

Minerals and Waste Joint Plan



Sustainability Appraisal

Strategic Flood Risk Assessment

Volume I - Data Review Document

June 2018

Strategic Flood Risk Assessment (Level 1)

Volume 1: Mineral, Waste and Flood Risk: A Data Review Document

To support the Joint Minerals and Waste Plan produced by North Yorkshire County Council, City of York Council and the North York Moors National Park Authority.

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Data Restrictions

In accordance with Environment Agency data license Z31600 readers should note that the Information or other data derived from the Information that the mapping is not to be used at an individual property level.

1. Introduction

Flooding is a regular occurrence in the United Kingdom and across North Yorkshire and the City of York. There are regular media reports of disruption to travel, damage to infrastructure and even danger to life as a result of flooding. Many of us will, if we haven't at some point been affected by flooding ourselves, know an individual or a business that has been affected by a flood.

The causes of flooding are often debated. Climate change is predicted to make flooding more likely as rainfall may become more intense and sea levels are expected to rise at an increasing rate. However, it is clear that flooding is already a problem, and while climate change may already be having an influence, factors such as the increased area of impermeable land, such as that found in urban areas, is also a contributing factor.

Minerals and waste development is not immune from the risk of flooding and the National Planning Policy Framework (NPPF) requires that a 'sequential' approach to avoiding flood risk should be taken. That same document asserts that a Strategic Flood Risk Assessment (SFRA) must be undertaken.

North Yorkshire County Council, City of York Council and the North York Moors National Park are working together to produce a Minerals and Waste Joint Plan. Planning policy in the National Planning Policy Framework dictates that this Plan must take account of flood risk:

"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere."

In addition:

"Local Plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change, by:

- *applying the Sequential Test;*
- *if necessary, applying the Exception Test;*
- *safeguarding land from development that is required for current and future flood management;*
- *using opportunities offered by new development to reduce the causes and impacts of flooding; and*
- *where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to facilitate the relocation of development, including housing, to more sustainable locations."*

The NPPF advises that a SFRA will provide the basis for applying the Sequential Test.

2. The Strategic Flood Risk Assessments across the Joint Minerals and Waste Plan Area

2.1 What is an SFRA?

A SFRA is an assessment of the risk posed by flooding from a range of sources to a range of locations in a defined geographical area. The Government has published guidance on SFRA on the Planning Practice Guidance website that accompanies the National Planning Policy Framework. Within that document a definition is offered which states:

“A Strategic Flood Risk Assessment is a study carried out by one or more local planning authorities to assess the risk to an area from flooding from all sources, now and in the future, taking account of the impacts of climate change, and to assess the impact that changes or development in the area will have on flood risk”¹.

A central function of SFRA is to determine where flood risk is and what the associated level of that risk is. The SFRA is then used to inform the Sequential Test and a sequential approach to the allocation of development. The Sequential Test and sequential approach seeks to direct development to those areas at least risk of flooding and is explained in detail in chapter 6 of this report. However, wherever the local planning authority are unable to allocate all proposed development and infrastructure in accordance with the Sequential Test (taking into account the flood risk vulnerability of the intended land use), the scope of the SFRA will need to be increased to provide the necessary information in order to apply the Exception Test².

This means that a SFRA should be undertaken over two distinct levels. The first level should provide the information necessary to apply the Sequential Approach taking into account climate change, the impact of development on flood risk and measures to manage those impacts; the second level should provide the information necessary to apply the Exception Test.

This Document forms Level 1 of the SFRA process.

However, the Environment Agency (EA) has advised us that there are already a number of SFRAs at a district / unitary authority level across the Joint Plan Area. This requires an approach that will make the best use of existing work, but supplementing it with new work to ensure that the evidence that supports the Joint Plan is up to date with contemporary planning policy and the latest available flood risk data.

This SFRA does not replace any existing SFRAs, it seeks only to inform site submissions to the Minerals and Waste Joint Plan. It does not apply to other forms of development and for minerals and waste development should only be considered for plan making purposes.

¹ Department for Communities and Local Government. Planning Practice Guidance: Flood Risk and Coastal Change [URL: <http://planningguidance.communities.gov.uk/blog/guidance/flood-risk-and-coastal-change/strategic-flood-risk-assessment/>]

² See chapter 3 for an explanation of the exception test.

It should be noted that the district / unitary authority level SFRA's will be superseded when any new versions of these documents are published.

2.2 Aligning the Joint Plan SFRA with the Environment Agency's Preferred Approach

Prior to the switch from County Minerals and Waste Core Strategies to a Joint Plan North Yorkshire County Council had undertaken various stages of work on SFRA. This largely focussed on assembling evidence for SFRA via two volumes: a Technical Volume that included the methodology for the assessment and a compendium of data sources; and a 'Decision Support Volume' that gave guidance on undertaking the sequential test and implementing flood management measures at future development sites. As the Joint Plan developed a certain amount of updating work had been undertaken, though the intention was to move to a further stage of undertaking 'sequential tests' of sites and presenting a volume of maps.

The Environment Agency made several key suggestions during a meeting held in summer 2014. These are summarised as follows:

- Comments were raised about a new SFRA covering the whole Joint Plan as it would introduce multiple sources of data which may be confusing or contradictory and would be inefficient as it may duplicate work already done. The Agency felt that as minerals and waste sites are not particularly sensitive to flooding the existing district tier SFRA's should be used as the starting point, and that the current SFRA should address gaps;
- The EA agreed that a key opportunity for the SFRA is that sites can be restored for flood alleviation and biodiversity;
- The EA drew attention to a recent examination into the Doncaster Site Allocation DPD. The inspector was critical of the way that submitted sites had been sequentially tested and suggested that flood risk should be given greater weight. In line with paragraph 100 and 102 of the NPPF the Inspector suggested that all allocations which must be subject to the Exception Test should be accompanied by a site specific FRA.

Following this meeting a review was undertaken of some of the key differences between local level SFRA's compared to some of the key requirements of NPPF compliant SFRA.

This showed that there is already a great deal of valuable information in existing SFRA's, though as Government guidance and data continue to change there are several areas where further information could support existing SFRA's. Areas with the most divergence from current guidance are:

- Consideration of climate change – most extant SFRA's include some consideration of this but data has evolved since the publication of some earlier SFRA work;
- Consideration of non-fluvial flood information – no assessments make use of the updated flood map for surface water, and most rely on historical records;
- Descriptions of the sequential test – most SFRA's consider fluvial flooding though consideration of other forms of flooding is variable;
- Applicability of Sustainable Drainage Systems (SuDS) – some assessments vary in their approach to this.

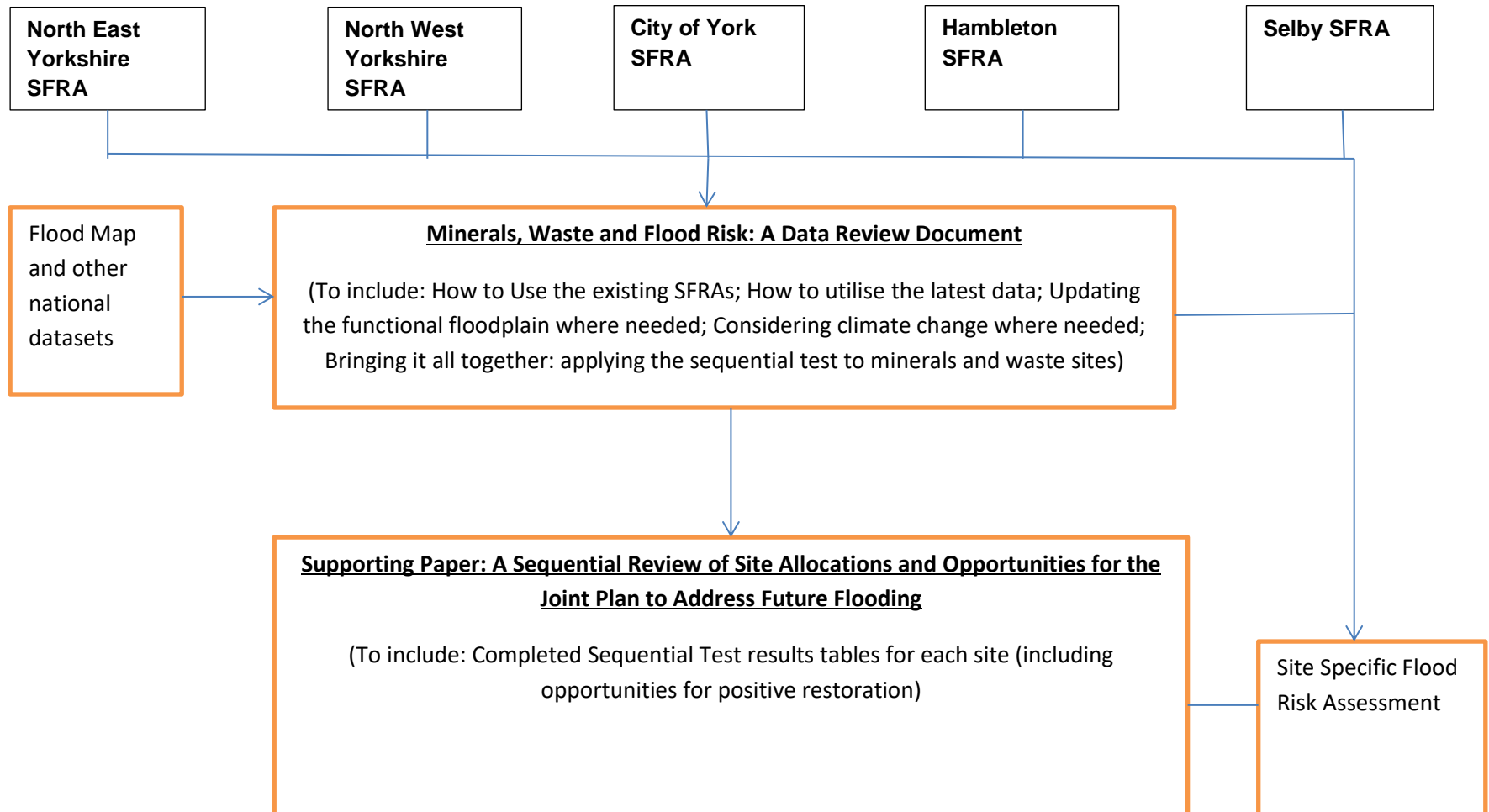
Any divergence from current guidance on SFRA is inevitable, given that many SFRAs pre-date the NPPF and the latest EA mapping.

While there is some variation in approach, there are areas of similarity too, particularly in the consideration of assets such as flood management measures, and in the approach to functional floodplain amongst the more contemporary SFRAs.

2.2.1 Aligning the SFRA Approach with Environment Agency Suggestions

Having considered the differences and similarities between local level SFRAs a proposed structure for a Joint Plan SFRA was set out that maximises the use of existing SFRAs whilst ensuring consistency with current guidance. This is illustrated in Figure 1 below.

