the Percy Main North area, although the flooding is more extensive within this area. The only identified pathway through the embankment is the below ground sewer network. Discussions are required with NWL to confirm whether there are connections to the sewer network in this location, if this is the case then the outputs from the pluvial modelling may be overly conservative. In addition discussions should be held with NEXUS to determine the technical feasibility of introducing culverts beneath the metro track, although any such introduction has the potential to increase flood risk to the downstream and therefore a feasibility study with associated modelling would be required.

The immediate contributing catchment to the Percy Main South CDA is 0.3km^2, however the majority of the Percy Main North CDA also drains towards Percy Main South. Effectively the combined catchment for Percy Main North and Percy Main South is 3.2km^2.

10.3.7 *Wallsend North CDA and Flooding Hotspot*

Modelling has shown that there is an area at risk of pluvial flooding in the Wallsend North area. A total of 54 properties and 56 properties have been identified as being potentially at risk of flooding during the modelled 1 in 75 year and 1 in 200 year events respectively (Figure 10-8).

Figure 10-8: Surface Water Flooding in Wallsend North

Potential flooding within Wallsend North is along the course of a culverted watercourse running alongside the park to the east of Chicken Road. Should the culverted watercourse be identified as the cause of flooding to this area there could be the opportunity for de-culverting the watercourse and thus improving amenity and biodiversity and providing educational benefits to the park. Any such de-culverting would result in the diversion of the watercourse into the park, using the park as a flood storage area. However this would be subject to a feasibility study and assessment of prevailing ground levels within the park compared to level of the culvert.

The contributing catchment for the Wallsend North CDA has been identified as being approximately 2.6km^2.

10.3.8 *Wallsend South CDA and Flooding Hotspot*

Modelling has shown that there is an area at risk of pluvial flooding in the Wallsend South area. A total of 76 properties and 87 properties have been identified as being potentially at risk of flooding during the modelled 1 in 75 year and 1 in 200 year events respectively (Figure 10-9).

Figure 10-9: Surface Water Flooding in Wallsend South

Flooding within the area is generally made worse by the presence of the railway (metro) embankment, which essentially impounds any surface water to the north.

The contributing catchment for the Wallsend South CDA has been identified as being approximately 0.3km^2.

10.3.9 ***West Monkseaton CDA and Flooding Hotspot***

Modelling has shown that there is an area at risk of pluvial flooding in the West Monkseaton area. A total of 61 properties and 73 properties have been identified as being potentially at risk of flooding during the modelled 1 in 75 year and 1 in 200 year events respectively (Figure 10-10).

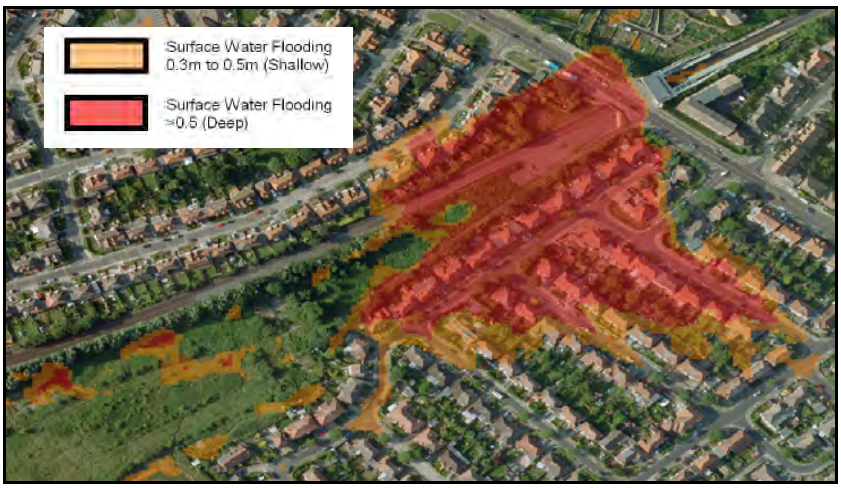

Figure 10-10: Surface Water Flooding in West Monkseaton

Within the West Monkseaton CDA there is opportunity to manage flood risk through increasing community awareness and resilience programmes as well as capital works. Work currently being undertaken by NTC in this area suggests that maintenance may be a factor in the flooding within this area in combination with the capacity of the downstream culverted watercourse.

