A57 Link Roads

TR010034

9.42 Flood Risk Assessment (Tracked)

Rile 8(1)(k)

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

May 2022

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning
(Applications: Prescribed Forms and
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A57 Link Roads
Development Consent Order

9.42 FLOOD RISK ASSESSMENT (TRACKED)

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1. Introduction

1.1 Scheme Background

1.1.1 The Flood Risk Assessment (FRA) has been prepared to support the application by Highways England (the Applicant) for a Development Consent Order (DCO) to authorise the construction, operation and maintenance of the A57 Link Roads (previously known as Trans Pennine Upgrade) (herein referred to as 'the Scheme').

1.1.2 The FRA has been prepared in accordance with the National Planning Policy Framework (NPPF)[1] (2019) and the Design Manual for Roads and Bridges (DMRB) LA 113 Road drainage and the water environment[2].

1.1.3 The A57 and A628 between Manchester and Sheffield currently suffer from heavy congestion, creating unreliable journeys. This restricts potential economic growth, as the delivery of goods to businesses is often delayed and the route is not ideal for commuters, which limits employment opportunities.

1.1.4 The current Scheme has evolved over more than 50 years as different ideas have been explored, it has formerly been known as the Trans-Pennine Upgrade (TPU) and is also referred to as the "Mottram Moor Link Road and A57 Link Road project" in the Government's second Roads Investment Strategy (RIS).

1.1.5 The two new link roads being delivered by this Scheme are:

- Mottram Moor Link Road – a new dual carriageway from the M67 junction 4 roundabout to a new junction on the A57(T) at Mottram Moor
- A57 Link Road – a new single carriageway link from the A57(T) at Mottram Moor to a new junction on the A57 in Woolley Bridge.

1.1.6 The footprint of the Scheme includes the physical extent of the permanent works, together with land required temporarily to aid construction and is referred to as the Scheme area; delineated by the DCO boundary.

1.1.7 The Scheme lies mainly within the administrative boundaries of Tameside Metropolitan Borough Council, in the west of Greater Manchester. A small section to the west crosses over the DCO boundary with High Peak Borough Council and Derbyshire County Council. Therefore, Tameside Metropolitan Borough Council and Derbyshire County Council have Lead Local Flood Authority (LLFA) responsibilities regarding the Scheme.

1.1.8 There are no Internal Drainage Boards that cover any watercourses that are crossed by the Scheme.

[redacted]

1.2 Scheme Overview

1.2.1 The relevant Scheme engineering design is illustrated on the following plans, which have been submitted with the DCO application:

- The Works Plans and Work Plan Schedule (TR010034/APP/2.3)
- The Scheme Layout Plans (TR010034/APP/2.6)
- The Culverts and Drainage plans (TR010034/APP/2.12).

1.2.2 The main features of the Scheme are set out in the following table.

Table 1-1 Main features of the Scheme

Feature	Description
Road	A new offline bypass of 1.12 miles (1.8km) of dual carriageway road connecting the junction of the M67, A57(T) and A560 to Mottram Moor Junction A new offline bypass of 0.81 miles (1.3km) of single carriageway connecting the A57(T) Mottram Moor to the A57 Woolley Bridge.
Junctions	Creation of two new junctions, Mottram Moor Junction and Woolley Bridge Junction and improvement works to the existing M67 Junction 4.
Structures	Creation of five new structures (Old Mill Farm Underpass, Roe Cross Road Overbridge, Mottram Underpass, Carrhouse Lane Underpass, River Etherow Bridge and Roe Cross Road overbridge)
Drainage, culverts and Watercourse realignments	Construction of new drainage channels and culverts, and realignment of watercourses.
Construction compound	One main temporary construction compound area, located on agricultural land to the east of the M67 Junction 4.

1.2.3 The Scheme is considered a Nationally Significant Infrastructure Project (NSIP), therefore the Applicant is required to apply for a DCO. An Environmental Impact Assessment (EIA) has been undertaken and an Environmental Statement (ES) (TR010034/APP/6.3) prepared to support the application for the DCO submission. This FRA should be reviewed along with the Road Drainage and Water Environment chapter (Chapter 13) of the ES.

1.2.4 Chapter 2 (The Scheme) of the ES, provides more detail on the works proposed.

1.2.5 The Scheme area comprises the areas of land required to construct, operate and maintain the Scheme, refer to the Temporary Works Plans (application document TR010034/APP/2.8).

1.3 Flood Risk Assessment

1.3.1 The FRA considers the risk to the Scheme from all sources of flooding along with the potential flood risk impacts of the Scheme.

1.3.2 The approach uses hydraulic modelling or other quantitative assessment to better understand likely significant effects where possible. The approach assesses what measures are planned to avoid or minimise flood risk both to the

Scheme and receptors in the catchments through which it passes. The approach finally describes the key residual route-wide flood risks to the Scheme.

1.3.3 A FRA should consider all types of flooding to satisfy the following three key objectives:

- To assess flood risk to the Projects and to demonstrate that any residual risk to the development and its users would be acceptable
- To assess the potential impact of the proposed development on flood risk elsewhere and to demonstrate that the development would not increase flood risk elsewhere
- To satisfy the requirements of the National Planning Policy Framework (NPPF)

1.3.4 There are three levels of FRA:

- Level 1 FRA (Screening Study): To identify if there are any flooding issues related to a development site which may warrant further consideration. The screening study will ascertain whether a Level 2 or Level 3 FRA is required
- Level 2 FRA (Scoping Study): Undertaken if a Level 1 study indicates that the site may lie within an area which is prone to flooding or that the site may increase flood risk due to increased runoff; and to confirm the possible sources of flooding which may affect the site. The Scoping Study will identify residual risks that cannot easily be controlled and, if necessary, will recommend that a Level 3 FRA is undertaken
- Level 3 FRA (Detailed Study): Undertaken if the Level 2 study concludes that quantitative analysis is required to assess flood risk issues related to the development site. This may include detailed hydraulic modelling of rivers or drainage systems

1.3.5 This assessment forms a Level 3 FRA.

1.4 Overview of Flood Risk

1.4.1 In accordance with the NPPF, the following sources of flooding have been considered in this assessment:

- Fluvial flooding from watercourses
- Overland surface water runoff from adjacent sites
- Groundwater
- Artificial sources (reservoirs and canals)

1.4.2 Given the inland nature of the Scheme, flooding from tidal or coastal sources are not relevant and thus is scoped out of further assessment.

1.4.3 Existing flood risk is predominantly associated with fluvial flood risk where the Scheme crosses existing watercourses, and surface water flooding as a result of water ponding. Flood risk has been identified from groundwater, sewers and reservoirs. Flooding from all the above sources are explored within this assessment.

1.5 Consultation

1.5.1 Consultation with key stakeholders has been undertaken throughout this assessment process. Key stakeholders and their key points of discussion are summarised below.

Table 1-2 Summary of flood risk consultation

Consultee	Type of correspondence	Subject
Environment Agency	Email correspondence – November 2017 – ongoing	Regular communication with the Environment Agency flood risk team to agree the FRA scope, gain approvals in principle of the River Etherow model and hydrology, and to proposed flood mitigation works.
Environment Agency	Meeting – 13 April 2018	Presentation of River Etherow baseline flood modelling results and discussion around flood risk mitigation requirements and strategies. Agreement on key design parameters for the Scheme crossing of the Etherow, including freeboard and set back distances.
Environment Agency	Email correspondence – 26 June 2018	Confirmation of approval in principle of the baseline hydraulic and hydrological modelling of the River Etherow.
Environment Agency	Meeting – 9 October 2018	Discussion on the s42 response received from the Environment Agency and attempted to address their concerns raised.
Tameside Metropolitan Borough Council - as Lead Local Flood Authority	Meeting – 17 April 2018	Discussion on the Scheme drainage design and the culverting and diversion of land drainage ditches (ordinary watercourses). The Lead Local Flood Authority confirmed that in principle they have no issues with the proposed drainage works.
Environment Agency	By email - 12 March 2020	Agreement in Principle received on the proposed changes to the River Etherow structure
Environment Agency	By email – 6 November 2020	Email sent to the EA to inform them of the additional statutory consultation and the updates Preliminary Environmental Report (PEIR) with the intention to set up a meeting to discuss the updated Scheme and any outstanding issues.
Environment Agency	Meeting – 3 December 2020	• In agreement with the EA, the Applicant will proceed with the climate change guidance as set out in NPPF. Flood Risk and Coastal Change Table 1 July 2020[3] to inform the design. The Applicant is undertaking a further sensitivity run of 95% increase in flows to examine the vulnerability of this type of development (Essential infrastructure) to future flood risk and develop the FRA and modelling assessment and progress the design in accordance with this. • The Applicant discussed the constraints around the existing flood envelope and that the purpose is for additional flood storage not just re-

[3] Flood risk assessments: climate change allowances - [redacted]

Consultee	Type of correspondence	Subject
		landscaping, so positioning is dictated by existing flood envelope. • The consultee identified flood risk permit requirements and land ownership. • The Applicant notes that through modelling the strategy does manage flood risk effectively within the area and that the EA will continue to be consulted on this. • The Applicant will add on peak river flow when running the hydraulic model to ensure the soffit level is set correctly and the compensatory flood storage volume is adequate over the lifetime of the new highway structure.
Environment Agency	Email 7 December 2020	• The Applicant advised the Environment Agency that it would review the potential for the Flood Compensation Storage Area to be used for ecological enhancement and mitigation • The Applicant will add on peak river flow when running the hydraulic model to ensure the soffit level is set correctly and the compensatory flood storage volume is adequate over the lifetime of the new highway structure. • In agreement with the EA, the Applicant will proceed with the climate change guidance as set out in NPPF. Flood Risk and Coastal Change. Table 1 July 2020 (.gov.uk) to inform the design. The Applicant is undertaking a further sensitivity run of 95% increase in flows to examine the vulnerability of this type of development (Essential infrastructure) to future flood risk and develop the FRA and modelling assessment and progress the design in accordance with this.
Environment Agency	Email April 2021	• Email confirming agreement with the EA, that the Applicant will undertake a hydrogeological risk assessment following completion of additional ground investigation. Due to the programme, the additional ground investigation and hydrogeological risk assessment will be undertaken after the environmental impact assessment.

2. Methodology and Design Principles

2.1 Introduction

2.1.1 The FRA draws on a range of disciplines and designs, including, drainage, earthworks, culverts, and previous hydrological and hydraulic modelling to ensure all sources of flood risk are assessed as part of the FRA.

2.1.2 The Risk of Flooding from Surface Water (RoFSW), first published in 2013, replaces the updated Flood Map for Surface Water (uFMfSW) and provides an indication of surface water flood risk across England. Whilst it is not a substitute for detailed hydrological and hydraulic modelling, the RoFSW it is suitable to identify where more detailed modelling may be required. Detailed hydraulic modelling will be undertaken as part of the drainage strategy.

2.1.3 As a national scale model, structures and culverts were beyond the scope of the RoFSW assessment. This can result in overestimates of flooding upstream of embankments through which flow would be conveyed by a structure and as such the ponding and depth of flooding indicated does not occur.