Figure 1: The Structure of this SFRA



This new structure for the SFRA attempts to bring together the results of existing local SFRA's with the work that has already been undertaken in North Yorkshire to create an NPPF compliant SFRA. This should ensure that the minimal necessary work is undertaken to create a level platform for arriving at sequential test results for minerals and waste sites. As such, it dispenses with the previous notion of a decision support document and mapping document, but retains elements of the technical document, thought only in as much as is relevant to 'adding value' to existing SFRA's by enabling the utilisation of up to date data and, where necessary, providing a methodological bridge between some of the older SFRA's and the latest thinking on issues such as mapping climate change.

This new structure also includes a supporting paper where sites are mapped and the results of sequential testing can be explained. This volume will recognise that minerals development in particular has the potential to play a unique role in the management of flooding. This will include consideration of flood storage and SuDS (considered in a way aligned with the County Council's and York's role as SuDS Approval Bodies).

2.3 Review of Existing SFRA's

As stated above, this SFRA covers the Minerals and Waste Joint Plan area. Due to the administrative structure of North Yorkshire, this County Matters plan encompasses the plan areas of District level Local Planning Authorities. These Local Planning Authorities, to support their Local Development Frameworks, have in some cases individually, and in other cases as groups, produced their own SFRA's to inform District level planning (including employment and housing sites). Similarly the City of York has its own SFRA, and the North York Moors National Park is covered by district / local authority level SFRA's covering its area.

In this review we have only considered SFRA's that are relevant to the site submissions to the Minerals and Waste Joint Plan.

The following sections are correct at the time of writing this SFRA, however, we understand that Craven, Harrogate and Hambleton have recently commissioned new SFRA work to inform their Local Plans. As this SFRA is informed by the District SFRA's we will further review this SFRA and evidence data when the District SFRA's are updated.

2.3.1 North West Yorkshire Strategic Flood Risk Assessment

This SFRA was produced in 2010 by JBA Consulting. The SFRA comprises a User Guide, a Technical Report and a series of supporting maps. The study covers 'the local authority areas of Craven District Council, Harrogate Borough Council, and Richmondshire Council' though the study states that the 'Yorkshire Dales National Park is not part of this assessment although actions taken in the National Park have the potential to influence flood risk downstream and we have considered these where appropriate'. The SFRA goes on to describe the main urban centres, including 'Skipton, Harrogate, Knaresborough, Ripon, Richmond and a number of villages' stating that 'the SFRA concentrates on future development within the districts, which will generally occur around these urban centres'.

In addition to mapping Flood Zones 2 and 3a, the study maps the functional floodplain (Flood Zone 3b) using flood outlines for the 1:25 (4%) or greater chance of happening each year provided by the Environment Agency (excluding developed and defended areas). In addition an extension to the functional floodplain is suggested (Candidate Flood Zone 3b). Other sources of flooding are considered and river modelling studies, historical data and LIDAR data add resolution to the assessment. The EAs comment in general is that: *“Where available, the 1:20 (5%) modelled level should be used to delineate functional floodplain. The 1:25 (4%) modelled level is used to infer the location of functional floodplain when the 1:20 (5%) modelled level is not available. A further site specific flood risk assessment will then be required if a site affected by the 1:25 (4%) modelled level is to be brought forward to determine the actual level of risk.”*

The SFRA includes strategic maps of selected areas for the following types of flood risk:

- PPS25 Flood Zones;
- 1 in 100 (1%) event flood depths;
- 1 in 100 (1%) event flood hazards;
- Climate change sensitivity;
- Flood risk management;
- Refined surface water flooding;
- Historical Flooding.

The North West Yorkshire SFRA also proposes seven Critical Drainage Areas, where runoff associated with new development might increase flood risk from surface water drainage and / or sewer capacity.

The SFRA is available from the following sources:
harrogate.gov.uk/sfra/

cravencd.gov.uk/CHttpHandler.ashx?id=915&p=0

harrogate.gov.uk/sfra/reports/2009s0266%20NW%20Yorkshire%20SFRA%20Volume%202%20Technical%20Report%20FINAL.pdf

2.3.2 North East Yorkshire Strategic Flood Risk Assessment

The North East Yorkshire SFRA was commissioned by Ryedale District Council, Scarborough Borough Council and the North York Moors National Park Authority and undertaken by Arup. It was published in March 2006 and updated in February 2010.

The study area covers the whole of the local authority areas of Ryedale and Scarborough including the North York Moors National Park.

The study delineates Flood Zones 2, 3a, and 3b (the functional floodplain) and goes further by defining 3 sub zones to Flood Zone 3a (3a(i), 3a(ii) and 3a(iii)). In addition to flooding from rivers and the sea, groundwater flooding, surface water flooding, sewer flooding, drainage incidents and flooding from reservoirs are considered. Consideration of climate change is based on topographical data to discern the relative sensitivity of settlements to increased water levels arising from climate change.

The study goes into greater detail in certain locations where there is significant development pressure (Malton and Norton, Pickering and Whitby). In particular flood depth mapping has taken place using a Digital Elevation Map based on LIDAR remote sensing data. Rapid Inundation Zones are also defined by assigning a hazard rating to areas behind flood defences where overtopping could occur.

The SFRA also defines Critical Drainage Areas, including areas that drain behind defences and former 'critical ordinary watercourses' within these Areas. It should be noted that the Critical Drainage Areas cited in the North East Yorkshire SFRA are not formally Critical Drainage Areas for the purposes set out in the NPPF or the Development Management Procedure Order.

The SFRA (2010 update) is available from the following source:
ryedaleplan.org.uk/other-documents/evidence-base/122-north-east-yorkshire-strategic-flood-risk-assessment-2006

2.3.3 Hambleton Strategic Flood Risk Assessment

Hambleton SFRA was published in 2006. Flood Zones 2 and 3 are mapped on maps generated for individual settlements. Town and village maps / descriptions consider historical flood risk as well as flooding from rivers, overflowing of drainage infrastructure, surface water flooding and areas of potential high water table.

2.3.4 Selby Strategic Flood Risk Assessment

Selby District Council commissioned Scott Wilson Consultancy to carry out a Level 1 Strategic Flood Risk Assessment, the updated version of which was published in 2008. The study area of the report is the administrative boundary of Selby District Council. The study maps Flood Zones 1, 2, 3a and 3b, as well as historical flooding incidents, storm water sewer flooding, flood defences, flood warning areas, and reservoir flooding.

Flood Zone 3b is defined as Flood Zone 3 when it is undefended and outside of development limits. Flood Zone 2 is used as a surrogate to represent the potential impact of climate change. Selby District Council are currently updating their SFRA. In particular, the EA would urge caution about the use of their existing functional floodplain definition which is very precautionary and arguably not representative of where water has to flow or be stored in times of flooding.

Selby District Council has also commissioned a level 2 SFRA.

Both the Level 1 and Level 2 SFRA are available at:
selby.gov.uk/strategic-flood-risk-assessment

2.3.5 North Yorkshire Preliminary Flood Risk Assessment

In response to the Flood Risk Regulations 2009 North Yorkshire County Council, as Lead Local Flood Authority, submitted a Preliminary Flood Risk Assessment to the Environment Agency in 2011. The report was written by the consultancy Jacobs.

The Flood Risk Regulations implement the European Floods Directive which requires the completion of a four stage process (undertaken on a six yearly cycle) that comprises the following:

- Preliminary Flood Risk Assessment and reporting;
- Identify Flood Risk Areas;
- Prepare Flood hazard and Flood Risk Maps
- Prepare Flood Risk Management Plans

As the LLFA North Yorkshire County Council is required to implement the regulations in relation to local (ordinary watercourses) flood risk. The preliminary Flood Risk Assessment represents the first step in the process, representing a high level screening exercise that involves collecting information on historic and future floods.

Of most relevance to this SFRA, two objectives of the PFRA are to:

- Assess historic flood events within the study area from local sources of flooding (including flooding from surface water, groundwater and ordinary watercourses), and, where possible, the consequences and impacts of these events; and
- Establish an evidence base of historic flood risk information, which will be built upon in the future and used to support and inform the preparation of NYCC's Local Flood Risk Strategy.

The PFRA is available from:

northyorks.gov.uk/

[n3cabinet_scrutransporteconomreports/20110608/06preliminaryfl/06preliminaryfl.pdf](http://northyorks.gov.uk/n3cabinet_scrutransporteconomreports/20110608/06preliminaryfl/06preliminaryfl.pdf)

2.3.6 City of York Strategic Flood Risk Assessment

Produced in March 2013 (Revision 2) this SFRA was produced in response to the NPPF and associated Technical Guidance. It provides an overview of flood risk issues in the York area, maps of flood risk zones (including Flood Zone 3b) and a summary of the sequential and exception tests in the York context. It also identified Rapid Inundation Zones (RIZs), defined as follows:

“Where detailed flood levels and topographic data were available, depth of flooding likely from the 1 in 100 (1%) event has been shown. This provides an indication of the flood risk within Zone 3, and allows for the calculation of rapid inundation zones where the combination of depth and velocity could lead to a potential loss of life”.

Historical records and flood defences have also been reviewed. Climate change is considered and highlighted as a consideration for FRAs for all development sites in Flood Zone 2, 3a and 3b and as a part of considering surface water drainage.

The SFRA is available from

york.gov.uk/downloads/download/2369/strategic_flood_risk_assessment_documents

Table 1 summarised the variability between SFRA's as well as their common elements.

Table 1: Review of local level SFRA

SFRA component ³	North East Yorkshire SFRA	North West Yorkshire SFRA	City of York SFRA	Hambleton SFRA / SFRA Supplement	Selby SFRA
Year produced / policy framework.	2006 / PPG25 // 2010 / PPS25	2010 / PPS25	2011/NPPF	2006 / PPG25. 2009 update reviewed some key settlements in relation to a newer iteration of the flood map.	2008 / PPS25
Maps showing main rivers, ordinary watercourses and flood zones including functional floodplain if appropriate.	Yes – subdivide floodplain into 3a (i/ii/iii) / 3b / 3c (functional floodplain) / Rapid Inundation Zones.	Yes – Flood Zones 3 and 3b defined. In the north west Yorkshire SFRA Flood zones 3b is defined as undeveloped areas in Flood Zone 3.	Yes – 2, 3, 3b (functional floodplain) / Rapid Inundation Zones	Flood Zones 2 and 3. Flood Zone 3 is defined as being made up of 3 types of land, including functional floodplain and undeveloped areas.	Yes – for functional floodplain use an approach where Flood Zone 3 outside of urban areas is represented as Flood Zone 3b.
An assessment of the implications of climate change for flood risk ⁴ .	Analysis done for settlements using local topography.	Uses river modelling studies with a +20% adjustment for climate change from rivers. Climate change also considered for 1 in 200 (0.5%) surface water risk.	Described and advised for FRA (river and surface).	Not considered.	Consider only for rivers and use flood Zone 2 as a surrogate for flood zone 3 under climate change.

³ As suggested in the Government’s Planning Practice Guidance and linked Environment Agency document ‘Strategic Flood Risk Assessments: Guidance to Support the National Planning Policy Framework’.

⁴ Consistent with the Environment Agency document ‘Climate Change Allowance for Planners: Guidance to Support the National Planning Policy Framework’.