The contributing catchment for the West Monkseaton CDA has been identified as being approximately 3.1km^2.

10.3.10 ***West Moor East CDA and Flooding Hotspot***

Modelling has shown that there is an area at risk of pluvial flooding in the West Moor East area. A total of 96 properties and 108 properties have been identified as being potentially at risk of flooding during the modelled 1 in 75 year and 1 in 200 year events respectively (Figure 10-11).

Figure 10-11: Surface Water Flooding in West Moor East

Potential flooding in this area is as a result of water backing up behind the railway embankment. There are no development allocations within West Moor East, however as the Balliol East development area is immediately downstream, there may be potential to increase flows beneath the metro line to alleviate the flooding, with storage of the increased flows incorporated within the development area.

NWL, North Tyneside Council, other Councils and the EA have also recently been progressing the Tyneside Sustainable Sewerage Study, this has identified the potential for a strategy for the wider Killingworth area, including increasing surface water storage at Killingworth Lake.

The contributing catchment for the West Moor East CDA has been identified as being approximately 3.1km^2.

10.3.11 ***West Moor West CDA and Flooding Hotspot***

Modelling has shown that there is an area at risk of pluvial flooding in the West Moor West area. A total of 46 properties and 51 properties have been identified as being

potentially at risk of flooding during the modelled 1 in 75 year and 1 in 200 year events respectively (Figure 10-12).

Figure 10-12: Surface Water Flooding in West Moor West

The West Moor West CDA is very large relative to the extent of flooding; therefore source control measures are likely to have a significant impact on reducing the potential flood extent. There is no obvious location for above ground storage and below ground storage is likely to be too costly given the property numbers at risk. Part of the Whitehouse Farm and Weetslade development sites lie within this CDA.

NWL, North Tyneside Council, other Councils and the EA have also recently been progressing the Tyneside Sustainable Sewerage Study, this has identified the potential for a strategy for the wider Killingworth area, including increasing surface water storage at Killingworth Lake.

The contributing catchment for the West Moor West CDA has been identified as being approximately 3.1km^2.

10.4 Flood Risk to and from Future Development

NTC are currently planning for future development up to 2027. During this period the plan is for the provision of 7,892 dwellings, of which 3,033 already have planning permission. The proposed new development is to be located in the ten key housing sites identified within the Preferred Options document, and the urban areas of Wallsend and North Shields. There are also eight key employment sites identified across North Tyneside.

Due regard should also be given to the impact that the proposed new development across North Tyneside could have on flood risk. Development of new residential and employment land across North Tyneside has the potential to increase flood risk, primarily as a direct consequence of increased runoff.

It is therefore critical, that future development across North Tyneside does not increase runoff post development. Also, where new development is situated on a flowpath at a higher elevation to a known flooding hotspots, then where practicable measures are put

in place as part of the development to provide betterment to existing areas known to suffer from flooding.

A number of sites have apparent downstream receptors (for example, Gosforth Business Park is located on a greenfield site adjacent to an area of significant surface water flooding in Longbenton) and therefore as part of the development plans for these sites, consideration should be given to the attenuation of runoff over and above the maintaining of the status quo.

Also a number of sites are likely to discharge directly to adjacent local watercourses and again these have potential to increase downstream flood risk, should attenuation of runoff not be implemented. Table 6-2 provides an initial screening overview of the potential risk of increased runoff from the proposed development sites across North Tyneside.

10.4.1 *Risk to Future Development*

Results from the pluvial modelling undertaken as part of the SWMP identify that the majority of the proposed development sites are not at a significant risk of flooding from surface water flooding in events up to the 1 in 200 year event.