2.1.4 The FRA has defined fluvial flooding as all flood risk associated with Main Rivers and Ordinary Watercourses, this includes where flood risk from the RoFSW maps has been used to define the Ordinary Watercourse flood extents (owing to a lack of hydrological and hydraulic model data in these areas).

2.2 Data Sources

2.2.1 Scheme data has been supplemented by the following sources to inform the assessment of flood risk to the Scheme.

Table 2-1 Key data sources

Data Description	Date	Data owner
Tameside Strategic Flood Risk Assessment – Volume 2 (Tameside Metropolitan Borough Council)[4]	2011	Tameside Council
EA indicative flood risk maps, the EA Flood Zones, and Risk of Flooding from Surface Water[5] (RoFSW The EA Catchment Data Explorer website[6])	2016	EA
Preliminary Flood Risk Assessment [7]	2011	Tameside Council
Local Flood Risk Management Strategy[8]	2016	Tameside Council
EA Etherow Model		EA
Factual reporting from a number of site-specific ground investigations, full details of which are provided in the Ground Investigation Report (GIR) (TR010034/APP/7.6)	2018	Highways England

[4] Tameside Metropolitan Borough Council, 2011 Tameside Level 1 Update and Level 2 Strategic Flood Risk Assessment
[5] EA (2016a, 07 04). Environmental Spatial Data Catalogue. Retrieved from gov.uk: https://environment.data.gov.uk/
[6] [redacted]
[7] Tameside Metropolitan Borough Council, 2011. Preliminary Flood Risk Assessment
[8] Tameside Metropolitan Borough Council, 2016. Tameside Flood Risk Management Strategy

Data Description	Date	Data owner
Ordnance Survey (OS) OpenData [9]	2021	Ordnance Survey
Multi-Agency Geographic Information for the Countryside (MAGIC) Map[10]	2021	Multi-Agency
British Geological Survey (BGS) Geology of Britain viewer map[11]	2021	BGS
Online historic mapping resources, e.g. National Library of Scotland (NLS) [12]	2021	
High-resolution aerial photography, e.g. Google Earth.	2021	

2.2.2 The Etherow hydraulic model data received and subsequently developed as part of the design works for the Scheme was provided by the EA to be used in the modelling package Flood Modeller-Tuflow.

2.2.3 The data sources listed above have been used to identify water environment receptors assessed, including surface watercourses and groundwater bodies.

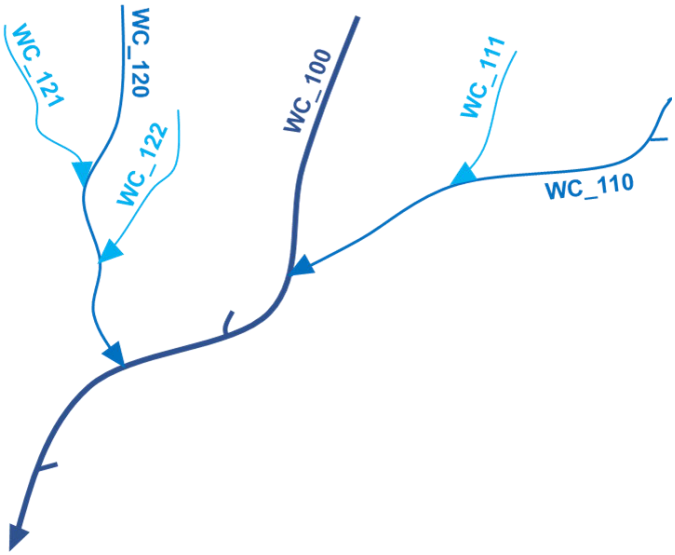
2.2.4 Site surveys were undertaken under relatively dry conditions, and the overall watercourse function and stability were inferred through professional judgement and the interpretation of features on site. The watercourse features and processes observed may vary with time, seasonality, and high flow events.

2.2.5 Some watercourses (or lengths of watercourses) were not visited due to access restrictions. Where a site visit was not possible, these watercourses have been characterised through desk study using openly available data and professional judgement.

2.2.6 Many of the identified surface watercourses are unnamed on OS mapping, such that all identified watercourses within the Scheme boundary have been assigned a unique identifier code for ease of reference and consistency across chapters and assessments. Watercourses which are named have also been assigned an identifier code. The numbering system uses the format “WC_xxx”, where “WC” stands for “watercourse” and “xxx” is a unique three-digit number which is also used to indicate stream order.

2.2.7 Using the example shown in Insert 2-1, WC_100 is a major named watercourse (i.e. first order), WC_110 and WC_120 are tributaries of that river (i.e. second order), and WC_111, WC_121 and WC_122 are tributaries of the second order streams (i.e. third order). The numbering system also accommodates ordering of incoming tributaries from upstream to downstream (e.g. WC_110 joins WC_100 upstream of WC_120). To avoid longer codes, where there are very short (< 100 m in length) tributaries of a watercourse, these are incorporated into the assessment for the watercourse they are joining. Watercourses which are located within the Red Line Boundary (RLB), but flow into a major named watercourse outside of the RLB, are given the first digit 0 (i.e. “WC_0xx”).

[9] [redacted]



Insert 2-1 Example watercourse numbering system

2.3 Methodology

2.3.1 The Scheme has been assessed for flood risk within this FRA with the following aims,

- Assess the existing flood risk to the Scheme from fluvial, surface water, groundwater sources, sewers and reservoirs to ensure the proposed design takes into account existing flood risk issues
- Evaluate the potential impact of the proposed Scheme on flood risk

Fluvial flood risk mapping

2.3.2 The existing flood risk has been assessed by reviewing the EA's RoFSW flooding and Flood Zones 2 and 3 and existing EA 1D/2D hydrological and hydraulic model. The assessment focuses on the Scheme route and the proposed works and how these may impact on flood risk.

Limitations

2.3.3 This assessment has relied upon the accuracy and level of detail of the documented data sources. Detailed topographical survey data was not available for many of the watercourse locations where crossings and outfalls would be proposed.

2.3.4 The watercourse features and processes observed may vary over time/seasons and high flow events. Site walkover surveys were undertaken under relatively dry conditions, and the overall watercourse function and stability were inferred through professional judgement and the interpretation of features on site.

2.3.5 The accuracy of hydraulic modelling is primarily dependent on the quality of hydrological and topographical data. Key factors include the resolution of the topographic data (for example LiDAR), the accuracy of surveys of hydraulic structures, the availability of data on past flooding and the limitations of the modelling software.

2.3.6 The assessment has been undertaken on the design at present and it is anticipated further detailed design work will be undertaken.

2.3.7 The detailed design of the culvert crossing on the Ordinary Watercourses and Ordinary Watercourse realignment has yet to be finalised.

Groundwater flood risk mapping

2.3.8 Groundwater flooding generally occurs as a result of long duration rainfall events, when the associated recharge of permeable geological deposits raises the water table until it is above ground level. Groundwater flooding is generally of longer duration than fluvial or surface water flooding and may take weeks or months to recede. Flooding of subsurface structures can also occur where groundwater levels rise to just below ground level. Groundwater flooding can be associated with both permeable bedrock and superficial deposits.

2.3.9 A groundwater conceptual model has been developed based on both desk-based and site-specific groundwater information. Detailed information can be found in the Geology and soils chapter (Chapter 9) of the ES (application document reference TR010034/APP/6.3) and the WFD assessment (application document TR010034/APP/5.4). Additional ground investigation was carried out in 2021 and the hydrogeological conceptual model has been reviewed and updated with this data. The updated hydrogeological conceptual model is presented in Appendix 13.2 Hydrogeological Risk Assessment of the ES (TR010034/EXAM/9.43). This information will be used to support the later stages of design.

2.3.10 Specifically, in relation to groundwater flood risk, the EA aquifer designation mapping, BGS's groundwater flooding susceptibility mapping and the SFRAs from the relevant local councils have also been reviewed.

Flood resilience and resistance

2.3.11 Flood resilience is defined as designing or adapting an infrastructure asset so that although it comes into contact with floodwater, no permanent damage is caused, structural integrity is maintained and, if operational disruption does occur, normal operation can resume rapidly. Flood resistance is defined as designing or adapting infrastructure so that floodwater is excluded during flood events and normal operation can continue with no disruption caused.

2.3.12 Options are available to manage flood risk, including embankment raising, flood warning, limiting placement of assets in the floodplain, and raising assets above the predicted flood level. The Scheme will aim to provide resistance to flooding where possible, considering key constraints including:

- Interface with existing property and infrastructure which may limit the ability to raise embankment levels
- Financial constraints
- Land take restrictions

2.3.13 It is important to consider flood risk to the Scheme route at all stages of design, construction and operation, to ensure the route is resilient to flooding.

2.3.14 Table 2-2 outlines the proposed hierarchy of measures to manage flood risk to the Scheme route, with the table structure based on Table 6.2 from C6884[13].

[13] McBain, W., Wilkes, D., Retter, M. (2010) Flood resilience and resistance for critical infrastructure. CIRIA publication C688

Table 2-2 Flood risk management (FRM) measures

FRM measure category	Description	Risk management measures
Assess	Identify sources of flooding, mechanisms and impacts on receptor	FRA making use of available EA data to inform existing flood risk extents, depths and levels to establish the flood risk to the Scheme, including an allowance for climate change
Avoid	Locate assets in areas of lowest risk	Road junctions located outside of flood zone Signalling/communication/power equipment is located outside of flood zone
Substitute	Substitute assets which are incompatible with flooding	Preferential siting of less vulnerable assets in the flood zone
Control	Reduce likelihood of flooding – floodwalls, embankments	Construction of floodwalls and embankments to contain river waters. Installing an attenuation basin to reduce the rates at which runoff enters downstream drainage systems.
Mitigate	Assess residual risks and adopt mitigation measures – flood warning, emergency and recovery plans	Follow operational procedures during floods. Making use of existing EA data and services to provide flood warning, and potentially develop Flood Management Plan (or include in the Operation and Maintenance Plan actions, monitoring etc. to be undertaken)

Drainage strategy

2.3.15 The Surface Water Drainage Strategy is currently in development and will be included once finalised.

3. Flood Risk Policy

3.1.1 This section outlines flood risk planning policy and guidance, with further detail provided in Tameside Metropolitan Borough Council Local Flood Risk Management Strategy (Tameside Metropolitan Borough Council, 2016).

3.2 Flood Risk and Flood probability

3.2.1 Flooding is a natural process that can present a range of different risks depending on its form. Flood practitioners and professionals define the risks presented by flooding according to an Annual Chance Event, or as having a 'return period'.

3.2.2 Flood risk includes the statistical probability of an event occurring and the scale of the potential consequences. Flood risk is estimated from historical data and expressed in terms of the expected frequency of a flood of a given magnitude. The 10-Year, 50-Year and the 100-Year annual chance event floods have a 10%, 2% and 1% chance of occurring in any given year, respectively. However, over a longer period, the probability of flooding is considerably greater.