Areas at risk of other sources of flooding, such as surface water or reservoirs.	Yes, but do not use contemporary definitions (areas susceptible to surface water flooding, groundwater flooding, sewer flooding).	Sophisticated approach. Consider both surface water and sewer flooding by using bespoke JFLOW modelling.	Groundwater and overland flow recommended for FRA.	Flooding on ordinary watercourses / sewers noted based on historical data. Useful consideration of high water tables for groundwater flood risk.	Rely on historic flooding and sewer flooding records, though FRAs are required to investigate flooding from different sources.
Flood risk management measures, including location and standard of infrastructure and the coverage of flood warning systems.	Yes for flood management measures (relatively detailed assessment of coverage).	Draw from National Flood and Coastal Defence Database and EA mapping on areas benefitting from flood defences.	Flood defences (including standard of protection) and flood warning systems documented. Also contains guidance on flood risk management measures.	Defences noted and standard of protection described.	Data on flood defences gathered. Areas benefitting from flood defences mapped. Flood warning areas mapped.
Locations where additional development may significantly increase flood risk elsewhere.	Yes – define drainage sensitive areas.	Critical drainage areas perform this role.	Yes – contains a review of specific sites which have certain flooding issues, including where they may increase flood risk.	Yes – some locations are described.	No
Recommendations about the identification of critical drainage areas / surface water management plans.	Yes – lists Critical Ordinary Watercourses.	Consider national critical drainage areas and propose new critical drainage areas.	No, but may not be relevant.	No, but may not be relevant.	No, but may not be relevant.
Guidance on the preparation of flood risk assessments.	Yes	Yes – detailed approach laid out in volume 1.	Yes	SFRA as a whole could be used as an information source.	Yes
Advice on the applicability of SuDS.	SuDS referred to but specific guidance not available.	Yes chapter based on CIRIA guidance.	Yes, as part of a chapter on general surface water guidance.	No	Yes

Explanation of sequential test for all forms of flooding.	Yes – include flow charts for both rivers and other sources of flooding.	Clear application of sequential test for rivers.	Sequential test set out for fluvial flooding.	Sequential test set out for fluvial flooding.	Sequential test for rivers clearly laid out.
Rural coverage ⁵ .	Chapter on rural land management –some other flood risks are reported for whole area.	Yes	Some maps (flood zones / defences) show all parts of York.	Published maps and records relate to settlements rather than open countryside, though there is a considerable buffer where flooding is mapped around each settlement.	Yes – provide district wide maps.

⁵ A key requirement with SFRAs in the Joint Plan Area will be their applicability to the areas where sites may be developed.

3. Flood Risk Data Sources: Datasets that can supplement the Local SFRA

3.1 Sources of Flooding

Flooding can occur for a variety of reasons and from several sources. Table 2 summarises the possible sources of flooding in the Joint Plan Area and some key reasons why they might contribute to flooding.

Table 2: Sources of Flooding

Flooding Type	Key Causes
Flooding from Rivers and Ordinary watercourses	Flooding of rivers is usually caused by prolonged intense rainfall, often intensified by changes in the drainage regime or restrictions in a watercourse's capacity to flood adjacent land further up the catchment. Soil permeability and other factors such as the extent to which surfaces over which runoff can flow are paved, compacted or covered by trees and vegetation ⁶ also affects the rate at which water enters rivers.
Flooding from surface water and sewers	Flooding from surface water and sewers occurs when the drainage system cannot cope with rainfall. Flooding may occur as water flows downhill and gathers in depressions in the land, or when the drainage system is near to capacity water can be forced back up surface water sewers or combined sewer overflows.
Flooding from High Groundwater Levels	According to the British Geological Survey <i>'Groundwater flooding occurs as a result of water rising up from the underlying rocks or from water flowing from dormant springs. This tends to occur after long periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels'</i> ⁷ <i>'Groundwater rebound'</i> may also occur, which is where a phenomena such as built development causes groundwater abstraction to cease, which is followed by a rise in groundwater levels. A similar process can happen in disused mines and is called <i>'minewater rebound'</i> .

⁶ The Woodland Trust highlight research by the University of Manchester on the relative run off rates for land with different surfaces, including tree covering: *"The University's experiment involved creating nine test areas, each with three separate plots. These contained one plot containing a tree surrounded by asphalt, another with just asphalt and a third with just grass. Surface runoff was directed towards a drain and measured using a tipping bucket gauge to measure both the total amount and rate of water runoff. This suggests that the plots with trees helped reduce runoff by as much as 80% compared with the asphalt surface."* See: Woodland Trust, undated. New Research Suggests Trees can Protect Businesses from Flooding [URL: woodlandtrust.org.uk/en/news-media/corporate/Pages/floods-and-business.aspx] (accessed on 17 July, 2012).

⁷ British Geological Survey. 2010. Science Briefing 2010: Groundwater Flooding. [URL: bgs.ac.uk/research/groundwater/flooding/groundwaterHomesFAQ.html] (accessed on 17 July,

Flooding Type	Key Causes
Flooding from reservoirs and artificial sources	There are several non-natural sources of flood risk including flooding from canals, reservoirs and man-made lakes. These sources of flooding can occur when the facility is overwhelmed by high rainfall or when a dam or bank fails. Flooding from such sources can happen suddenly and can cause significant damage and danger to life.

3.2 Evolving Data

Flood risk data is evolving rapidly as methodologies improve for more accurately predicting flood risk and the effect of climate change. It is important that the sequential testing of minerals and waste developments is consistent both with local level work that has been carried out through local level SFRAs and the latest available data. This chapter summarise the key data sources that have been utilised which are additional to local level SFRA data.

3.3 The Environment Agency Flood Map and Fluvial Flooding

The Flood Map for Planning is produced and regularly updated by the EA. It combines detailed local data with information from a national model of England and Wales. The Flood Map for Planning shows the following:

“Flooding from rivers or sea without defences - the natural floodplain area that could be affected in the event of flooding from rivers and the sea

For flooding from rivers the map indicates the extent of a flood with a 1% (1 in 100) or greater chance of happening each year

For flooding from the sea the map shows the extent of a flood with a 0.5% (1 in 200) or greater chance of happening each year

Extent of extreme flood - the extent of a flood with a 0.1% (1 in 1000) or greater chance of happening each year

Flood defences - flood defences such as embankments and walls, and flood storage areas (which are areas of land designed and operated to store flood water)

Areas benefiting from flood defences - where possible we show the areas that benefit from the flood defences shown, in the event of a river flood with a 1% (1 in 100) chance of happening each year, or a flood from the sea with a 0.5% (1 in 200) chance of happening each year. If the defences were not there, these areas would flood. Note that we do not show all areas that benefit from flood defences”⁸

Main rivers - these are usually larger streams and rivers. Our powers to carry out flood defence works apply to main rivers only. In England, Defra decides which are the main rivers. The Welsh Assembly Government does this in Wales.

The Flood Map for Planning does not provide information on flood depth, speed or volume of flow. It doesn't show flooding from other sources, such as groundwater, direct runoff from fields, or overflowing sewers”.

⁸ Environment Agency, 2016, Flood Map for Planning apps.environment-agency.gov.uk/wiyby/37837.aspx

AS THE FLOOD MAP IS THE LATEST AVAILABLE SOURCE OF FLOOD DATA ACROSS THE PLAN AREA IT WILL ALWAYS BE USED AS THE STARTING POINT FOR UNDERTAKING THE SEQUENTIAL TEST.

We have supplemented data from the Flood Map in this SFRA with additional data, where it is available, to give a more accurate picture of flooding, and to allow us to further identify initial functional floodplain and climate change where they aren't already found in local level SFRAs.

Table 3 outlines the data sources used in this review.

Table 3: Data Sources used in the Review of Flooding from Rivers

Data	Format	Source
Flood Zone 2	MapInfo file	Environment Agency
Flood Zone 3	MapInfo file	Environment Agency
River Centrelines	MapInfo file	Environment Agency
River Network (detailed)	MapInfo file	Environment Agency
National Flood and Coastal Defence Database - Defences	MapInfo file	Environment Agency
Flood Storage Areas	MapInfo file	Environment Agency
Detailed Flood Modelling (Modelled Flood Outlines) for locations where available.	MapInfo files	Environment Agency
CFMP JFLOW Modelled Flood Outlines where available (Ouse, Esk and Derwent)	MapInfo files	Environment Agency
Environment Agency Historic Flood Map	Shape File	Environment Agency
District Council Flooding records	MapInfo file	North Yorkshire County Council LFRMS
North Yorkshire County Council Highway Local Flooding – by area (checked for fluvial flooding)	MapInfo file	North Yorkshire County Council LFRMS
North Yorkshire Fire and Rescue (only where flood cause is clearly fluvial)	MapInfo file	North Yorkshire County Council LFRMS
NYCC Flooding Incidents Recorded (only where flood cause is clearly fluvial)	MapInfo file	North Yorkshire County Council LFRMS
North Yorkshire Preliminary Flood Risk Assessment Locally Significant Flooding Issues and Potential Schemes (checked for coincidence of rivers and single / multiple flood events)	MapInfo file	North Yorkshire County Council LFRMS

3.4 Surface Water and Sewer Flooding

Until recently the EA produced maps of 'areas susceptible to surface water flooding' and a separate 'flood map for surface water' which looked at the areas that may become flooded by surface water during an extreme rainfall event. However, in December 2013, a new Updated Flood Map for Surface Water was launched. This new map shows areas at risk of flooding from surface water. The Updated Flood Map for Surface Water (UFMSW):

"Used a sophisticated computer model to simulate rain falling on the ground to see where rain water flows and ponds, based on a ground model of 2m squares. The ground height was raised to represent buildings (typically by 0.3m), flow paths were better represented through structures such as bridges and rail embankments, and roads were lowered (by 0.125m) so flood flow paths are better represented. Ground roughness was varied to take account different land use.

*Total rainfall depths were calculated on 5km squares: using rainfall with a 1 in 30, 1 in 100 and 1 in 1000 chance of occurring in each year and three different storm durations (1, 3 and 6 hours). These were adjusted to take into account infiltration (to represent the difference between urban and rural areas) and drainage (assuming a constant rate of flow is removed in all urban areas) Very shallow flooding and very small areas of flooding were removed. The results were validated using historical observations and local modelling data in three pilot areas."*⁹

The UFMSW assigns new risk categories to surface water flooding. These are:

High – the chance of flooding in each year is greater than 3.3% (1 in 30)

Medium – the chance of flooding in each year is 3.3% (1 in 30) or less but greater than 1% (1 in 100)

Low – the chance of flooding in each year is 1% (1 in 100) or less but greater than 0.1% (1 in 1000)

Very low – the chance of flooding each year is 0.1% (1 in 1000) or less

In our assessment data was provided to us at 3 levels: 1 in 30 (3.3%) risk, 1 in 100 (1%) risk and 1 in 1000 (0.1%) risk. This would represent the outer boundary of each of the first 3 categories listed above, i.e. 'high', 'medium' and 'low'.

As rivers tend to follow valley lines, which represent the low points in a landscape, surface water flooding also often occurs near these features. In addition, surface water flooding will often occur next to other water bodies, such as reservoirs and along ordinary watercourses. However, areas of surface water flooding may also occur in the wider landscape.

Table 4 shows the data sets that have been used to determine flood risk from surface water (where it is not already covered in a contemporary fashion in local level SFRAs).

⁹ Environment Agency, 2013. Risk of Flooding from Surface Water: Updated Flood Map for Surface Water.