There are however limited areas of surface water flood risk within some of the sites as shown in Table 10-2 and this should be taken into consideration as part of the masterplanning for the specific development areas.

10.4.2 *Risk from Future Development*

Due regard should also be given to the impact new development across North Tyneside could have on flood risk. Development of new residential and employment land across North Tyneside has the potential to increase flood risk, primarily as a direct consequence of increased runoff.

It is therefore critical, that future development across North Tyneside does not increase runoff post development. Also, where new development is situated on a flowpath at a higher elevation to a known flooding hotspots, then where practicable measures are put in place as part of the development to provide betterment to existing areas known to suffer from flooding.

A number of sites have apparent downstream receptors (for example, Gosforth Business Park is located on a greenfield site adjacent to an area of significant surface water flooding in Longbenton) and therefore as part of the development plans for these sites, consideration should be given to the attenuation of runoff over and above the maintaining of the status quo.

Also a number of sites are likely to discharge directly to adjacent local watercourses and again these have potential to increase downstream flood risk, should attenuation of runoff not be implemented. Table 10-2 and Table 10-3 provide an initial screening overview of the potential risk of increased runoff from the proposed development sites across North Tyneside.

TABLE 10-2 : FLOOD RISK TO AND FROM PROPOSED RESIDENTIAL DEVELOPMENT			
Development Area	**Flood Risk**		**Comments**
	to	**from***	
Residential			
Station Road East	✓	✓	Limited potential for flooding. Downstream flooding at Wallsend, therefore attenuation of runoff may provide betterment.
Station Road West	×	✓	No flooding on the site. Downstream flooding at Wallsend, therefore attenuation of runoff may provide betterment.
East Benton Farm	×	✓	No flooding on the site. Downstream flooding at Wallsend, therefore attenuation of runoff may provide betterment.
West Chirton South	✓	✓	Limited potential for flooding at site. Downstream flooding at Percy Main, attenuation of runoff may provide betterment.
Whitehouse Farm	✓	✓	Small area of potential flooding at site. Downstream flooding at Killingworth, attenuation of runoff may provide betterment.
Scaffold Hill	✓	×	Potential flooding on part of site. Unlikely to significantly increase downstream flood risk, attenuation would be prudent.
Annitsford Farm	✓	✓	Limited potential for flooding across site, mostly limited to eastern boundary. Unlikely to significantly increase downstream flood risk, however attenuation of runoff would be prudent as discharge to Sandy's Letch is likely.
Shiremoor West (South)	✓	✓	Limited potential for flooding across site. Runoff likely to drain to Brierdene Burn which may increase flood risk at Backworth therefore attenuation of runoff may provide betterment.
Shiremoor West (North)	×	✓	Little potential for flooding across site. Runoff likely to drain to Brierdene Burn which may increase flood risk at Backworth therefore attenuation of runoff may provide betterment.
Wellfield	×	×	Small area of potential flooding at site associated with watercourses passing through site. No downstream receptors.
Wallsend AAP	✓	✓	Areas of notable flooding across AAP and potential to provide betterment though attenuation of runoff. Careful consideration should be given to both as development plans for the AAP emerge.
North Shields AAP	×	×	Limited potential for flooding across site and few downstream receptors.
Coast AAP	×	×	There are limited areas of flooding across AAP. There is also potential to provide betterment though attenuation of runoff, should this be required. However through careful consideration of both through the development of plans as the AAP emerges, neither are likely to be a major constraint.