3.2.3 For example, for the 1% annual chance flood:

- There is a 1% chance of the 1% annual chance event flood occurring or being exceeded in any single year
- There is a 26% chance of the 1% annual chance event flood occurring or being exceeded in a 30- year event period
- There is a 51% chance of the 1% annual chance event flood occurring or being exceeded at least once in a 70-year period

3.2.4 Table 3-1 provides a summary of the relevant annual chance event and corresponding return period events.

Table 3-1 Definition of annual chance event and return period events

Annual chance (%)	Return period (years)
100%	1 in 1-year (annual)
10%	1 in 10-year
5%	1 in 20-year
2%	1 in 50-year
1%	1 in 100-year
0.5%	1 in 200-year
0.1%	1 in 1000-year

3.3 National Policy Overview

3.3.1 The NPPF is the Government's overarching planning policy document for England and sets out the Government's policy on development relating to flood risk. The broad aim of the NPPF is to reduce the number of people and properties within the natural and built environment at risk of flooding. The NPPF

protects people and property from flooding by steering development to areas at lowest risk. Where development needs to be in locations that are at risk from flooding, the NPPF ensures that the development is safe without increasing flood risk elsewhere and, where possible, reducing flood risk overall.

3.3.2 The developer must prove to the Local Planning Authority and the EA that any existing flood risk or flood risk associated with the proposed development can be satisfactorily managed.

3.3.3 In accordance with the NPPF, a site-specific FRA is required for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems; and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

3.4 Flood zones and vulnerability classification

3.4.1 The EA's Flood Map is divided into three separate Flood Zones. These Flood Zones are used by NPPF in determining the appropriateness of proposed developments when considering flood risk through the application of the Sequential Test. They represent the probability of flooding without flood defences in place. The Flood Zones are defined in Table 3-2.

Table 3-2 Definitions of EA Flood Zones

Flood Zone	Definition
Flood Zone 1: Low Probability	Land where the annual chance of flooding is lower than 0.1% for either fluvial or sea flooding.
Flood Zone 2: Medium Probability	Land where the annual chance of flooding is between 0.1 and 1.0% for fluvial flooding
Flood Zone 3a: High Probability	Land where the annual chance of flooding is 1.0% or greater for fluvial flooding. Or, land where the annual chance of flooding is 0.5% or greater for flooding from the sea
Flood Zone 3b: Functional Floodplain	Land where water has to flow or be stored in times of flooding. Local planning authorities identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the EA.

3.4.2 The EA's Flood Map also defines Areas Benefitting from Defences (ABDs) within Flood Zone 3, however this category is not expressly determined within NPPF or the Sequential Test process.

3.4.3 NPPF provides guidance on assessing the vulnerability of land uses in relation to flood risk and classifies new developments into one of five categories:

- Essential Infrastructure
- Water Compatible
- Less Vulnerable
- More Vulnerable
- Highly Vulnerable

3.4.4 The Scheme is classified as Essential Infrastructure.

3.5 Compatibility

3.5.1 Table 3-3 sets out the NPPF flood risk vulnerability and flood zone compatibility assessment, as taken from the NPPF Planning Practice Guidance. The table indicates which development types are appropriate within each Flood Zone. Essential Infrastructure is acceptable in Flood Zone 3a and 3b, however an exception test is required. The exception test will form part of this Level 3 FRA.

Table 3-3 Flood risk vulnerability and Flood Zone compatibility

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

3.6 Climate Change

3.6.1 The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF and supporting Planning Practice Guidance on Flood Risk and Coastal Change explain when and how FRA should be used. This includes demonstrating how flood risk will be managed now and over the development's lifetime, taking climate change into account. Local planning authorities refer to this when preparing local plans and considering planning applications.

3.6.2 As of 19 February 2016, the government updated the climate change guidance which is to be considered during the planning process. This supersedes the climate change guidance within the Planning Practice Guidance, where typically a 20% allowance on river flows was given. The guidance states how climate change should be assessed as part of this FRA.

3.6.3 The following sets out which climate change allowance needs to be applied according to the development type and Flood Zone.

3.6.4 The relevant allowances for the Mersey catchment which apply to the Scheme are 41% for the central band and 53% for the ~~upper~~Higher.

3.7 Local planning policy overview

3.7.1 In relation to flood risk from the Scheme, the EA has operational jurisdiction over Main Rivers and LLFAs have jurisdiction over Ordinary Watercourses and flooding from surface water and groundwater sources. LLFAs may be either Unitary Authorities or County Councils. The following sets out some key

definitions as stated in the Flood and Water Management Act 2010:

- Watercourse: includes all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows
- Main River: Watercourse shown as such on a Main River map; these are the responsibility of the EA
- Ordinary Watercourse: 'A 'watercourse' that does not form part of 'a 'Main River'. These are the responsibility of the LLFA.

3.7.2 The Scheme passes through land that falls under the jurisdiction of Tameside Metropolitan Borough Council and Derbyshire County Council. Flood risk has therefore been assessed with respect to the specific flood risk policy of these local authorities.

3.7.3 Given the timescales associated with the preparation of the FRA report, policies may change or be updated over this period. Local planning policies will be reviewed and updated as necessary.

4. Assessment of Flood Risk

4.1 Introduction

4.1.1 The following section describes the existing flood risks for all flood risk sources, followed by an assessment of flood risks to the Scheme, mitigation measures and lastly residual flood risk.

4.2 Overview

4.2.1 The Scheme is located within the administrative boundaries of Tameside Metropolitan Borough Council and High Peak Borough Council. Most of the Scheme is located within Tameside Metropolitan Borough Council and the immediate eastern end of the Scheme is located within High Peak Borough Council.

4.2.2 The Scheme commences with a new connection to the existing M67 Junction 4 at its junction with the A57(T) and the A560.

4.2.3 From M67 Junction 4, an all-purpose dual carriageway would run to the north east across existing farmland towards Mottram Moor Junction.

4.2.4 At Roe Cross Road, the Scheme passes under a new overbridge and will enter the proposed Mottram Underpass at Old Road. Mottram Underpass is proposed to be constructed using the cut and cover method to carry the new road beneath Old Road, Old Hall Lane and the community of Mottram.

4.2.5 After exiting the Mottram Underpass, the Scheme would be in cutting of approximately 12 m depth and would turn southwards as it continues towards a new junction, Mottram Moor Junction, immediately south of the existing Mottram Moor.

4.2.6 The route then continues as an all-purpose single carriageway, across existing farmland, heading toward the River Etherow. A new bridge structure would be constructed to carry the Scheme over the River Etherow.

4.2.7 The route would then terminate at a new signal controlled ‘T’ junction on the A57 at Woolley Bridge, known as Woolley Bridge Junction.

4.2.8 Surrounding land uses are predominantly agricultural, commercial and residential properties.

4.3 Topography

4.3.1 The topography of the area has been assessed using LiDAR data. This shows that in general the land rises in the east/north east portion of the DCO boundary, falling towards the River Etherow located towards the south/south east DCO boundary.

4.4 Groundwater character

Published geology and hydrogeology

4.4.1 A summary of geology and hydrogeology underlying the Scheme is based on a review of the regional geology using the British Geological Survey (BGS) 1:50,000 scale bedrock and superficial deposits mapping.

4.4.2 Glacial Till (glacial boulder clay) is the predominant mapped superficial geology within the study area. An area of Glaciofluvial Deposits overlies the bedrock to the south west of the Scheme. An area of Alluvium occurs to the south and east of the Scheme associated with the River Etherow.

4.4.3 The mapped solid geology of the study area is dominated by the Millstone Grit Group, as shown on BGS 1:50,000 series mapping. The series comprises a sequence of thick sandstone (or grit) units interbedded with mudstone and/or siltstone units.

4.4.4 The bedrock underlying the Scheme is all classed as Secondary A aquifer, which is defined as *"permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of baseflow to rivers."*[14]. The presence of wells on historical OS maps indicates that groundwater has been extracted from the Millstone Grit strata in the past[15].

4.4.5 The Till is classified as a Secondary Undifferentiated aquifer. A Secondary Undifferentiated aquifer "has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type."[14]. The areas of Glaciofluvial Deposits and Alluvium are classified as Secondary A aquifers.

4.4.6 In the Mottram in Longdendale area, the Glacial Till behaves as an aquitard, confining the Millstone Grit aquifer and inhibiting upward groundwater flow. Groundwater is present within the Glacial Till as discontinuous perched lenses.

4.4.7 In the eastern section of the scheme, Glacio-fluvial deposits exist between the Millstone Grit and Glacial Till, forming a confined water bearing unit.

4.4.8 There is a fault zone within the bedrock in the vicinity of the Mottram Underpass. In addition to displacing the bedrock and superficial geology, the fault causes artesian groundwater conditions to the east of the fault zone, relative to lower or absent groundwater to the west of the fault zone.

Site specific geology and hydrogeology

4.4.9 A number of previous ground investigations have been undertaken in the Scheme area between 1995 and 2018. Full details of these investigations are provided in the Geology and soils chapter (Chapter 9) of the ES (application document reference TR010034/APP/6.3) and in the Ground Investigation Report (GIR) (application document TR010034/APP/7.6).

4.4.10 Supplementary ground investigation was undertaken in 2021 as the previous

[14] Environment Agency (2020) Aquifer designations. Available at [redacted] [27 October 2020]
[15] Mott MacDonald (2005), A57/A628 Mottram Tintwistle Bypass and A628/A616 Route Restraint Measures. Volume 4: Annex A - Assessment of potential settlement due to dewatering during tunnel construction

investigations were designed around an alternative Scheme design, resulting in gaps in the site-specific information.

4.4.11 The data available from borehole logs confirm that the geology encountered is generally consistent with the anticipated published geology in terms of strata type and lithology.

4.4.12 Aquifer property testing has been undertaken as part of the ground investigations. The sandstone units of the Millstone Grit Group are fracture dominated and this heterogeneity is reflected in the highly variable hydraulic conductivities measured. The Till is well defined by the tests and has a hydraulic conductivity within the range of zero (i.e. no-flow) to 0.019 m/d.

4.4.13 Groundwater level data were collected between January 1994 and July 2021 and a summary of the historical data is presented in Appendix 13.1 (TR010034/APP/6.5). This has been reviewed alongside more recent data from 2018 and 2021 and used to form a groundwater conceptual model presented in the Hydrogeological Risk Assessment (ES Appendix 13.2 (TR010034/EXAM/9.43)).

4.4.14 The available groundwater level data show that groundwater levels are generally consistent with the topography, with groundwater flow towards the south east.

4.4.15 The Millstone Grit Group is generally confined by the Glacial Till and is also self-confining, due to its layered structure. Artesian groundwater conditions were locally encountered during the 2018 and 2021 ground investigation around the Mottram Underpass area and within the Eastern Cutting area. The significant faulting in this area results in the groundwater level being over 10 m lower to the west than it is to the east, where it is artesian. It is interpreted that there is a significant barrier to groundwater flow across this zone.

4.5 Existing Flood risk

History of flooding

4.5.1 The Historic Flood Map (HFM) shows areas of past fluvial flooding. These outlines can be viewed on in relation to the DCO boundary in Figure 4-1.

4.5.2 There are several historical flood outlines deriving from flood events from the River Etherow and Glossop Brook where flooding has occurred, with the largest flood extent occurring in July 2002 and as recent as October 2019. The SFRA details the occurrence of flooding in 1998 between Hollingworth and Woolley bridge.