Table 4: Surface Water Flooding Data Sources

Data source	Source	Format
Updated Flood Map for Surface Water	Environment Agency	MapInfo file
District Council Flooding records	North Yorkshire County Council LFRMS	MapInfo file
North Yorkshire County Council Highway Local Flooding – by area (checked for surface flooding)	North Yorkshire County Council LFRMS	MapInfo file
North Yorkshire Fire and Rescue (only where flood cause is clearly surface water flooding)	North Yorkshire County Council LFRMS	MapInfo file
NYCC Flooding Incidents Recorded (only where flood cause is clearly surface water flooding)	North Yorkshire County Council LFRMS	MapInfo file
North Yorkshire Preliminary Flood Risk Assessment Locally Significant Flooding Issues and Potential Schemes (checked for surface water flooding)	North Yorkshire County Council PFRA	MapInfo file
Yorkshire water – other flooding DG5 data	North Yorkshire County Council LFRMS	MapInfo file

3.5 Groundwater Flooding

Groundwater flooding is caused by the emergence of water from underground aquifers. It can be caused by a range of factors, including:

- Prolonged periods of rainfall – this cause of groundwater flooding happens mostly in areas underlain by high permeability aquifers where groundwater levels rise and flood overlying land;
- Flooding of the superficial aquifer resulting from high river levels – as river levels become elevated they can flow through the bank into the superficial aquifer which may ultimately flood, particularly if the river bank is higher than the adjacent floodplain;
- Rebound – where abstraction of groundwater ceases, the groundwater level can return to a natural level. This may cause problems if springs start to reform in areas that have since been developed. A similar phenomenon, ‘mine water rebound’ occurs when mines refill with water after pumping / removal of water that previously entered the mine ceases. As water levels build this can cause flooding from previously dry points in the mine network, and may cause pollution episodes in surface water or overlying aquifers.¹⁰

Data sources for groundwater flooding are noted in Table 5, below. We supplement local level SFRA with consideration of this data where needed.

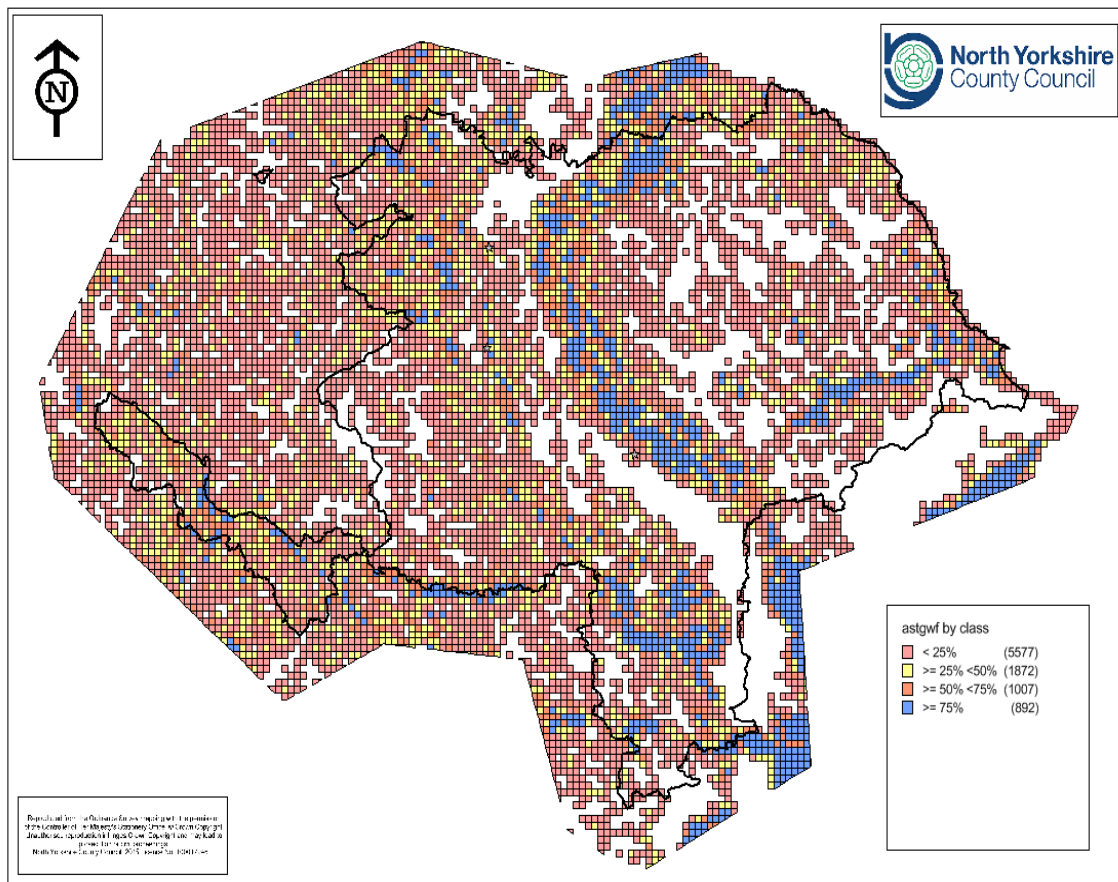
¹⁰ Sunderland City Council, 2010. Strategic Flood Risk Assessment 2010: Volume 1 Guidance

Table 5: Data sources for Groundwater Flooding

Data	Source	Details
Areas susceptible to Groundwater Flooding	Environment Agency	MapInfo
North Yorkshire Preliminary Flood Risk Assessment Locally Significant Flooding Issues and Potential Schemes (checked for groundwater flooding events)	North Yorkshire County Council	MapInfo. According to the PFRA groundwater flooding is known to be a cause of flooding to a small number of properties throughout North Yorkshire in some areas as a result of natural springs in the hillside next to properties, and, because both groundwater and surface water flooding ponds in nearby low lying areas.
District level historic flooding records (checked for possible groundwater flooding)	North Yorkshire Local Flood Risk Management Strategy	MapInfo. Checked for possible groundwater flooding if site falls within an area of high groundwater risk.
North Yorkshire Fire and Rescue (checked for where flood cause is probable groundwater flooding)	North Yorkshire Local Flood Risk Management Strategy	MapInfo. Checked for possible groundwater flooding if site falls within an area of high groundwater risk.
Borehole data	Submitted planning applications	Nearby minerals planning applications checked for all submitted sites as these often give borehole data.

Map 1 shows the Areas Susceptible to Surface Water Flooding. The blue squares represent those with the largest proportion of area where groundwater may emerge.

Map 1: Environment Agency Areas Susceptible to Groundwater Flooding



As can be seen from the map much of the catchment has a relatively low proportion of land area that is susceptible to groundwater flooding, though areas of higher susceptibility do exist in localised bands bordering higher land in the east of the plan area, as well as along the Wharfe as it straddles the county boundary and in the lower Ouse catchment in Selby District.

Sometimes flooding results from the interaction of groundwater with surface water. According to North Yorkshire's Preliminary Flood Risk Assessment:

"There is no substantial evidence of direct groundwater flooding in the majority of North Yorkshire. However, it is known to be a contributing factor in specific circumstances and that it may exacerbate surface water flooding. For example, it is known to be a cause of flooding to a small number of properties in some areas as a result of natural springs in the hillside next to properties, and, that both groundwater and surface water flooding ponds in nearby low lying areas."

The PFRA predicted that there are 138 properties and 123 dwellings at risk of flooding in the whole of the County.

Within the Plan area there are small areas which are prone to clearwater¹¹ flooding and small areas which are prone to flooding because they lie on superficial permeable deposits¹². This data has informed the areas susceptible to groundwater flooding map above. Distinguishing between clearwater and superficial permeable sources of flooding can help inform how flooding may occur. For instance, localised sands and gravels on top of less permeable bedrock, particularly in valley bottoms where a high water table can flow into a depression, or close to a river or stream may indicate that flooding from a superficial permeable source is possible¹³.

Minerals development, where it involves extracting from beneath the surface is particularly vulnerable to groundwater flooding. The depth of minerals sites is often critical, and minerals sites may be affected by ingress of groundwater in areas where surface development would not normally be affected by groundwater flooding.

3.6 Flooding from Reservoirs and Artificial Sources

Reservoirs are very unlikely to flood, and there are no incidents resulting in loss of life since 1925¹⁴. However, during the exceptionally wet summer of 2007 serious structural damage to a dam at Ulley Reservoir, Rotherham was reported nationally. This highlighted the potentially catastrophic risk presented by a damaged reservoir facility. If a dam were to collapse a large volume of water would be released, quickly flooding a large area.

Nationally 14 incidents where emergency drawdown of reservoir waters was required took place between 2004 and 2008¹⁵. The Environment Agency publishes outline maps of where water would flow in a worst case scenario of reservoir failure.

Canals may flood in a similar fashion to reservoirs, for instance by overtopping as facilities become overwhelmed or as a result of bank failure. As with reservoirs, water can be released quickly from canal floods.

Flooding can occur from other sources where water is retained above ground level, such as quarrying and gravel extraction sites. This may increase floodwater depths and velocities in adjacent areas.

Table 6 shows the data sources we have used to consider this sort of flooding (where it is not already covered in a contemporary fashion in local level SFRAs).

¹¹ Clearwater flooding is caused by the water table in an unconfined aquifer rising above the ground surface. It occurs when high groundwater levels combine with high unsaturated zone moisture and heavy rainfall. (Source: British Geological Survey, undated. Groundwater Flooding in an Unconfined Major Aquifer Setting [URL: bgs.ac.uk/research/groundwater/flooding/major.html]

¹² Flooding from superficial permeable deposits is also referred to as flooding in a shallow unconsolidated sedimentary aquifer setting. According to the BGS “These aquifers are susceptible to flooding as the storage capacity is often limited, direct rainfall recharge can be relatively high and the sediment may be very permeable, creating a good hydraulic connection with adjacent river networks”. (Source: Flooding in a Shallow Unconsolidated Sedimentary Aquifer Setting [URL: bgs.ac.uk/research/groundwater/flooding/unconsolidated.html]

¹³ See for example UK Groundwater Forum, undated, My Property may be Affected by Groundwater Flooding, what can I do? [URL: groundwateruk.org/faq_groundwater_flooding.aspx]

¹⁴ Environment Agency, undated. Am I at Risk of Reservoir Flooding? [URL: environment-agency.gov.uk/homeandleisure/floods/124783.aspx]

¹⁵ Gateshead Council, undated. Flooding Reservoirs [URL: gateshead.gov.uk/Council%20and%20Democracy/emergency/Flooding-Reservoirs.aspx]

Table 6: Data Sources used in the Review of Flooding from Artificial Sources

Data	Source	Format
Reservoir Flood Map	Environment Agency	Web based mapping tool. As the risk of reservoir flooding is extremely low we have not referred to this in the sequential testing of sites, though this should be considered in Flood Risk Assessments for all sites in proximity to rivers.
British Waterways Canal breaches and overtopping	North Yorkshire Local Flood Risk Management Strategy	MapInfo
North Yorkshire County Council Highway Local Flooding – by area (checked for artificial source flooding)	North Yorkshire County Council LFRMS	MapInfo file
District Flooding incidents (checked for artificial source flooding)	North Yorkshire County Council LFRMS	MapInfo file
North Yorkshire Fire and Rescue (checked for artificial source flooding)	North Yorkshire County Council LFRMS	MapInfo file

4. Updating the Functional Floodplain

4.1 From a local to a plan-wide approach

The Planning Practice Guidance which accompanies the National Planning Policy Framework gives details of what land should be considered 'functional floodplain'. The functional floodplain (also referred to as Flood Zone 3b) comprises land where water has to flow or be stored in times of flood. According to the Guidance:

*"This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency."*¹⁶

The definition of Flood Zone 3b above explains that local planning authorities should identify areas of functional floodplain in their SFRAs in discussion with the EA and the lead local flood authority. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood with an annual probability of 1 in 20 (5%) or greater in any year, either naturally or as part of a flood storage area, should provide a starting point for consideration and discussions to identify the functional floodplain.