TABLE 10-3 : FLOOD RISK TO AND FROM PROPOSED EMPLOYMENT DEVELOPMENT			
Development Area	**Flood Risk**		**Comments**
	to	**from***	
Employment			
Tyne Tunnel Trading Estate	✗	✗	Little potential for flooding across site. No downstream receptors.
West Chirton Industrial Estate	✓	✓	Limited potential for flooding across site. Downstream flooding at Percy Main, therefore attenuation of runoff may provide betterment.
Balliol Business Park East	✓	✓	Areas of potential flooding to site. Potential for increased runoff post-development, therefore attenuation of runoff may provide betterment.
North Bank Area	✗	✗	Little potential for flooding across site and no apparent downstream receptors.
Esso	✓	✗	Limited potential for flooding across site and no apparent downstream receptors.
Gosforth Business Park	✓	✓	Areas of potential flooding to site. Potential for increased runoff post-development, therefore attenuation of runoff may provide betterment.
Weetslade	✓	✓	Limited potential for flooding across site due to topography. Runoff likely to drain towards Seaton Burn which may increase flood risk at Dudley, therefore attenuation of runoff may provide betterment.
Proctor and Gamble	✗	✗	Little potential for flooding across site and no apparent downstream receptors.

** where attenuation is not implicitly recommended above, due to a lack of apparent downstream receptors it is still good practice to ensure that as a minimum there is no increase in runoff as a direct result of the development.*

10.4.3 *Additional Considerations*

For all of the above development areas it is also essential that the impact of future development on existing infrastructure, including the drainage systems, is assessed as part of the planning process (on a development by development basis) and that this is adequately managed by NTC in consultation with NWL and the EA where applicable. An initial assessment of constraints has been undertaken as part of the North Tyneside WCS, which has been undertaken in parallel with the SWMP.

As more detailed development plans come forward, then a more in-depth assessment of constraints may be required.

10.5 Communicate Risk

10.5.1 *Professional Stakeholders*

There are various professional stakeholders interested in increasing their knowledge of risks from surface water flooding. It is important that the North Tyneside Flooding Task and Finish Group actively engages with these groups, where appropriate, to share the findings of this report. This will ensure that emerging plans and policies are informed by the most up-to-date available understanding of surface water flood risk issues.

It is recommended that NTC consider making the intermediate pluvial modelling mapped outputs available on their website for professional stakeholders and members of the public to access and view.

10.5.2 *Local Resilience Forums*

In line with the SWMP Technical Guidance it is strongly recommended that the information provided in the SWMP are issued to LRFs. Surface water flood maps and knowledge of historic flood events should be used to continuously update Incident Management Plans and Community Risk Registers for the area. In addition, maps showing the depth of pluvial flooding during a range of return period rainfall events can be used to inform operations undertaken by emergency response teams especially near public buildings and major routes throughout North Tyneside.

10.5.3 *Communication and Engagement Plan*

It is recommended that a Communication and Engagement Plan should be produced for North Tyneside to effectively communicate and raise awareness of surface water flood risk to different audiences using a clearly defined process for internal and external communication with stakeholders and the public.

Local Government Group guidance highlights the following issues when considering preparation of a Communication Plan:

- Ensuring communities have enough information to increase their own resilience,
- Addressing past floods and managing future risks, thus adapting to climate change,
- Optimising existing communication activities being delivered by partners; potential for joint working,

- Making sure that all audiences have a clear understanding of the key messages, how to access the right information, and how communities can take the necessary precautions before, during and after flood events.

In light of these recommendations, the Communication Plan should:

- Develop clear key messages from the SWMP (and PFRA) relating to local surface water flood risk and management,
- Create simplified maps and meaningful data for communications materials,
- Clearly define a structure for multi-agency partnership working (based on the Flooding Task and Finish Group),
- Provide a strategy for communicating the SWMP findings to political stakeholders, LRF members, Regional Flood and Coastal Committee (RFCC) members and the general public, and engaging these parties in future local flood risk management actions.

Recommendation 1: Actively engage with professional stakeholders to communicate findings of SWMP and local flood risk management.

Recommendation 2: Issue the SWMP to LRFs and use the SWMP to inform emergency response operations and update Incident Management Plans and Community Risk Registers.

Recommendation 3: Design and gain buy-in to a Communication and Engagement Plan to identify how to effectively communicate and raise awareness of local flood risk to different audiences.