

Visual Impact Provision (VIP) - Peak District (East) Project

EAR Volume 1 Chapter 9: Water Resources

Appendix 9I Flood Risk Assessment

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EXECUTIVE SUMMARY

This Flood Risk Assessment (FRA) supplements the Environmental Assessment report (EAR) and is also accompanied by a SuDS Strategy for the Peak District (East) Visual Impact Provision (VIP) project.

This document has been produced in accordance with the National Planning Policy Framework (NPPF) and supporting Planning Practice Guidance (PPG). As set out in the NPPF and PPG, the objectives of a FRA are to establish that:

- Flood risk is taken into account at all stages of the planning process to ensure that new development is appropriate for its location;
- The Proposed Project will remain safe; and
- The Proposed Project will not increase flood risk elsewhere and will reduce flood risk overall, where possible.

In order to do so, this FRA has been used to:

- Identify elements of the Proposed Project at risk of flooding based on Environment Agency mapping, and groundwater flood risk mapping provided by JBA;
- Meet the PPG requirements; and
- Develop flood risk mitigation measures to ensure that the Proposed Project does not result in an increase in flood risk elsewhere during its construction, operational and decommissioning phases.

The primary source of flood risk to the Proposed Project is fluvial, from the River Don. Detailed 1D/2D flood modelling of the River Don has been undertaken to support this FRA. The flood modelling has been used to ensure that the Proposed Project will remain safe and will not result in an increase in flood risk elsewhere, over its intended design lifetime.

This FRA confirms that the Proposed Project will meet the requirements of the NPPF/PPG. Specifically, this FRA has demonstrated that:

- The land use of the Proposed Project is appropriate for location within Flood Zones 1, 2 and 3 and the development proposals will not involve an increase in the number of people or staff visiting or working within a flood risk area during its operational phase;
- The Proposed Project will remain operational and safe for users in times of flooding over the duration of its intended operational lifetime;
- A SuDS strategy will be implemented for the design lifetime of the Operational phase of the Proposed Project in order to sustainably manage the surface runoff generated from the new impermeable areas; and
- The Proposed Project will not have a detrimental impact on the floodplain of the River Don due to the temporary nature of the work.

In summary, this FRA has demonstrated that the Proposed Project is appropriate for its location, will remain operational and safe for users in times of flooding, and will not result in an increase in off-site flood risk.

GLOSSARY AND ABBREVIATIONS

Abbreviation/Term	Description
Aquifer	A body of permeable rock that is capable of storing significant quantities of water and through which groundwater moves
mAOD	metres Above Ordnance Datum (Newlyn)
Area of Outstanding Natural Beauty (AONB)	An area of outstanding natural beauty (AONB) is land protected by the Countryside and Rights of Way Act 2000 (CROW Act). It protects the land to conserve and enhance its natural beauty.
Bedrock aquifer	Solid geological formations e.g. sandstone, chalk and limestone.
CBS	Cement Bound Sand
EA	Environment Agency
ES	Environmental Statement
FEH	Flood Estimation Handbook
Floodplain	A floodplain is the area that would naturally be affected by flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas
FRA	Flood Risk Assessment (England)
FZ	Flood Zone
FZ1	Areas outside of flood zones 2 or 3, i.e. where the risk of flooding from rivers or the sea is less than a 0.1 per cent chance of occurring each year
FZ2	An area that could be affected by flooding, either from rivers or the sea, if there were no flood defences. These areas are likely to be affected by a major flood, with up to a 0.1 per cent chance of occurring each year
FZ3	An area that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded: <ul style="list-style-type: none"> from the sea by a flood that has a 0.5 per cent or greater chance of happening each year; or from a river by a flood that has a 1 per cent or greater chance of happening each year.
Groundwater	Water flowing through or contained beneath the ground surface
LLFA	Lead Local Flood Authority
NGTS	National Grid Technical Specification
NPPF	National Planning Policy Framework
Permeability	The property or capacity of a rock, sediment or soil for transmitting a fluid

Abbreviation/Term	Description
PPG	Planning Practice Guidance
Principal aquifer	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river baseflow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
Runoff	The water derived from snow or rain falling on a surface which does not permeate into the soil
Secondary A aquifer	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. These are generally aquifers formerly classified as minor aquifers.
Secondary B aquifer	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
Secondary Undifferentiated aquifer	Aquifer that 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.
SuDS	Sustainable Drainage System - SuDS seek to mimic natural drainage systems and retain water on or near to the site, when rain falls, in contrast to traditional drainage approaches, which tend to pipe water off the site as quickly as possible. SuDS offer significant advantages over conventional piped drainage systems and are applicable to most sites.
Superficial aquifer	Permeable unconsolidated (loose) deposits. For example, sands and gravels.
Surface Runoff	The flow of water over a land surface when rainfall can no longer soak into the ground below.

1 INTRODUCTION

1.1 Purpose

This document presents the findings of a Flood Risk Assessment (FRA) undertaken to accompany a planning application for National Grid's proposed Visual Impact Provision (VIP) project in the Peak District (East), UK. The VIP Project is located within the Peak District National Park and the associated planning application will be submitted to Barnsley Metropolitan Borough Council as the Lead Local Flood Authority (LLFA) for determination.