A functional floodplain is a very important planning tool in making space for flood waters when flooding occurs. Generally, development should be directed away from these areas using the EA's catchment flood management plans, shoreline management plans and local flood risk management strategies produced by lead local flood authorities.

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

Across the plan area local level SFRAs take a very varied approach to mapping the functional floodplain. This ranges from simply stating that Flood Zone 3 should be considered as functional floodplain when it lies outside of settlements to use of 1 in 25 (4%) flood risk modelling.

Table 7 summarises the different approaches taken by local level SFRAs.

¹⁶ Department for Community Local Government, 2015.

Table 7: Different approaches to functional floodplain.

SFRA	North East Yorkshire SFRA	North West Yorkshire SFRA	City of York SFRA	Hambleton SFRA / SFRA Supplement	Selby SFRA
Approach to functional floodplain.	Yes – subdivide floodplain into 3a(i/ii/iii) / 3b / 3c (functional floodplain).	Yes – Flood Zones 3 and 3b defined. In the north west Yorkshire SFRA Flood zones 3b is defined as undeveloped areas in Flood Zone 3.	Yes – 2, 3, 3b (functional floodplain).	Flood Zones 2 and 3. Flood zone 3 is defined as being made up of 3 types of land, including functional floodplain.	Yes – for functional floodplain use an approach where Flood Zone 3 outside of urban areas is represented as Flood Zone 3b.

However, the Environment Agency have provided the authors of this SFRA with 1 in 20 (5%) flood risk data which would allow a methodology consistent with current planning practice to be developed.

We have therefore taken the following tiered approach:

1. In areas where functional floodplain has been defined in a local SFRA we have utilised the mapped data or definition in that SFRA to define functional floodplain. The mapped data in some areas takes a very precautionary nature and therefore has been applied with this in mind.
2. In areas where 1 in 20 (5%) flood risk data is available to the authors of this report this is used as the basis for defining the functional floodplain. We have also referred to this as initial functional floodplain in our strategic review of minerals and waste sites. However, a more detailed mapping exercise would be required to fully delineate functional floodplain in such areas to remove small scale features that are not functional, in line with the definition presented in this SFRA.

While 1 in 20 (5%) data can provide the starting point for functional floodplain, further data can be applied to add or remove areas from the functional floodplain to make it more accurate. The definition of functional floodplain and its' allocation only refers to fluvial flooding. However, other sources and forms of flooding also need to be considered, with an appropriate weight applied to them based on the level of risk inferred. Table 8 shows the data that we have collected to help define the functional floodplain.

Table 8: Data used to help define the Functional Floodplain

Data Layer	Source	Shown on map as
Historic Flood Event Outline*	Environment Agency	Historic Flood Outline
Broadscale Modelled Outline (1 in 20 (5%) flood where available)	Environment Agency	1 in 20 (5%) risk
Modelled Outline (1 in 25 (4%) flood where available)	Environment Agency	1 in 25 (4%) risk
Flood storage areas	Environment Agency	Flood Storage Area
Areas Benefiting from Flood Defences	Environment Agency	Areas Benefitting from Defences
Flood defence	NFCDD	Defence
Main River Centreline	Environment Agency	Main River
Road Rail Infrastructure	North Yorkshire County Council	Road / Rail
Historic Flood Record*	NYCC	Historic flooding
Other areas considered to be defended with a suitable standard of protection	Qualitative judgement on NFCDD data	Only shown where relevant / where flood defences are shown

*Historic records of flooding are not necessarily an indication of functional floodplain. However, the frequency of historic flooding should be used to help delineate the functional floodplain.

Submitted minerals and waste sites which contain land that is defined as being functional floodplain should use the methodologies outlined in relevant SFRA to further delineate and confirm the functional floodplain. Where such a definition is not available the following definition should be used:

Functional Floodplain = IF three or more historic flood records¹⁷ occur in one location within Flood Zone 3, OR the area is defined as flood storage OR the area is defined as having a 1 in 20 flood risk AND the areas benefitting from flood defences, other areas considered to be defended with a suitable standard of protection, road and rail infrastructure and built development are removed from that area THEN the remaining area is functional floodplain.

The formula is varied accordingly according to the whether 1 in 20 (first preference), 1 in 25 (second preference), or a Flood Zone 3 proxy (third preference) is used.

While we show key information layers that make up the functional floodplain in our sequential testing of minerals and waste sites in this SFRA, where the Exception Test is needed it may be necessary to consider the need to extend the scope of the SFRA to a Level 2 in accordance with the NPPF.

¹⁷ These must relate to separate flood events which are clearly related to fluvial flooding, and suggest a frequent return period for flooding (i.e. the pattern of flooding would be broadly consistent with a =>1 in 20 return period).

Specific flood risk assessment for sites that are in proximity to functional floodplain should attempt to further delineate the functional floodplain by cleaning up the maps to remove anomalies, such as where functional floodplain apparently lies behind an area benefitting from flood defences, whether those flood defences are 'maintained and functional'¹⁸, and to check inconsistencies, for instance where an area benefitting from flood defences lies in a place where there is no linear or non-linear (e.g. a pumping station) defence. In some cases a defence may be indicated though no area benefitting from the defence is shown or no Standard of Protection for that defence is shown. These functional floodplain areas should be considered further and confirmed as functional floodplain in site specific Flood Risk Assessments.

In some cases the functional floodplain area overlaps existing developed areas. While these are excluded from the definition of Flood Zone 3b, they can be described at a site level as flood zone 3a(i). Flood Zone 3a(i) can be defined as developed land within Flood Zone 3b where water would flow or be stored in times of flooding if not already constrained by development or infrastructure. Identification of 3a(i) allows the council to assess risk within Flood Zone 3a in more detail showing areas where existing development or infrastructure is likely to be restricting flood flows and water storage that would otherwise be within the functional floodplain. Should any potential development sites in Flood Zone 3a(i) become available for new or further development (e.g. brownfield sites) then both the risk at the sites and their role in managing flood risk in the surrounding area should be carefully considered in line with Local Plan policies. Flood Zone 3a(i) includes the areas of land that would be in Flood Zone 3b if not already developed and should therefore be used as an indicator of flood risk, from a modelled 1 in 20 (5%) / 25 (4%) event, to existing developed sites.

In flood zone 3a(i) land (for instance gardens and parks) may still play a functional role in terms of the storage and flow of water. This should be considered during site specific flood risk assessment, which should look at the predicted flow path of water.

¹⁸ Maintained and functional defences are listed within the NFCDD database

5. Considering Climate Change

5.1 Considering Climate Change Effects on Rivers and the Sea

Climate change is expected to increase flood risk by increasing the area of rivers expected to flood due to increased rainfall and rising sea levels. The National Planning Policy Framework states the importance of accounting for climate change when considering flood risk:

“Local Plans should apply a sequential, risk based-approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change, by:

-applying the Sequential Test;

-if necessary, applying the Exception Test;

-Safeguarding land from development that is required for current and future flood management;

-Using opportunities offered by new development to reduce the causes and impacts of flooding; and

-Where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to facilitate the relocation of development, including housing, to more sustainable locations”¹⁹.

Because local level SFRA have been undertaken at different periods of time, under different guidance and different climate change projections, consideration of climate change varies considerably between areas.

Table 9 shows the ways in which district level SFRA consider climate change from rivers.

Table 9: Climate change consideration in existing SFRA

SFRA	North East Yorkshire SFRA	North West Yorkshire SFRA	City of York SFRA	Hambleton SFRA / SFRA Supplement	Selby SFRA
Approach to climate change for rivers and the sea.	Described – qualitative analysis done for settlements using local topography.	Uses river modelling studies with a +20% adjustment for climate change from rivers.	Described and advised for FRA (river and surface).	Not considered	Considered only for rivers and use flood zone 2 as a surrogate for flood zone 3.

¹⁹ Department for Communities and Local Government. 2012. National Planning Policy Framework [URL: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf]

As there is no one prevailing methodology, and an evident need to apply as consistent an approach as possible across the Plan Area we have undertaken a qualitative approach based on assessment of application of EA climate change guidance to Flood Zones 2 (1:1000 (0.1%)) and 3 (1:100 (1%)) and 1:20 (5%) event outlines provided by the EA. The EA guidance (published in February 2016) on climate change for the Plan Area is for the Humber River Basin Management Plan (RBMP) area, in which the Plan Area lies.

Table 10: Environment Agency climate change guidance for the Humber RBMP

River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Humber	Upper end	20%	30%	50%
	Higher central	15%	20%	30%
	Central	10%	15%	20%

The EA have supplied the Joint Plan Authorities with a broad scale modelled outline of the 1 in 20 (5%), 1 in 100 (1%) and 1 in 1000 (0.1%) flood events that have been qualitatively assessed with consideration to the above climate change guidance for up to 2115. The qualitative assessment considered the present day Flood Zone for each site and the potential for that site to change Flood Zone based on climate change and local influences such as topography and proximity to subsequent Flood Zone extents. This data takes into account tidal as well as river flooding (however, coastal flooding is not considered based on advice from the EA due to the fact that sites will predominantly not be placed at coastal locations).

The appropriate allowance for climate change will depend on the vulnerability and predicted lifetime of the development being considered. EA guidance on use of appropriate allowance is provided in Table 11.

Table 11: Environment Agency guidance on use of climate change allowances

<p>In flood zone 2</p> <ul style="list-style-type: none">• essential infrastructure – use the higher central and upper end to assess a range of allowances• highly vulnerable – use the higher central and upper end to assess a range of allowances• more vulnerable – use the central and higher central to assess a range of allowances• less vulnerable – use the central allowance• water compatible – use none of the allowances <p>In flood zone 3a</p> <ul style="list-style-type: none">• essential infrastructure – use the upper end allowance• highly vulnerable – development should not be permitted• more vulnerable – use the higher central and upper end to assess a range of allowances• less vulnerable – use the central and higher central to assess a range of allowances• water compatible – use the central allowance <p>In flood zone 3b</p> <ul style="list-style-type: none">• essential infrastructure – use the upper end allowance• highly vulnerable – development should not be permitted• more vulnerable – development should not be permitted• less vulnerable – development should not be permitted• water compatible – use the central allowance <p>If (exceptionally) development is considered appropriate when not in accordance with flood zone vulnerability categories, then it would be appropriate to use the upper end allowance.</p>

5.2 Climate Change Effects on Surface Water

Local level SFRA's give very limited consideration to the effects of climate change on surface water²⁰. The Planning Practice Guidance to the National Planning Policy Framework states that SFRA should “assess the risk to an area from flooding from all sources, now and in the future, taking account of the impacts of climate change...” The EA ‘climate change allowances for planners’ guidance to support the NPPF²¹ gives an indication of the possible effects of climate change, stating that recommended national precautionary sensitivity ranges for peak rainfall intensity will rise by:

- Between +5% to 10% between 2015 and 2039;
- Between +10% to 20% between 2040 and 2069;
- Between +20% to 40% between 2070 and 2115.