4.5.3 The Tameside Metropolitan Borough Council Preliminary Flood Risk Assessment (PFRA) documents a number of historic flooding incidents that occurred within the district that are attributable to main river channel exceedance, related to the sewer network and surface water drain blockages.

Flooding from Rivers (EA Flood Map and EA Flood Model)

4.5.4 A review of the EA's Flood Map for Planning indicates that the majority of the DCO Boundary is located in the low risk fluvial Flood Zone 1, however areas of Flood Zone 2 and 3 are crossed by the proposed road alignment (please refer to Figure 13.4 in the Environmental Statement (TR010034/APP/6.4)).

Main Rivers

4.5.5 The proposed A57 Link Road crosses the River Etherow, which is designated as Main River. The River Etherow is part of the Upper Mersey catchment, with its source being Salter's Brook, a watercourse on the border of Derbyshire and Barnsley in the Pennines. The River Etherow is a tributary of the River Goyt. With a steep to moderate channel gradient, it flows along the south eastern DCO boundary of the borough into Stockport where it joins the Goyt south of Compstall.

4.5.6 The flooding mechanism in this location is primarily through overtopping of both banks in the vicinity of Longdendale and downstream to the confluence with Glossop Brook. Overtopping of formal flood defences occurs along the right bank downstream and is stored on adjacent agricultural land. There is no designated flood storage area in Longdendale. In addition, the formal flood defences provide insufficient standard of protection (<1%AEP) to form an area benefiting from flood defences (ABD).

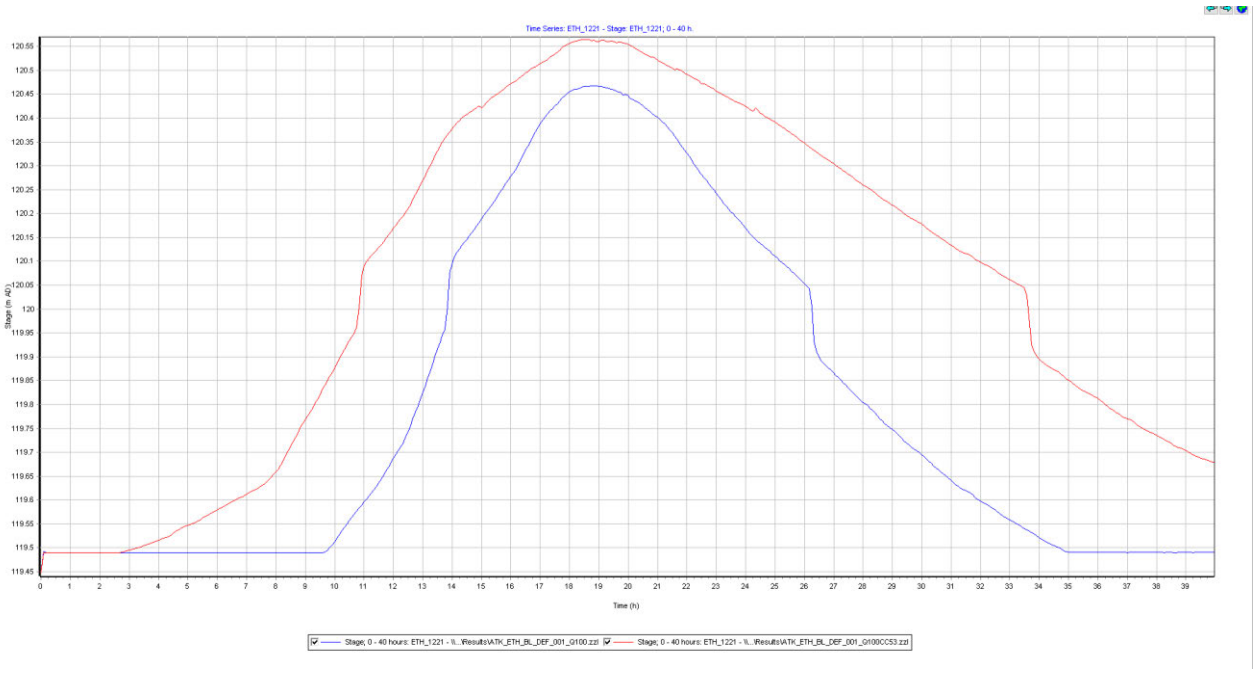
4.5.7 A detailed 1D-2D Flood Modeller TUFLOW hydraulic model of the River Etherow was obtained from the EA. The model was updated in December 2019 as part of a value engineering exercise undertaken by the Applicant as part of this Scheme and considers a range of return period fluvial flood events. The River Etherow is located within the Mersey river basin and therefore, in accordance with the EA's climate change guidance. (July 2020) [16]. The potential impacts of climate change on flood risk to the Scheme have been assessed using the 53% increase in peak river flows. Insert 4-1 shows the modelled flood depths for the 1% annual chance event plus climate change of 53%.

4.5.8 The 1% AEP plus 53% climate change flood level at the proposed River Etherow crossing is 120.565m AOD. Peak water levels for the 1%, 1% plus climate change events are shown in Table 4-1 and Insert 4-1.

Table 4-1 Modelled flood levels at the proposed crossing location of the River Etherow

Return period	Peak water level (mAOD)
1% annual chance event	120.467
1% annual chance event plus climate change allowance 53%	120.565

[16] Flood Risk and Coastal Change. Table 1 July 2020. URL: [redacted]



Insert 4-1 1D hydrograph at the proposed River Etherow Crossing for the 1% AEP and 1% AEP plus climate change allowance

4.5.9 Glossop Brook is a tributary of the River Etherow, it flows north westerly from Long Clough Brook to join the River Etherow in Brookfield. The EA flood map indicates the area surrounding the confluence and upstream reach to be at risk of flooding, impacting commercial and residential properties along Glossop Brook. The flooding from both the River Etherow and Glossop Brook appears to be hydraulically linked by potential propagation of flood waters.

Ordinary Watercourses

4.5.10 Figure 4-2 shows RoFSW across the Scheme. Hurstclough Brook originates near Mottram in Longdendale within Tameside and flows southerly and crosses the A57 before joining the River Etherow at Broadbottom. Hurstclough Brook is only designated as Main River downstream of the Scheme extent and therefore will be assessed as an ordinary watercourse within this assessment. The reach of Hurstclough Brook that is proposed to be realigned by the Scheme is therefore the jurisdiction of the LLFA.

4.5.11 The EA's Risk of Flooding from Surface Water (RoFSW) mapping indicates that north of Hyde Road the area is shown to be at risk from the 1% and 3.3% annual chance event, with the river alignment indicating a high risk (of greater than 3.3% annual chance event). However, this may be as a result of LiDAR indicating bankfull flow as high risk rather than risk of flooding itself. There are no receptors shown to be at risk with the exception of the A57 itself, although this is unlikely due to the A57 being embanked and the watercourse passing underneath is unlikely to overtop.

4.5.12 Tara Brook (WC_200) is a tributary of the River Etherow. It flows in an easterly direction, crossing Carrhouse Lane and then flows south easterly parallel to Woolley Lane to join the River Etherow at Home Farm. The EA's RoFSW mapping indicates that near Carrhouse Lane the area is shown to be at risk from the 0.1% and 1% annual chance event. Flood extents at this location are not

shown to impact any receptors. An area approximately 300m downstream from this point, is shown to be at risk from a greater than 3.3% annual chance event although this flood risk does not seem to impact any receptors. Tara Brook is shown in the 1% and 0.1% annual chance events to be hydraulically linked to surface water flow. A flood flow route is evident along Mottram Moor and Wooley Lane where surface water and Tara Brook combine. The watercourse then joins the River Etherow where the area is shown to be at risk from the 0.1% and 1% annual chance event.

4.5.13 Additionally, there are a number of watercourses that originate to the north of Mottram Moor that conflux before crossing the A57 and joining Tara Brook. These include:

- WC_210
- WC_211
- WC_212
- WC_213
- WC_214
- WC_215

4.5.14 The source of these watercourses is unknown beyond Old Hall Lane. WC_211 flows southerly towards Mottram Moor Road with the ROFSW map indicating little risk from flooding from this watercourse. Site investigations found this watercourse to be deeply incised until the confluence with WC_212. Watercourses WC_212, WC_213 and WC_214 are not well defined on joining the WC_211 which becomes WC_210 entering into culvert running parallel to Mottram Moor Road. Risk of flooding along the aforementioned watercourses is limited to that of the 1% and 0.1% annual chance event much owing to the topology of the riparian zone. At these higher chance events significant areas of surface water flood risk are evident in the vicinity of Lodge Court and north of Coach Road, with the latter appearing to be hydraulically linked with WC_215. WC_210 then flows beneath the road toward its confluence with Tara Brook. edge of Lodge Court. The brook is well defined and steep. The EA's RoFSW mapping indicates that the area around the brook is at very low risk, with this area shown to be at a risk of less than 0.1% annual chance event.

4.5.15 WC_130, north of the reservoir keepers house is a tributary of the River Etherow. The EA's RoFSW mapping indicates that the area around the source of this small watercourse is shown to be at risk from a greater than 3.3% annual chance event. Further downstream, the area is shown to be at risk from the 0.1% and 1% annual chance event.

4.5.16 WC_140 is a surface water flow path that flows south easterly toward the River Etherow. There are suspected subsurface field drains along this path and the EA's RoFSW mapping indicates that the majority of flooding is confined with the exception of limited areas that are shown to be at risk of the 0.1% annual chance event, however no receptors are shown to be affected by this potential flooding.

Flooding from Groundwater

4.5.17 Tameside Metropolitan Borough Council Strategic Flood Risk Assessment (SFRA) states that there are no documented records of groundwater flooding within Tameside Metropolitan Borough Council district. The body of evidence presented in the SFRA on groundwater shows that generally, the risk of groundwater flooding within the district is low. While groundwater flood risk is not recorded in the High Peak BC SFRA, the Derbyshire CC SFRA[17] presents the Areas Susceptible to Groundwater Flooding (AStGWF) map (Insert 4-2). The AStGWF map is a strategic scale map showing groundwater flood areas on a 1 km grid. It identifies areas susceptible to groundwater flooding based on geological and hydrogeological conditions. It does not show either the likelihood or impact of groundwater flooding occurring and is therefore not a risk-based dataset. It also only identifies where groundwater might emerge, not its flow route once above ground. Bearing this in mind, it remains a useful indicator of where groundwater flooding may be an issue. The mapping shows that in the locality of the Scheme between <25% and <50% of each of the 1 km grid squares are susceptible to groundwater emergence.

4.5.18 The AStGWF mapping suggests the likelihood of groundwater flooding in the area is highly variable. Site specific groundwater information has identified a key area around Mottram in Longdendale where artesian groundwater conditions were recorded during the 2018 and 2021 ground investigations. Where artesian groundwater conditions exist, the likelihood of groundwater flooding is higher, as any connection between the surface and the confined aquifer would result in groundwater emerging above ground.

4.5.19 Site-specific groundwater level data is available between November 1994 and July 2021 from ground investigation. During the 2021 monitoring, across the whole scheme area, groundwater levels have ranged between 0.0 and >27.0 mbgl. In the vicinity of the proposed Mottram cutting and underpass, groundwater levels are frequently at, or within 2 m of, ground level. A Hydrogeological Risk Assessment (Appendix 13.2 of the ES(TR010034/EXAM/9.43)) has been carried out to review and update the groundwater conceptual model with data from the 2021 ground investigation, which was not available for inclusion at the point of DCO submission to the Planning Inspectorate in June 2021.