²⁰ Some limited qualitative information is included in the north east Yorkshire SFRA but it is largely focussed on fluvial flooding.

²¹ Environment Agency (2016) Climate Change Allowances for Planners - Guidance to support the National Planning Policy Framework. Available at: gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

In the absence of appropriate data to support this degree of resolution, in this SFRA the effect of climate change in relation to surface water is taken to be:

-Flooding at a <1 in 30 (3.3%) (high risk), >1 in 100 (1%) (medium risk) and 100 to >1000 (0.1%) (low risk) level up to 2039 should be taken to occur at the stated rate;

-Flooding at a >1 in 100 to >1 in 1000 (0.1%) level (low risk) should be considered to occur at a >1 in 100 (1%) (medium risk) rate and >1 in 100 (1%) (medium risk) should be considered as being >1 in 30 (3.3%) (high risk) level after 2039.

As with flood risk from rivers and the sea, the appropriate allowance for climate change will be applied depending on the predicted lifetime of the development being considered. For flood risk assessments and strategic flood risk assessments the EA advise that both the central and upper end allowances should be assessed to understand the range of impact.

Table 12: Environment Agency guidance on peak rainfall intensity allowances

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

6. Bringing it all Together: Applying the Sequential Test to Minerals and Waste Sites

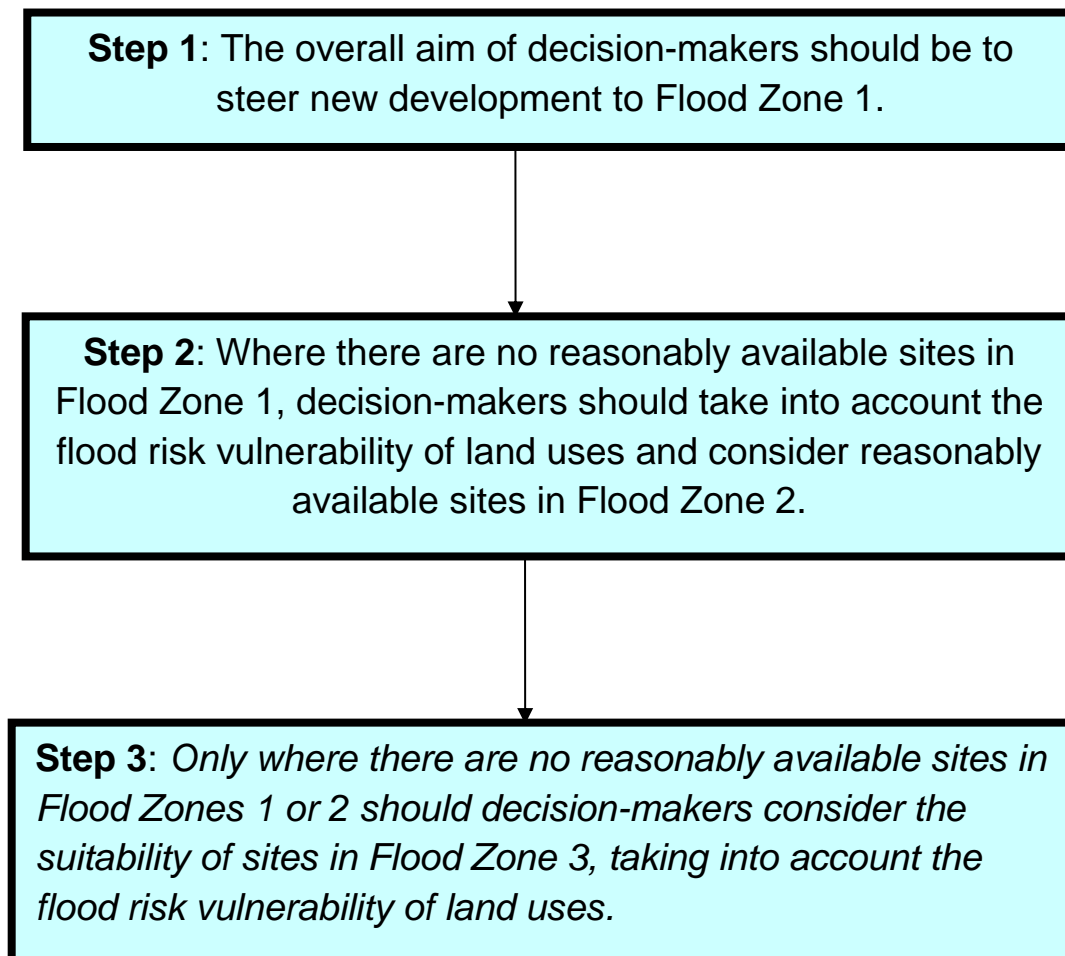
6.1 What is the Sequential Test?

The Sequential Approach, as it relates to rivers and the sea, is described in the Planning Practice Guidance to the National Planning Policy Framework as follows:

“The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of river or sea flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required”²².

This is summarised by Figure 2 below.

Figure 2: The Sequential Approach



²² DCLG, 2015. Planning Practice Guidance [URL: <http://planningguidance.communities.gov.uk/blog/guidance/flood-risk-and-coastal-change/the-aim-of-the-sequential-test/>]

As Figure 1 illustrates, when undertaking the sequential test, it is important to consider the flood risk vulnerability of land uses when considering sites for development outside of Flood Zone 1. This is described in the Planning Practice Guidance and summarised in Table 13 below. The categories of development which are considered most likely to be considered in the Joint Plan have been highlighted.

As the Planning Practice Guidance only covers the issue of land use vulnerability in relation to fluvial flooding we have adapted Table 13 to show land use vulnerability to consider the other sources of flooding considered in this SFRA and local SFRA's.

Table 13: The Flood Risk Vulnerability of Land Uses

Flood risk vulnerability classification	Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Types of development ²³	<ul style="list-style-type: none"> -Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk; -Essential utility infrastructure which has to be located in flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood; -Wind turbines. 	<ul style="list-style-type: none"> -Flood control infrastructure -Water transmission infrastructure and pumping stations -Sewage transmission infrastructure and pumping stations -sand and gravel working -Docks, marinas and wharves -Navigation facilities -Ministry of defence installations -Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. -Water-based recreation (excluding sleeping accommodation); -Lifeguard and coastguard stations; -Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential 	<ul style="list-style-type: none"> -Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding; -Emergency dispersal points; -Basement dwellings; -Caravans, mobile homes and park homes intended for permanent residential use; -Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'essential infrastructure'). 	<ul style="list-style-type: none"> -Hospitals; -Residential institutions such as residential care homes, children's homes, social services, prisons and hostels; -Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels; -Non-residential uses for health services, nurseries and educational establishments; -Landfill and sites used for waste management facilities for hazardous waste -Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan. 	<ul style="list-style-type: none"> -Police, ambulance and fire stations which are not required to be operational during flooding; -Buildings used for shops, financial professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in 'more vulnerable' and assembly and leisure; - Land and buildings used for agriculture and forestry; -Waste treatment (except landfill and hazardous waste facilities); -Minerals working and processing (except for sand and gravel

²³ Those types of development highlighted are anticipated to be the most common forms of development to take place in the Plan Area.

Flood risk vulnerability classification	Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
		facilities such as changing rooms; -Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.			working); -Water treatment works that do not need to remain operational during times of flood; -Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	x	Exception test required	✓
Zone 3b: Functional Floodplain	Exception test required	✓*	x	x	x
Consideration of other forms of flooding (significant categories are shaded blue)					
Surface water very low probability	✓	✓	✓	✓	✓
Surface water low probability	✓	✓	✓	✓	✓

Flood risk vulnerability classification	Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Surface water moderate probability	✓	✓	Exception test required where supported by other risk factors ²⁴	✓	✓
Surface water high probability	Exception test required where supported by other risk factors	✓	Exception test required where supported by other risk factors	Exception test required where supported by other risk factors	✓
Groundwater very low / low probability	✓	✓	✓	✓	✓
Groundwater moderate probability	✓	✓	Exception test required where supported by other risk factors	✓	✓
Groundwater high probability	Exception test required where supported by other risk factors	✓	Exception test required where supported by other risk factors	Exception test required where supported by other risk factors	✓

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

- Remain operational and safe for users in times of flood;
- Result in no net loss of floodplain storage;
- Not impede water flows and not increase flood risk elsewhere.

²⁴ See 4.22 below for additional detail on other risk factors.

6.2 The Sequential Approach: other forms of flooding and climate change

In addition to applying the Sequential Test to flooding from rivers and the sea, the National Planning Policy Framework requires other forms of flood risk to be taken into account. In this SFRA data on the following types of flood risk (excluding rivers and the sea) has been gathered:

- Flooding from surface water and sewers;
- Groundwater flooding; and
- Flooding from artificial sources (reservoirs and impounded water bodies such as canals).

The SFRA relies to a significant degree on national surface, groundwater and artificial flood risk data. However, conditions on the ground may create significant variation in susceptibility to flooding. Therefore, these other sources of flooding will, even when considered to be low risk in national datasets, be investigated further through site specific flood risk assessment to ascertain if they are significant and present a greater level of risk. The list below highlights some of the risk factors for the key types of other flooding that are considered for groundwater and artificial flooding when undertaking the sequential test:

- History of groundwater or surface / artificial sources water flooding;
- Presence of a gradient greater than 1 in 100 over which water might flow
- High groundwater levels or the presence of marsh vegetation;
- Large impervious areas adjacent to the site or geological faults and arrangements of permeable and non-permeable strata that may facilitate groundwater flooding;
- Presence of ditches, springs, canals or other water features adjacent to the site²⁵

As stated previously, the National Planning Policy Framework states that Local Plans should take account of climate change in the longer term²⁶. In addition the Environment Agency's 'climate change allowances for planners' guidance to support the NPPF suggests how climate change can be considered within a Strategic Flood Risk Assessment. Chapter 5 of this SFRA shows the methodologies by which climate change has been taken into account in this SFRA.

Where development is proposed in an area affected by climate change induced flood risk, that development should be steered away from that area unless it can be demonstrated that the time frame for the development is sufficiently short so as to render the development unaffected by climate change, or the flood risk vulnerability of the development proposed suggests that even with climate change, the development would remain suitable.

In order to bring all these flooding variables together Table 14 sets out a more complete sequential test process for those sites where multiple sources of flooding exist

It should be noted that in some cases a particular flood risk may be confined to only a small part of a development site. It may be possible to avoid the risk through restricting development to only that part of the site that is at an appropriate level of flood risk, thereby avoiding the need to find alternative sites.