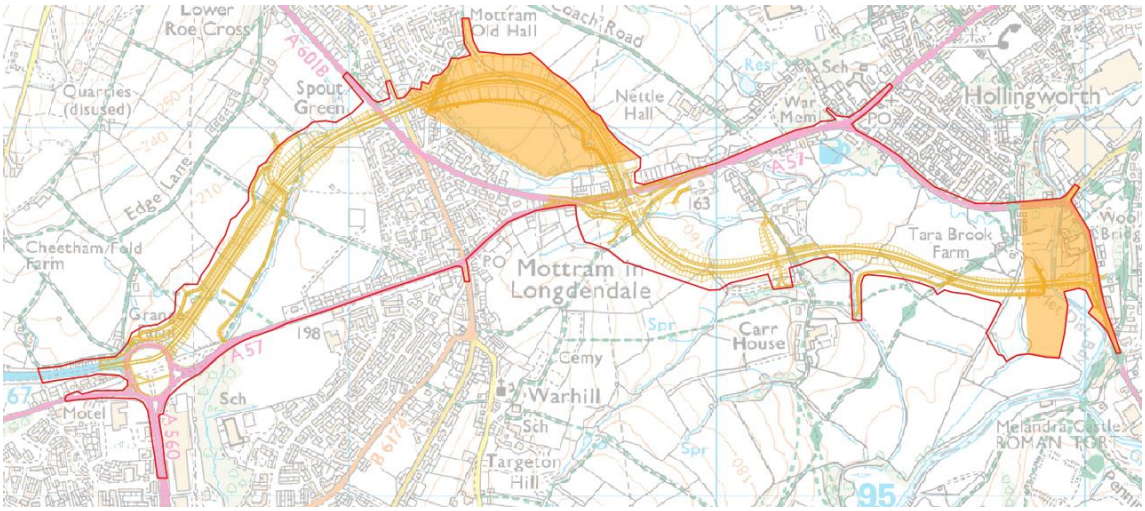
4.5.20 The data show that the groundwater setting is complex, with significant changes in groundwater level over short distances, localised areas of higher and lower permeabilities, and possible lenses of confined and semi-confined aquifer resulting in areas of artesian groundwater. In this setting assigning a groundwater flood risk category is challenging. However, the AStGWF mapping has been used as a starting point, which shows the scheme location to be in the lowest two categories.

4.5.21 Based on the currently available information, while much of the Scheme is at low risk of groundwater flooding, some areas, in the vicinity of Mottram, are considered to be at medium risk. Areas where artesian groundwater were identified during the 2018 and 2021 ground investigations are shown on Insert

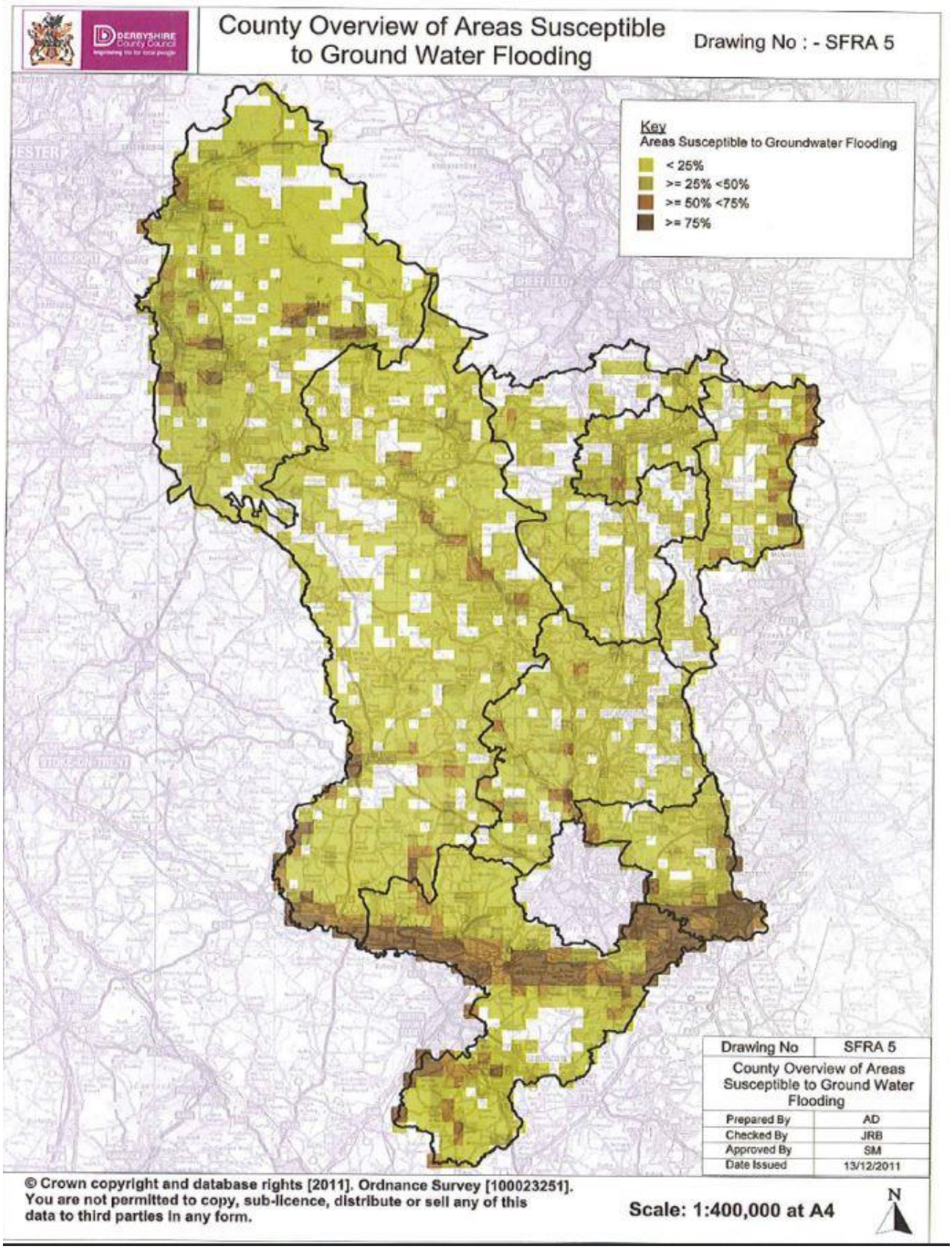
[17] Derbyshire County Council (2012), Strategic Flood Risk Assessment (SFRA) Level 1. Accessed online March 2021: [redacted]

4-2. It is these areas where groundwater flood risk is likely to be medium rather than low.

Insert 4-2 Areas where artesian groundwater was identified in 2018 and 2021 (marked in orange)



Contains Ordnance Survey data © Crown Copyright 2022.



Insert 4-3 Areas Susceptible to Groundwater Flooding

Flooding from Surface water

4.5.22 The EA's RoFSW mapping indicates the presence of surface water flood risk in the following areas of the Scheme:

4.5.23 North of Hyde Road A57 and the road itself is shown to be at risk from 1% annual chance event upwards. Flood depths at the 0.1% annual chance event are predicted to be below 300mm.

4.5.24 Overland flow routes are shown to flood within the DCO boundary at the 0.1% annual chance event in the vicinity of Old Hall Lane. The risk of flooding originates in the residential area and traverses overland spreading on an area of steep agricultural land flowing toward WC_211. Flood depths associated with this event are expected to be below 300mm. An additional overland flow path originating in the vicinity of Stalybridge Road and along the A57 appears to also flow towards WC_211. Risk here is presented from the 1% annual chance event upwards with depths expected to be below 300 mm.

4.5.25 West of Carrhouse Lane (Easting: 399872, Northing: 395557) there is a field drain flowing into an attenuation pond. The EA's RoFSW mapping indicates that the area around the field drain is shown to be at risk of the 0.1% and 1% annual chance event.

4.5.26 North of Mottram Moor Road and the road itself is shown the be at risk from 3.3% annual chance event upwards. This is shown to be predominantly associated with WC_220. The overland flow paths are shown to impact a number roads and associated properties including Coach Road, Hollinhey Terrace, Wedneshough and Mottram Moor A57 before flowing down Wooley Lane and entering Tara Brook. Predicted depths are predominantly below 300 mm given the steep nature of the topology however the ROFSW map indicates limited areas of ponding with flood depths over 900 mm.

Flooding from Other sources

4.5.27 Five reservoirs are located in the headwaters of the River Etherow (Bottoms, Valehouse, Rhodeswood, Toreside and Woodhead). These reservoirs could pose a flood risk to the study area in the event of a breach. The EA's Risk of Flooding from Reservoirs map indicates that extensive flooding, (over 2 m deep and over 2 m/s) will cover the majority of the Mottram in Longdendale area, including the study site and most of the A57 Woolley Lane. This level of risk to the Scheme is considered to be highly unlikely and the Scheme is likely to be affected by flood water no more than a few centimetres as indicated by Tameside Reservoir Advice and as such, would remain free from flooding, although warnings of such rare incidents and reservoir flood planning should be sought from LLFA.

4.5.28 The Tameside Metropolitan Borough Council SFRA reports that the risk of flooding from canals and reservoirs in Tameside Metropolitan Borough Council is generally low.

4.5.29 EA's Risk of Flooding map indicates that there are some flood defences on the River Etherow at the study site, however the flood defences do not provide sufficient standard of protection to protect from the 1% annual exceedance probability event.

4.5.30 The Tameside Metropolitan Borough Council SFRA does not report a detailed analysis of the scale and consequences of sewer flooding. This is due to a lack of model data available to indicate which parts of the sewer network may have insufficient capacity and areas at risk of flooding from sewers.

4.6 Scheme flood risk

Highway Works

4.6.1 The Scheme mainly compromises the creation of two new link roads at the western end of the Trans-Pennine route (A57(T) / A628 / A616) as follows:

- Mottram Moor Link Road – a new dual carriageway from the M67 Junction 4 roundabout to a new junction on the A57(T)[18] at Mottram Moor
- A57 Link Road – a new single carriageway link from the A57(T) at Mottram Moor to a new junction on the A57 in Woolley Bridge.

Mottram Moor Link Road

4.6.2 Highway works will focus on a new offline dual carriageway link road (Mottram Moor Link Road) connecting the M67 Junction 4 to A57(T) Mottram Moor Junction

4.6.3 The Mottram Moor Link road would be approximately 1.12 miles (1.8km) in length, commencing from a new connection at the existing M67 Junction at the junction between the M67 Junction 4 to A57(T) Mottram Moor Junction

- The Mottram Moor Link road would be approximately 1.12 miles (1.8km) in length, commencing from a new connection at the existing M67 Junction at the junction between the M67 Junction 4 to A57(T) Mottram Moor Junction
- The proposed road would then run north east across existing farmland, before entering a cutting and passing under a new overbridge of the A6018 Roe Cross Road. Mottram Moor Link Road would then enter Mottram Underpass, carrying the new road beneath the existing Old Road and Old Hall Lane.
- After exiting Mottram Underpass, the Mottram Moor Link Road would turn southwards as it continues in cutting towards a new traffic signal controlled junction, Mottram Moor Junction, at the intersection with the existing Mottram Moor.