²⁵ West Sussex County Council, 2010. Strategic Flood Risk Assessment of West Sussex: Volume II Technical Report. [URL: westsussex.gov.uk/yourcouncil/ppri/mwdf/sfra_vol2technical_jan10.pdf], East Riding of Yorkshire Council, 2011. Flood Risk Note for the Planning Application Process [URL: eastriding.gov.uk/corp-docs/forwardplanning/docs/spg/floodrisknote.pdf]

²⁶ Paragraph 99 of the NPPF

Table 14: Taking Account of Other forms of Flooding and Climate Change in the Sequential Approach

Sequential question	Yes	No
1. Is the site located in Flood Zone 1 in an area that <u>will not</u> be significantly affected by other sources of flooding or the impacts of climate change? ²⁷	Allocation or site can proceed	Progress to Step 2
2. Is the site located in Flood Zone 1 in an area that <u>will be</u> affected by other forms of flooding / climate change?	Allocation can proceed provided it is appropriate for its flood risk vulnerability classification. Undertake exception test if <u>other</u> sources of flooding (including the effects of climate change on those other types of flooding) are significant and required by the flood vulnerability of land uses table (Table 13).	Progress to step 3
3. Is the site located in Flood Zone 2 in an area that <u>will not</u> be significantly affected by other sources of flooding or the impacts of climate change?	Allocation can proceed provided it is appropriate for its flood risk vulnerability classification. Undertake exception test fluvial or <u>other</u> sources of flooding (including the effects of climate change on those other types of flooding) are significant and required by the flood vulnerability of land uses table (Table 13).	Progress to Step 4

²⁷ The effect of climate change in this assessment is the extension of Flood Zone 3. If an allocation falls into such an area treat as Flood Zone 3.

<p>4. Is the site located in Flood Zone 2 in an area that <u>will be</u> affected by other forms of flooding / climate change?</p>	<p>Establish whether the development type is suitable for Flood Zone 2 and other forms of flooding having considered the flood risk vulnerability of land uses (Table 13).</p> <p>Undertake exception test fluvial or <u>other</u> sources of flooding (including the effects of climate change on those other types of flooding) are significant and required by the flood vulnerability of land uses table (Table 13).</p>	<p>Progress to Step 5</p>
<p>5. Is the site located in Flood Zone 3 in an area that <u>will not</u> be significantly affected by other sources of flooding or the impacts of climate change?</p>	<p>Establish whether the development type is suitable for Flood Zone 3 having considered the flood risk vulnerability of land uses (Table 13).</p> <p>Undertake exception test fluvial or <u>other</u> sources of flooding (including the effects of climate change on those other types of flooding) are significant and required by the flood vulnerability of land uses table (Table 13).</p>	<p>Progress to Step 6</p>
<p>6. Is the site located in Flood Zone 3 in an area that <u>will be</u> affected by other forms of flooding / climate change?</p>	<p>Establish whether the development type is suitable for Flood Zone 3 and other forms of flooding having considered the flood risk vulnerability of land uses (Table 13).</p> <p>Undertake exception test fluvial or <u>other</u> sources of flooding (including the effects of climate change on those other types of flooding) are significant and required by the flood vulnerability of land uses table (Table 13).</p>	<p>Progress to Step 7</p>

<p>7. Can the site be located in Flood Zone 3b?</p>	<p>Establish whether the development type is suitable for Flood Zone 3b and other forms of flooding having considered the flood risk vulnerability of land uses (Table 13).</p> <p>Undertake exception test if site is defined as 'essential infrastructure' in flood risk vulnerability of land uses table (Table 13).</p>	<p>No further options are available. Allocation should be rejected.</p>
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As stated above the sequential test should consider other forms of flooding in addition to river/sea flooding. It can be useful to distinguish between different levels of significance in relation to flooding from surface water, groundwater and artificial sources. This can help when deciding whether to take a particular category of flooding into account during the sequential test. It can also help consider the appropriateness of mitigation that should be explored when undertaking a site specific FRA.

Table 15 shows low (and very low where applicable²⁸), moderate and high significance for different forms of flooding and indicates which categories of significance should be considered during sequential testing. All categories of significance should be considered during site specific FRA and also during Exception Testing.

Users should note that more than one type of flood risk may affect a given location.

Table 15: Significance categories – other forms of flooding
(Boxes coloured blue indicate that the category is to be considered significant during sequential testing (however, even low probability flooding may be revealed to be significant during a site based flood risk assessment / may still require mitigation measures to ensure safety)).

Flooding type	High probability	Moderate probability	Low probability	Very Low
Surface water and sewers (using updated flood map for surface water).	The chance of flooding in each year is greater than 3.3% (1 in 30)	The chance of flooding in each year is 3.3% (1 in 30) or less but greater than 1 % (1 in 100)	The chance of flooding each year is 1% (1 in 100) or less but greater than 0.1% (1 in 1000)	The chance of flooding each year is 0.1% (1 in 1000) or less.
Groundwater flooding	>75% of 1km square 'at risk'	>25% - 75% of area 'at risk'	<25% area 'at risk', i.e. unmarked on map.	
Artificial Sources	Judgement based assessment			

6.3 The Sequential Test

To demonstrate that any given development has been planned for consistently with the Sequential Approach it is necessary to document the extent to which the approach has been taken into account. Table 15 (above) should be seen as the mechanism by which the sequential test can be carried out for all forms of flooding. This approach has been followed in the sequential testing of site proposals for the Joint Plan, where standardised forms have been used to record the information required by following the sequential approach (completed standardised forms for Joint Plan allocations are shown in the supporting paper (volume II) of this SFRA).

²⁸ The four categories of risk for the updated flood map for surface water include 'very low', 'low', 'medium' and 'high'

6.4 Other Planning Issues to Consider when choosing alternative sites / undertaking the Sequential Test

The consideration of the sequential approach and the exception test does not operate in isolation. Table 15 shows that, after flooding from rivers, other forms of flood risk and climate change have been considered it may be necessary to choose a viable alternative site.

EA standing advice²⁹ provides some guidance regarding the identification of ‘reasonably available’ alternative sites stating “*these sites will usually be drawn from the evidence base/background documents that have been produced to inform the emerging Local Plan. In the absence of background documents, ‘reasonably available’ sites would include any sites that are known to the LPA and that meet the functional requirements of the application in question, and where necessary, meet the Local Plan Policy criterion for windfall development*”.

The reality in a Minerals and Waste Plan is that minerals can only be extracted where they are found which may limit the choice of available sites. Similarly, infrastructure availability, visual amenity, wildlife and the historic environment and a range of other planning and environmental constraints are taken into consideration. The search for reasonably available sites through the sequential test is therefore more constrained in some instances, but where this is the case, it is explained clearly in the SFRA supporting document. Where this happens, a decision is required as to whether to proceed to the exceptions test, or whether to abandon the site completely.

In seeking alternative sites we have defined each site by mineral type and waste facility category as summarised below. The sand and gravel sites has been further sub divided based on provision to specific market areas in line with the strategic approach in the draft Plan.

Table 16: Categories used in the Mineral and Waste Sites Sequential Testing process

Site Type (M or W)	Type Category
M	Sand and gravel (South)
M	Sand and gravel (North)
M	Magnesian limestone
M	Jurassic limestone
M	Sand / Silica sand
M	Building stone
M	Clay
M	Distribution / Processing
M	Recycling of inert waste
W	Energy from waste and waste transfer
W	Household Waste Recycling Centre
W	Landfill
W	Recycling

²⁹ Environment Agency (2012) Flood Risk Standing Advice for Local Planning Authorities, Version 3.1. Available at: http://cdn.environment-agency.gov.uk/LIT_9002_5a96ba.pdf (Accessed 21/03/2014).

7. Sustainability and SFRA

This SFRA can be seen as an important piece of evidence to support the Joint Plan. Sustainability is also seen as a fundamental consideration in passing the Exception Test.

The Joint Plan Authorities are required to produce a Sustainability Appraisal of the Joint Plan. Sustainability Appraisal (SA) is an assessment of the likely significant environment, economic and social effects of a plan.

The Authorities' approach to SA can be termed an 'objectives led appraisal'. This means that environmental, social and economic objectives have been defined for the SA. The SA will then consider the extent to which the plan is compatible and contributes to these objectives.

The SA's sustainability objectives are listed in Table 17, and can also be found on the North Yorkshire County Council website at:

<http://www.northyorks.gov.uk/article/26217/Sustainability-appraisal>

Table 17: Sustainability Appraisal Objectives for the Assessment of the Joint Plan

Sustainability Appraisal Objective
Protect and enhance biodiversity and geo-diversity and improve habitat connectivity
Enhance or maintain water quality and supply and improve efficiency of water use
Reduce transport miles and associated emissions from transport and encourage the use of sustainable modes of transportation
Protect and improve air quality
Use soil and land efficiently and safeguard or enhance their quality
Reduce the causes of climate change
Respond and adapt to the effects of climate change
Minimise the use of resources and encourage their re-use or safeguarding
Minimise waste generation and prioritise management of waste as high up the waste hierarchy as practicable
Conserve and enhance the historic environment, heritage assets and their settings
Protect and enhance the quality and character of landscapes and townscapes
Achieve economic growth and create and support jobs
Maintain and enhance the viability and vitality of local communities
Provide opportunities to enable recreation, leisure and learning
Protect and improve the wellbeing, health and safety of local communities
Minimise flood risk and reduce the impact of flooding
Address the needs of a changing population in a sustainable and inclusive manner

This SFRA has been written with two overarching purposes in mind. Firstly, it has been written to provide evidence on how flood risk should be considered for the Sustainability Appraisal of the Joint Plan, in particular the objective to 'minimise flood risk and reduce the impact of flooding'; secondly it has been written to inform the selection of submitted sites to the Joint Plan.

The table below shows key ways in which the SFRA can inform and contribute to the most relevant SA objectives.

Table 18: How the SFRA Supports the Sustainability Appraisal

SA Objective	How
Protect and enhance biodiversity and geo-diversity and improve habitat connectivity	SFRA and supporting volume shows that SuDS (see appendix 1) and flood storage areas are achievable at many development sites which will be a key means of creating habitats.
Enhance or maintain water quality and supply and improve efficiency of water use	SFRA provides guidance on improving the quality of water input from SuDS to groundwater and surface water. SFRA helps ensure new development is less prone to flooding thus helping to reduce ingress of pollutants to watercourses caused by floods washing over built infrastructure.
Minimise flood risk and reduce the impact of flooding	By enabling the sequential test to be undertaken, the SFRA will ensure that development will be located in the least flood prone locations and incorporate measures to deal with residual risk. Guidance on flood management measures in this SFRA, will help to promote reduction in downstream flood risk.
Respond and adapt to the effects of climate change	SFRA will help ensure that development is resilient to future flood risk which is a predicted consequence of climate change.

Sustainability Appraisal and the Exception Test

The National Planning Policy Framework sets out two key requirements that must be fulfilled for the Exception Test to be passed. These are:

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

In meeting the first part of the Exception Test 'wider sustainability benefits' should help fulfil two or more sustainability objectives. So, if a development has the wider benefit of, for example, significantly reducing climate change impacts and the level of construction waste generated, this should be expressed in terms of the sustainability objectives that it helps fulfil.

The question of whether those sustainability benefits outweigh flood risk is a matter of judgement. Clearly the more SA objectives that are met the more likely the sustainability benefits will be seen to outweigh the flood risk. Similarly the extent to which those objectives are met will be a consideration. So, for example, a development which reduces transport through the provision of a small amount of cycle parking is likely to be seen as being of lesser benefit than a development which, through its geographical position or through its integration with the rail network will cut emissions from transport by a significant quantum.