A57 Link Road

4.6.4 The route then continues to the south of Mottram Moor Junction with a new offline single carriageway link road, named the A57 Link Road, connecting the A57(T) Mottram Moor to the A57 Woolley Bridge.

- The A57 Link Road would be approximately 0.81 miles (1.3km) in length, which would continue in a false cutting from Mottram Moor Junction across existing farmland, heading toward the River Etherow

[18] The symbol (T) means that this section of the A57 is defined as a trunk road. Most motorways and many of the long distance rural 'A' roads are trunk roads. The respons bility for their maintenance lies with the Secretary of State and they are managed by Highways England in England

- A new bridge, River Etherow Bridge, would then carry the A57 Link Road over the River Etherow and the route would then terminate at a new traffic signal controlled 'T' junction on the A57 at Woolley Bridge, known as Woolley Bridge Junction.

4.6.5 The Scheme modelling has been undertaking using data contained within the outline design drawings. Earthworks associated with the Scheme have resulted in a change in schematisation of the river network; this includes representation of River Etherow flood defence, reprofiling the River Etherow channel, a new river crossing approach embankment and the new River Etherow Bridge. The Scheme elements have been examined to assess the possible interruption to the development of the flood flow routes and any resultant change in flood prevalence. It must be noted that the culverted reaches and realignment of the Ordinary watercourses have not been modelled as part of this FRA.

4.6.6 This modelling builds on the River Etherow Flood Risk Assessment work undertaken in 2018 by the Applicant.

4.6.7 Due to subsequent design changes to the River Etherow crossing, made during the Preliminary Design stage, the previous modelling work has been revisited. The changes primarily include a reduced width in the River Etherow crossing from 45m to 42m and removal of a pier and secondary channel on the right bank.

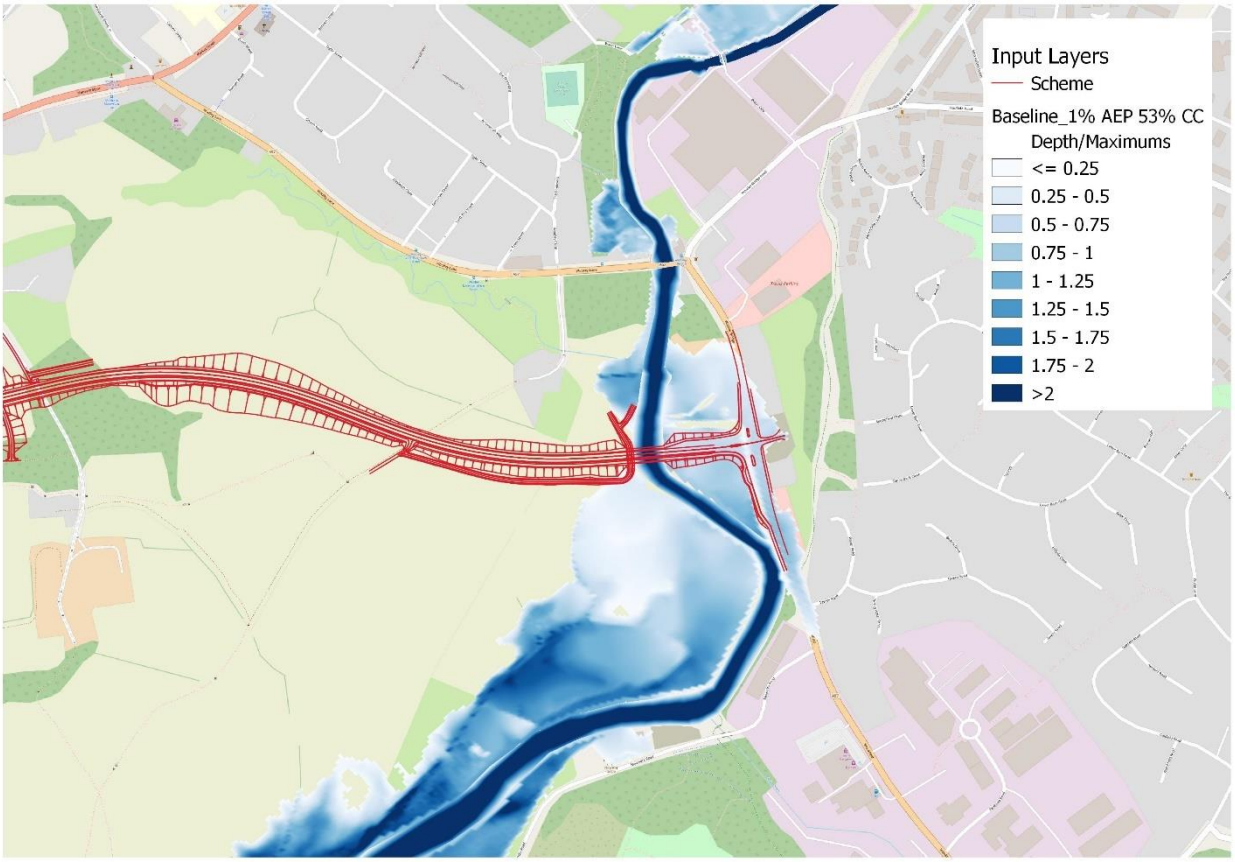
4.6.8 As part of this update, the baseline model has been updated to include additional cross sections to be in line with the cross-section schematisation in the with Scheme model.

4.6.9 The 1D/2D boundary was also amended to match the 1D section extents and ensure channel volume was represented correctly.

4.6.10 The changes made to the model meant that modelling of the Scheme with and without mitigation could be undertaken (e.g. changing of bank heights, floodplain levels, channel capacity) without changing conveyance in areas which remain unchanged between models. This ensures a direct comparison of results can be made between all modelled scenarios.

4.6.11 The proposed footprint of the embanked road alignment at Woolley Bridge Junction sits within Flood Zone 3 (as shown in Insert 4-4) with a resultant loss of floodplain volume of approximately 2190m^3.

4.6.12 There is a requirement by the EA to compensate for loss of floodplain storage due to the footprint of the embanked bridge approaches.



Insert 4-4 Baseline Flood depth map in relation to the proposed Scheme footprint for the 1% AEP event plus 53% climate change allowance

4.6.13 The flood risk management proposals modelled were determined through an iterative design process with the aim of mitigating against any detrimental impact on flood risk which includes:

- An embankment on the left bank upstream of the proposed bridge crossing, providing flood protection to properties and the new T junction
- An increase to channel capacity and conveyance through the proposed bridge crossing whilst maintaining a 5m easement to abutments
- Right bank lowering to allow flood flows to occur and direct flood waters to areas of proposed compensatory flood storage provision
- Creation of a compensatory flood storage provision along the right bank downstream of the proposed bridge crossing.

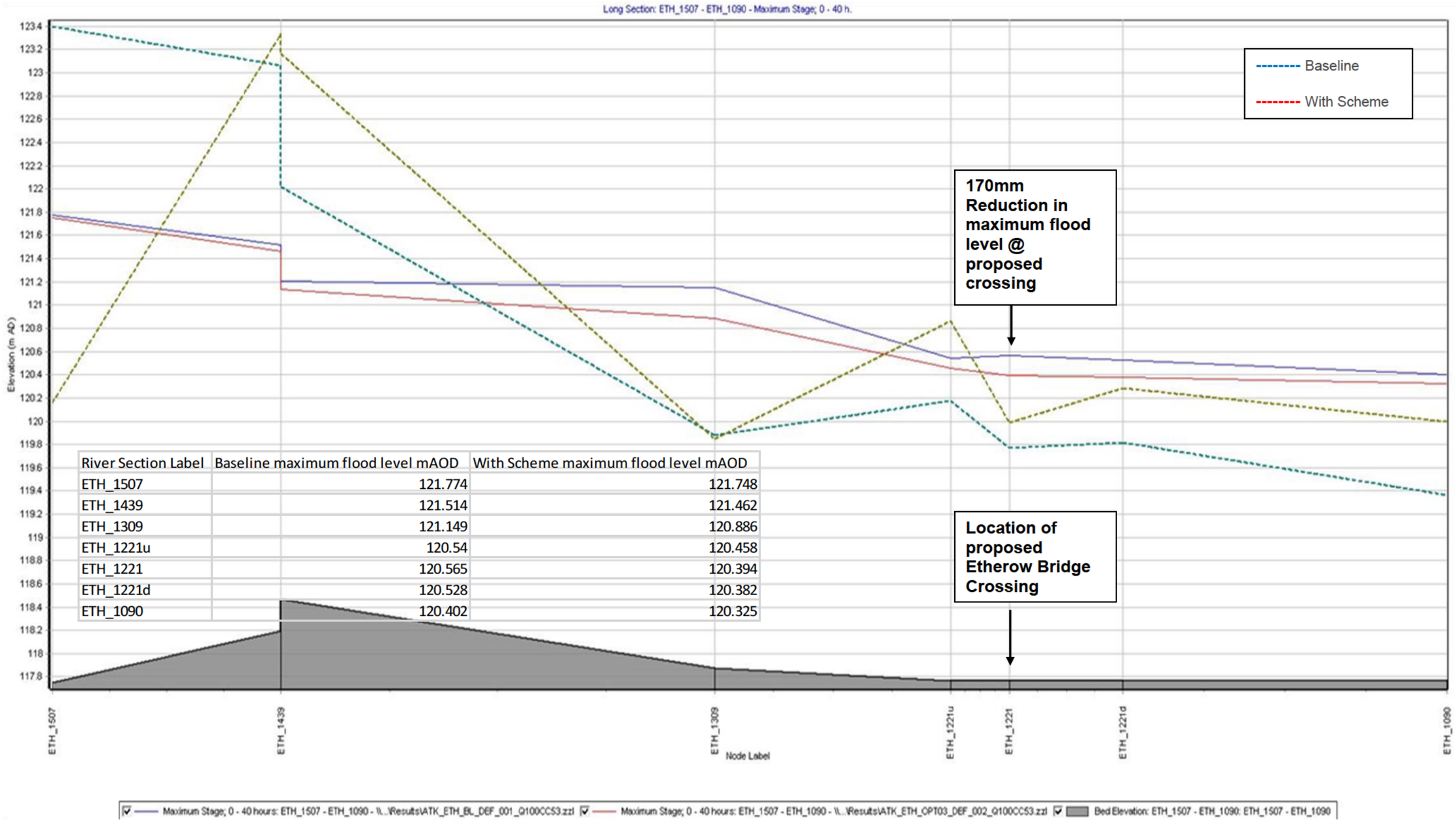
4.6.14 The modelling suggests lowering of the right bank downstream of the proposed bridge crossing will to allow flood flows to occur and to direct flood waters to areas of proposed compensatory flood storage provision.