These sustainability benefits should be quantified wherever possible so that an assessment of the magnitude of benefit can be made.

Whatever the benefits, however, the second part of the Exception Test must also be satisfied. This will require that the development itself will be made safe, and that flood risk will not be increased anywhere else. Wherever possible mitigation and management measures should be consistent with the sustainability objectives and the wider strategic context, in particular local Catchment Flood Management Plans.

The supporting volume to this SFRA sets out which sites have passed the Sequential Test, and which, if they are still to be pursued, will need to have the Exception Test applied to them.

Appendix 1: Sustainable Drainage and Water Management

Guidance on SuDS Application

Overview

Sustainable Drainage Systems (SuDS) encompass a range of drainage approaches that can be used to manage surface water drainage in a way that mimics the natural environment. SuDS are supported in the National Planning Policy Framework and Planning Practice Guidance which state that the use of SuDS should be given priority.

Most SuDS systems share some common principles. CIRIA describe a 'management train approach' to SuDS, where flood management starts with prevention or good practice measures, and source control is preferred to larger downstream site and regional controls. Indeed CIRIA state that as *'a general principle it is better to deal with runoff locally, returning the water to the natural drainage system as near to the source as possible. Only if the water cannot be managed on site should it be conveyed elsewhere'*³⁰.

There are a number of benefits to sustainable drainage systems. These include:

- Reducing peak flows to sewers and watercourses which can lessen the risk of flooding downstream;
- Improvements to water quality, particularly compared to conventional surface water sewers;
- Reduction in water demand through rainwater harvesting;
- Creation of habitats; and
- Allowing natural groundwater recharge where appropriate³¹.

Types of SuDS Systems

There are a number of attenuation and infiltration elements that may come together to form SuDS systems. These include:

Source Control and Prevention Techniques

Green roofs and rainwater harvesting: Green roofs are vegetated roofs which offer a means of reducing the volume and rate of run off from roofed areas and can also offer additional benefits such as improving the insulation of buildings and extending the life of the roof.

Rainwater harvesting can be used to collect rainwater from roofs and other appropriate hard surfaces. Typically water is held in containers and pumped to the point of use, often for flushing toilets.

³⁰ CIRIA, 2011. SUDS Management Train. [URL: ciria.org.uk/suds/suds_management_train.htm] (accessed 21/10/11)

³¹ CIRIA, 2007, Environment Agency, undated.

Permeable pavements: Permeable pavements allow water to filter through a hard standing area rather than simply running off. Infiltration is usually achieved through the use of a pervious surface material and substrate. While in some circumstances drainage may simply be to the ground, a need to protect the aquifer or unsuitable drainage may require the construction of a storage reservoir area, usually beneath the surface. Water then discharges, having been filtered through the surface and substrate, into an appropriate receptor such as a stream, or may be required to go through further SuDS stages.

Infiltration trenches and basins: Infiltration basins are depressions into which run off collects and then infiltrates into the ground. Infiltration trenches also allow infiltration of water through their base and sides, and are filled with a permeable material.

Conveyance

Swales: Swales are channels that can be constructed along roads or incorporated within green areas. They can be used to transfer runoff to storage areas or may form a limited storage area themselves. They provide an alternative to a traditional piped drainage system, and the flow of water, across vegetation, when at low velocity, provides a filtering function.

Filter drains: Filter drains are trenches that have been lined with a geotextile and filled with gravel³². They contain a perforated pipe that carries flow along the trench. Oil residues and sediments are removed by filtering, absorption and microbial action in the surrounding soil³³.

Passive Treatment (Site control or regional control)

Ponds and wetlands: Ponds and wetlands, as well as being key landscaping features, can be integrated into a sustainable drainage system to provide a storage area for runoff. The vegetation around wetlands can provide a cleaning function and the volume of water itself may provide a dilution function. Allowing native plant species to colonise wetlands, or using species of local provenance, can also ensure a sustainable drainage system provides the maximum opportunities for wildlife.

Filter strips and bio-retention areas: Filter strips are vegetated sections of land that are designed to receive runoff from upstream development. They are usually positioned between a hard surfaced area and a receptor for the water, such as a stream or another SuDS component. Runoff is cleaned of some pollutants and sediments by vegetated filtering, settlement and infiltration. Filter strips also slow run off velocity and can be designed to enhance the biodiversity value of a site.

³² Environment Agency, undated Sustainable Drainage Systems: An Introduction [URL: publications.environment-agency.gov.uk/PDF/GEHO0308BNSS-E-E.pdf]

³³ Environment Agency, undated. Sustainable Drainage Systems: A guide for developers [URL: publications.environment-agency.gov.uk/PDF/GEHO0308BNST-E-E.pdf]

Bio-retention areas are made up of shallow landscaped depressions that include a number of soil and vegetation features aimed at filtering and reducing runoff. CIRIA guidance states that bio-retention areas should contain components including grass filter strips, ponding areas, organic / mulch areas, soil, woody and herbaceous plants and a sand bed for drainage³⁴.

Detention basins: Detention basins allow temporary storage and a controlled release of runoff during storm events. They are, in normal circumstances, dry vegetated depressions that can often be used for other recreational purposes during dry weather. However, during a flood event they form a storage pool, receiving runoff and storing it, allowing water to continue on its journey only when the outflow level is reached. They can also be used as a means of temporary sediment control during construction, provided they are re-instated after the construction phase³⁵.

Choosing and consulting on the Correct Scheme

Different SuDS are appropriate in different locations and for different types of development. Factors to consider include:

- The type of development;
- The sensitivity of receptors for the drained water;
- The quality of drained water and the regulations that govern discharge;
- The physical and hydrogeological properties of the soil and underlying geology.

North Yorkshire County Council has published guidance on the design and maintenance of SuDS.

northyorks.gov.uk/media/30769/North-Yorkshire-County-Council-SuDS-design-guidance/pdf/SDG150617Rev3_LLFA_Design_Guidance.pdf

The Flood and Water Management Act, 2010 establishes a role for county and unitary local authorities as SuDS Approving Bodies (SABs).

A SuDS Approving Body (SAB) was to be established and was to be North Yorkshire County Council (NYCC) in its capacity as Lead Local Flood Authority (LLFA), this was a requirement of Schedule 3 of the Flood and Water Management Act 2010 and was to happen to ensure SuDS were implemented. However, government decided to abandon Schedule 3 so SABs were never created. Instead, the government implemented SuDS by amending the National Planning Policy Framework (NPPF) by means of House of Commons Written Statement HCWS161 and produced some new planning legislation, The Town and Country Planning (Development Management Procedure) (England) Order 2015. All of this resulted in the responsibility for SuDS being moved from the LLFA to the Local Planning Authority (LPA). As such NYCC in its capacity as LLFA provides technical advice on major planning applications as a statutory consultee.

³⁴ CIRIA, 2015. The SUDS Manual, CIRIA, London

³⁵ CIRIA, 2015. The SUDS Manual, CIRIA, London

The Town and Country Planning (Development Management Procedure) (England) Order 2015 Section 2 sets out the major development on which the LLFA is a statutory consultee:

- The winning and working of minerals or the use of land for mineral-working deposits
- Waste development
- The provision of dwellinghouses where - (i) the number of dwellinghouses to be provided is 10 or more; or (ii) the development is to be carried out on a site having an area of 0.5 hectares or more and it is not known whether the development falls within sub-paragraph (i)
- The provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more
- Development carried out on a site having an area of one hectare or more.

SuDS and the Regulatory Framework

It is essential that discharges to water are compliant with environmental legislation and where relevant authorisations, consents or permits must be obtained.

SuDS that involve infiltration are potentially subject to legislation such as the Water Framework Directive, which places restrictions on the discharge of pollutants to groundwater. In addition, the Environmental Permitting Regulations, 2010, provide a consolidated regime for the granting of permits to discharge polluted water.

Further guidance is available through the Environment Agency's Groundwater Protection Principals and Practice (GP3) guidance

gov.uk/government/uploads/system/uploads/attachment_data/file/297347/LIT_7660_9a3742.pdf

Finding out More

There are a number of detailed sources of information on SuDS. A short list of useful information sources is described below:

- **CIRIA** (the Construction Industry Research and Information Association) have produced a number of documents on SuDS. Several publications are available free from their website, though other publications incur a charge. The publication 'The SUDS Manual (CIRIA, 2015) gives extensive information on the selection and design on different SuDS elements;
- The **SUDSnet** website features a useful photo library and speakers presentations / conference proceedings from regular SUDSnet national conferences - sudsnet.abertay.ac.uk/index.htm;
- The **British Geological Survey** publish information on the effect of geology on infiltration-based SuDS – see bgs.ac.uk/suds/;
- The **University of Sheffield's Green Roof Centre** website contains numerous cases studies and discussions of the benefits of green roofs, which can be an important component of SuDS - thegreenroofcentre.co.uk/about_us.

Other Opportunities for Minerals and Waste Sites to Manage Flood Risk

Woodlands and agricultural farming practices: Planting woodlands can slow down flow (such as the Forestry Commission’s woodlands for water scheme) and also changing agricultural farming practices such as ploughing horizontally along the land gradient rather than vertically can also slow flow and prevent silt run off³⁶.

Designing out flood risk: There are a range of other approaches to ‘designing out’ flood risk on a site and the National Planning Practice Guidance includes advice on making development safe from flood risk, creating flood resistant and flood resilient development and developing flood evacuation plans.

Floodplain compensatory storage: There may also be a need to provide compensatory storage if development is in flood zone 3 or 3a as paragraph 100 of the National Planning Policy Framework states:

“Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere”.

This means that not only must appropriate management measures be put in place to make a site safe, the flood reduction role that land had played prior to development taking place must be effectively substituted for or enhanced. Even though the individual risk of increased flooding may be small, the cumulative risk of several separate developments may be significant, so each must seek to offset that risk.

Table 19: Types of Flood Plain Compensatory Storage

Direct or ‘level for level’ storage methods	These re-grade the land to replace lost storage volume.
Indirect methods	These rely on water entering an area for storage of water for later slow release. They can be remote from the floodplain or include solutions such as tanks. They are generally seen as a last resort because of their potential complexity.

³⁶ Farming for cleaner water and healthier soil (NE230); Farming and climate change (NE308) and [forestry.gov.uk/pdf/FRMG004_Woodland4Water.pdf/\\$FILE/FRMG004_Woodland4Water.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/444444/FRMG004_Woodland4Water.pdf)

Consultation

We would like you to comment in any way you see fit on this SFRA (Volume 1) and its supporting volume (Volume 2).

We are consulting on the findings of this report from **client to advise closer to time of publication.**

Comments should be sent to:

Environmental Policy,
Heritage Services, Waste and Countryside Services,
North Yorkshire County Council,
County Hall,
Northallerton,
North Yorkshire,
DL7 8AH
Tel: **01609 536493**

Email: mwsustainability@northyorks.gov.uk

Contact us

Minerals and Waste Joint Plan Team, Planning Services, North Yorkshire County Council, County Hall, Northallerton, North Yorkshire, DL7 8AH

Tel: **01609 780780**

Email: **mwjointplan@northyorks.gov.uk**