4.6.15 Any loss of flood volume will require replacing on a compensatory basis. This would require a compensatory flood storage replacement of a minimum of 2190 m^3. Initial work undertaken by Arcadis discussed and agreed with EA that a level for level replacement of the compensatory flood provision would not be possible due to the constraints of available flood free land in the study area. As such and shown in Insert 4-5 this is to be incorporated into the ground works in the form

'reduced ground levels' in the vicinity of the proposed works downstream of the bridge crossing and provides approximately 4,000m^3 more flood volume than the 2190m^3 displaced by the Scheme.

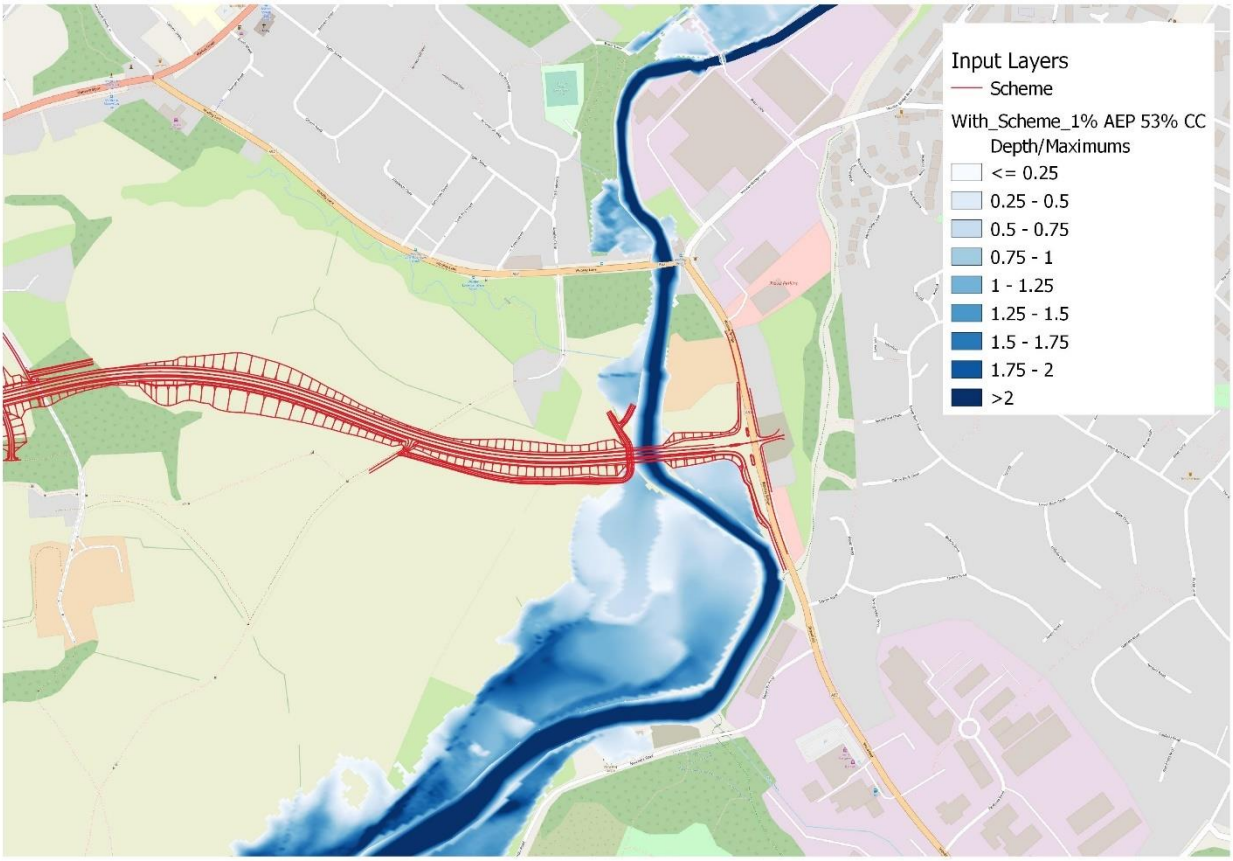
Insert 4-5 Area delineated and designated as Compensatory Flood Storage Area

4.6.16 The Scheme flood modelling which incorporates the defending of the left bank of the Etherow, the reprofiling of the River Etherow at the bridge crossing, the lowering of the right bank immediately downstream of the bridge crossing, development of a preferential flow route to the compensation area and the compensation area itself results in reduction in maximum peak level of 260mm when compared to baseline against the 53% cc flood level, with a peak downstream reduction of approximately 150mm thus not increase flood risk. See Insert 4-6 below for a modelled long section of baseline and with Scheme peak flood level and flood risk map associated with the Scheme (shown below in Insert 4-7).



River Section Label	Baseline maximum flood level mAOD	With Scheme maximum flood level mAOD
ETH_1507	121.774	121.748
ETH_1439	121.514	121.462
ETH_1309	121.149	120.886
ETH_1221u	120.54	120.458
ETH_1221	120.565	120.394
ETH_1221d	120.528	120.382
ETH_1090	120.402	120.325

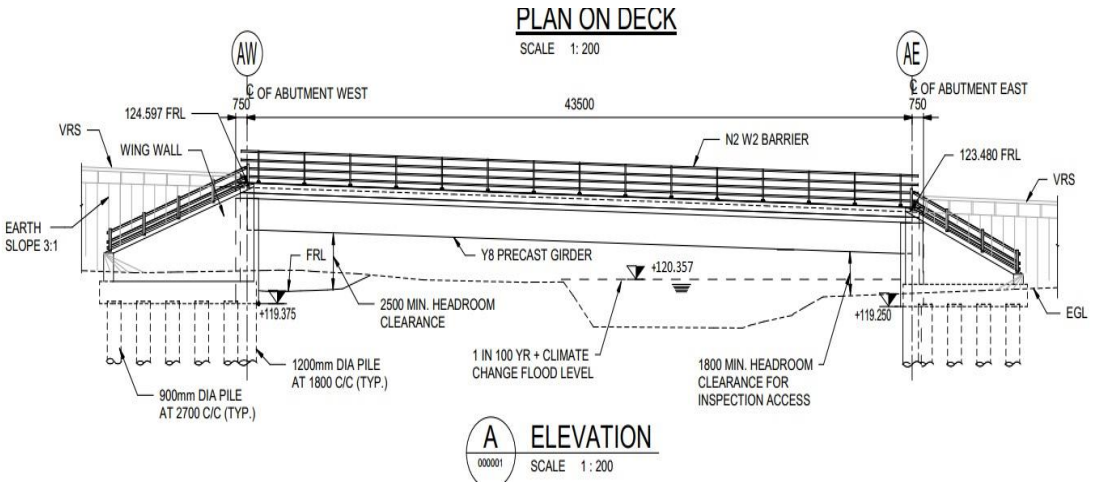
Insert 4-6 Approximately 500m Long Section covering immediately upstream and downstream of the proposed Etherow Bridge Crossing, comparing peak flood levels (mAOD) for pre and post Scheme for the 1%AEP event plus climate change allowance



Insert 4-7 Post Scheme Flood depth map for the 1% AEP event plus 53% climate change allowance

4.6.17 The maximum flood level in the 1% AEP+53%cc, is 120.39m AOD at the location of the proposed River Etherow crossing.

4.6.18 The Woolley Bridge junction crossing of the River Etherow is required to be set sufficiently high enough as not to create an obstruction during times of flood flow (1%AEP+53% CC+600 mm freeboard). See proposed cross section drawing of proposed River Etherow Bridge crossing below.



Insert 4-8 Proposed River Etherow Bridge Crossing design in relation to peak flood level for the 1%AEP event plus climate change allowance of 53%

Culverts

4.6.19 New culverts are proposed at the following watercourses:

- WC_200
- WC_210
- WC_214
- Hurstclough Brook (WC_300) (with river realignment)
- WC_340

4.6.20 Where culverts are proposed it will be a requirement in line with DMRB guidance that where the structures are longer than 12 meters it shall be at least 1.2 m in diameter for a circular culvert and 1.2 meters in height for a box culvert.

4.6.21 Where hydrological calculations or cover depth require a culvert smaller than that stated in the DMRB guidance, approval of the LLFA will be required.

Drainage

Scheme impacts on groundwater flooding

4.6.22 Scheme components which may have an impact on groundwater flood risk are:

- The new Mottram underpass which will be located 60 m east of Roe Cross Road, the top of which would be 2 m below ground level.
- The associated cutting at Mottram to the east of the underpass

4.6.23 Construction of underpasses and below ground longitudinal structures (e.g. sheet piling) if they intersect with groundwater, and the groundwater flow direction is perpendicular to the structures, may form a barrier to groundwater flow, and potentially increase groundwater flood risk on the upgradient side of the barrier.

4.6.24 The Hydrogeological Risk Assessment (Appendix 13.2 of the ES (TR010034/EXAM/9.43)) has been carried out to assess the potential impacts of the Scheme on groundwater levels and flows. To do this, a three dimensional groundwater model of the area of catchment surrounding the Scheme was constructed and calibrated to observed data to represent the baseline case. Key features of the Scheme were then applied in the model to allow the potential impacts from the Scheme to be simulated.

4.6.25 This assessment showed that increases in groundwater level would occur associated with the secant piles around Mottram Underpass. However, these increases would be limited to the immediate vicinity of the pile walls and would not extend beyond the red line boundary of the Scheme. This is because the dominant effect is one of drawdown of groundwater, associated with drainage in the adjacent cutting. Maximum increases in groundwater level were modelled to be <2 m which is within the seasonal variability of the groundwater level. The full results of the modelling and impact assessment are presented in Appendix 13.2 of the ES (TR010034/EXAM/9.43).

4.6.26 Mitigation measures to manage the risk of groundwater flooding at the Scheme construction and operation will include designing the drainage strategy to allow for management of groundwater contributions to surface water flow. Where possible, this would be in keeping with the current groundwater flow pathways. The current design is based on secant pile walls, other piling methods could be used to reduce the risk of increased groundwater levels upgradient of Mottram Underpass.

5. Conclusions and Recommendations

5.1 Conclusions

5.1.1 The works will comprise new link roads connecting the M67 Junction 4 to Woolley bridge, junction creation, new road in cutting, new underpasses and new bridge structures including a clear span crossing of the River Etherow.

5.1.2 Assessment of existing flood risk information has indicated that the Scheme passes through locations identified as being at risk of flooding from various sources. In accordance with local and national planning policy, this FRA has been undertaken to identify flood risk to the Scheme and the impact of the Scheme on flood risk elsewhere, within these locations.

5.1.3 Flood risk to the Scheme overall is generally considered to be low during construction and operation, the most significant sources are fluvial, and surface water flooding. The Scheme is defined as “Essential Infrastructure” and parts of the Scheme lie in Flood Zones 2 and 3 but are considered to be an acceptable development within these flood zones.

5.1.4 The EA and LLFA have been consulted to identify key requirements and data.

5.1.5 Allowances for climate change have been incorporated in accordance with the latest guidance (53% for design).

5.1.6 The impact of the Scheme on fluvial flood risk will predominantly be associated with earthworks encroaching into the River Etherow floodplain area in the vicinity of Woolley Bridge.

5.1.7 The Scheme with mitigation appears not to impact peak water adversely during the 1% annual chance event including climate change allowance in the vicinity of the proposed earthworks and crossing of the River Etherow.

5.1.8 Any loss of flood volume will require replacing on a volume for volume basis. A location and volume have been agreed with EA.

5.1.9 To achieve the requirements of the EA the compensatory flood storage provision of approximately 6,200m^3 has been delineated to reduce peak flood level during the 100 year plus climate change allowance event.

5.1.10 The soffit of the bridge crossing is above the 1% AEP flood level plus climate change allowance.

5.1.11 Surface water flood risk to the Scheme will predominantly be associated with sections of road in cutting. The proposed surface water drainage measures will mitigate flood risks elsewhere associated with the Scheme.

5.1.12 Groundwater flood risk to the Scheme is associated with construction of underpasses and below ground structures where they intersect with groundwater. A Hydrogeological Risk Assessment (Appendix 13.2 of the ES (TR010034/EXAM/9.43)) has been carried out in order to assess the local scale groundwater flood risk. This assessment did not identify any significant risks of groundwater flooding associated with the Scheme to areas outside the DCO boundary.

5.2 Recommendations

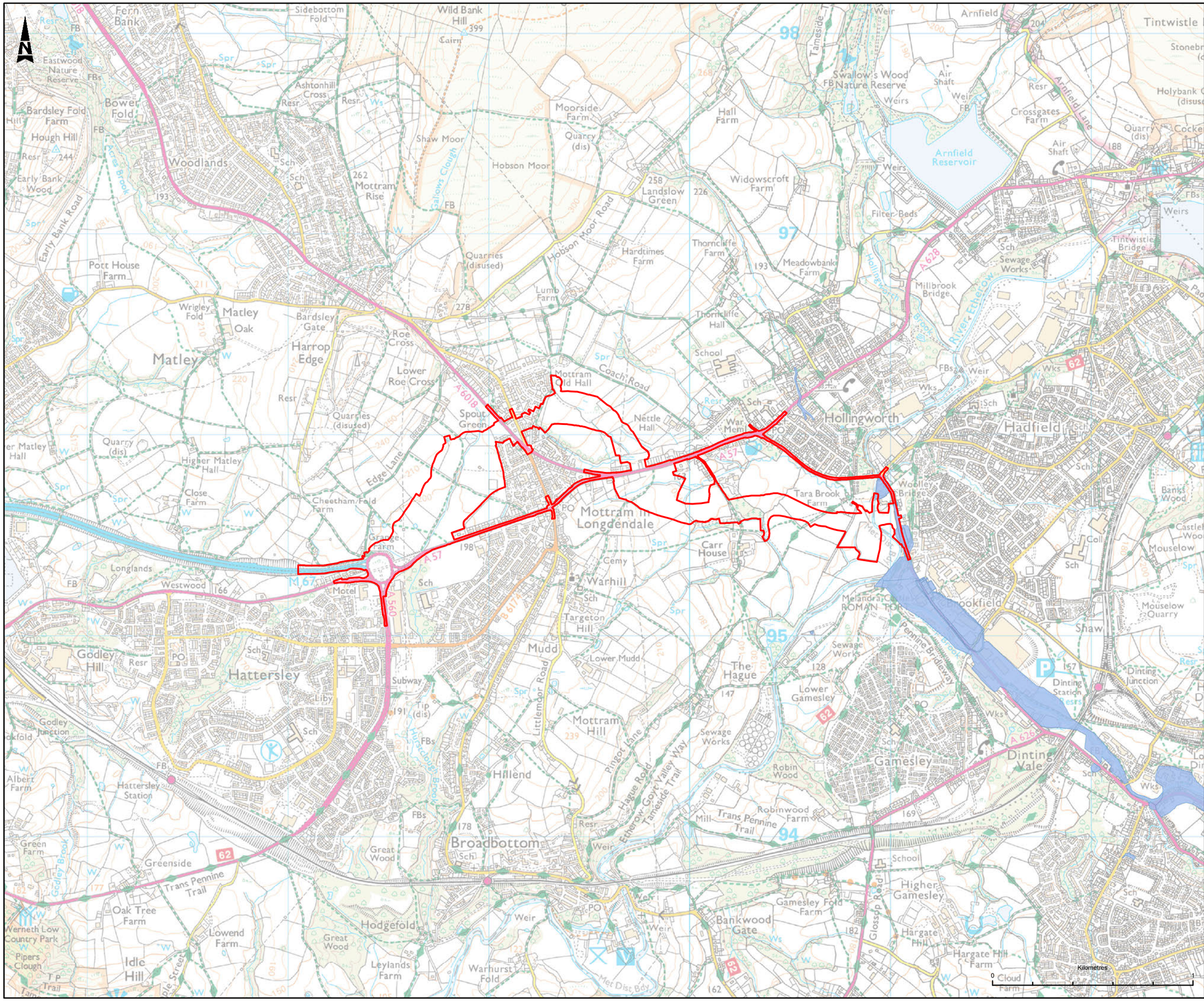
5.2.1 The setting of the soffit of the bridge crossing should be above the 1% AEP +CC flood level with a 600 mm freeboard allowance.

5.2.2 All culverted Ordinary Watercourse crossings and realignments should be undertaken in accordance with DMRB standards and best practice and agree with LLFA as part of the Land Drainage consenting process.

5.2.3 The supplementary ground investigation report should be used to further inform the assessment in terms of groundwater level information in the areas of the Scheme not covered by existing data.

Figures

Figure 4-1 Historic Flood Outline



LEGEND

DEVELOPMENT CONSENT ORDER (DCO) BOUNDARY

HISTORIC FLOOD OUTLINE

Description			
Status	Revision	Issue Date	
Description			
Status	Revision	Issue Date	
Description			
Status	Revision	Issue Date	
Description	DCO SUBMISSION		
Status A4	Revision P01	Issue Date 15/06/21	
Drawn SD	Checked PP	Reviewed LY	Authorised MR
Drawing Suitability DCO SUBMISSION			Status A4

Client: highways england

Scheme Name: A57 LINK ROADS

Drawing Title:

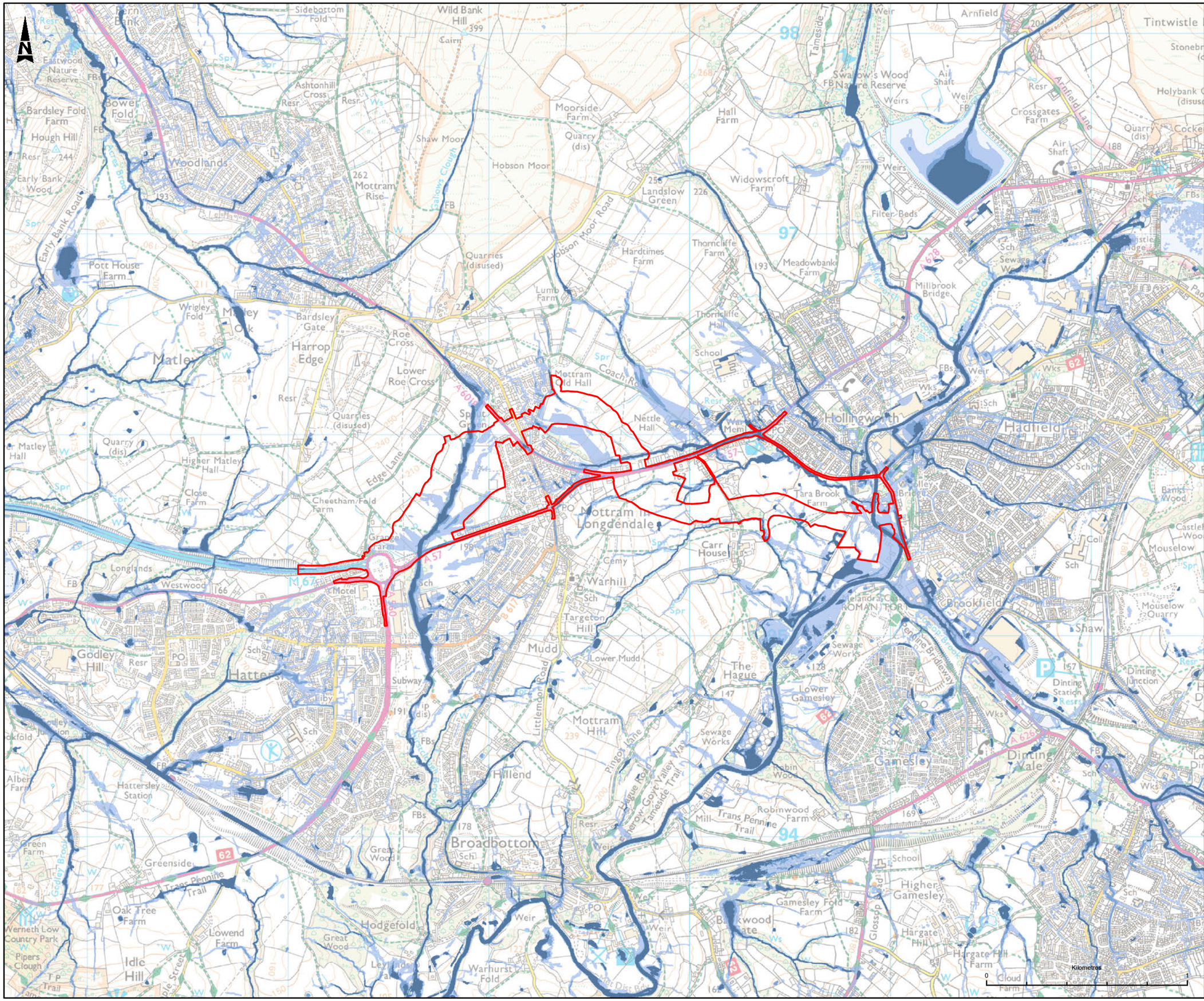
FIGURE 4-1
HISTORIC FLOOD OUTLINE

PINS Ref. No: TR010034/APP/5.5

Drawing Number
Scheme | Originator | Volume
HE551473 - BBA - EGN -
A57_AL_SCHEME - DR - LE - 080170
Location | Type | Role | Number

Scale	Original Size	Rev
1:17,500	A3	P01

Figure 4-2 Environment Agency Surface Water Flood Risk



LEGEND

DEVELOPMENT CONSENT ORDER (DCO) BOUNDARY

RISK OF FLOODING FROM SURFACE WATER (RoFSW)

- RoFSW 30 YEAR
- RoFSW 100 YEAR
- RoFSW 1000 YEAR

Description			
Status	Revision	Issue Date	
Description			
Status	Revision	Issue Date	
Description			
Status	Revision	Issue Date	
Description	DCO SUBMISSION		
Status A4	Revision P01	Issue Date 15/06/21	
Drawn SD	Checked PP	Reviewed LY	Authorised MR
Drawing Suitability DCO SUBMISSION			Status A4

Client: highways england

Scheme Name: A57 LINK ROADS

Drawing Title: FIGURE 4-2 ENVIRONMENT AGENCY SURFACE WATER FLOOD RISK

PINS Ref. No: TR010034/APP/5.5

Drawing Number

Scheme	Originator	Volume	
HE551473	BBA	EGN	
A57_AL_SCHEME	DR	LE	060454
Location		Type	Role	Number

Scale	Original Size	Rev
1:17,500	A3	P01

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