National Grid's Peak District (East) VIP project comprises:

- a temporary diversion of the Trans Pennine Trail;
- the construction of a new Sealing End Compound (SEC) and access road;
- temporary laydown areas, access tracks and site offices (including northern access road);
- the construction of a new 1.8km long underground cable route;
- the removal of existing infrastructure (VIP subsection); and
- the construction of a replacement pylon;

Planning permission is required for the Trans Pennine Trail diversion, construction of the new SEC and northern access route. Construction of limited sections of the proposed Trans Pennine Trail diversion and a short length (circa. 25m) of the northern access route are in the Environment Agency's (EA's) flood Zone 3 and therefore requires the submission of an FRA, details of which are in Section 3. This FRA forms an appendix to the Environmental Assessment Report (EAR).

Additionally, the EA does not hold any detailed information on flood risk on the River Don (i.e. flood level information derived from a detailed flood model of this watercourse). As such, detailed flood modelling of the River Don was undertaken to support this FRA, to ensure that flood risk was taken into account at every stage, and that the Proposed Project will not result in an increase in flood risk elsewhere.

This FRA, therefore, seeks to demonstrate that flood risk from all sources has been considered as part of the Peak District (East) VIP Project and that the requirements of a series of tests are met, namely the Planning Practice Guidance (PPG) Sequential and Exception Tests. This FRA is also accompanied by a SuDS Strategy report, which is included in Appendix 9K of the EAR.

This FRA has been produced in accordance with the National Planning Policy Framework (NPPF) and supporting PPG. As set out in the NPPF and PPG, the objectives of this FRA are to ensure that:

- Flood risk is taken into account at all stages of the planning process to ensure that the new development is appropriate for its location;
- The Proposed Project will remain safe; and
- The Proposed Project will not increase flood risk elsewhere and will seek to reduce flood risk overall where possible.

1.2 Overview of the Proposed Project

The Visual Impact Provision (VIP) Project represents a major opportunity to conserve and enhance the natural beauty, wildlife and environmental heritage within Great Britain's most protected landscapes. The VIP Project will make use of a £500m allocation by Ofgem to carry

out work to help reduce the impact of existing transmission lines in selected English and Welsh Areas of Outstanding Natural Beauty (AONBs) and National Parks.

Following the results of a landscape and visual impact assessment undertaken in 2014, covering 571km of overhead line (OHL) within the scope of the VIP Project, twelve transmission lines in eight AONBs and National Parks were identified as having the most significant visual impact. In September 2015, the VIP Project's Stakeholder Advisory Group considered a wide range of factors and recommended four projects to be taken forward for potential engineering work, one of which is located within the Peak District National Park.

National Grid is proposing to underground a section of the existing OHL within the Peak District National Park. The project is referred to as the Peak District (East) Project (hereafter referred to as the Proposed Project for the purpose of this FRA) and forms part of the wider VIP Project.

As outlined within Chapter 1 (Introduction) of the EAR, the Proposed Project will be subject to a number of consenting regimes.

The Proposed Project comprises the following main elements:

1.2.1 Trans Pennine Trail Diversion – Subject to Planning Application

Construction and subsequent removal of a temporary Trans Pennine diversion for use during the construction phase of the Proposed Project. The diversion will involve the use of two bridges, one being a permanent replacement of an existing bridge; the other a temporary bridge to cross over the River Don. The diversion is proposed in farmland immediately north of the River Don.

1.2.2 Sealing End Compound– Subject to Planning Application

Construction of a new SEC within Wogden Foot Local Wildlife Site (LWS) and a separate replacement tension pylon located approximately 40m north east of the SEC on the northern side of the River Don, close to the location of the existing Pylon 4ZO157. Within the SEC the circuits will terminate onto two full tension gantries to connect the cable Corridor to the remaining existing OHL. A permanent access off the Trans Pennine Trail will be required to the proposed SEC and associated laydown areas.

1.2.3 Access Point 7 and Northern Access Road– Subject to Planning Application

Temporary laydown areas, access tracks (including from the highway Windle Edge and Brook Hill Lane), to the pylons to be removed and along the Trans Pennine Trail to the SEC at Wogden Foot as well as site offices will be required to facilitate construction activities.

1.2.4 400kV Cable (Undergrounding)

An underground XLPE cable approximately 1.8km beneath the route of the Trans Pennine Trail from the entrance of the Woodhead Tunnel to a proposed new SEC. It includes works within the Existing Operational National Grid Compound at Dunford Bridge, works within the existing Trans Pennine Trail and the cable undergrounding within Wogden Foot Local Wildlife Site, along with associated access tracks and laydown areas.

1.2.5 Removal of Existing Infrastructure (VIP subsection)

Removal of the existing VIP Subsection including eight pylons (one of which will be replaced, see Pylon 4ZO157R below) and 2km of OHLs.

1.2.6 Construction of replacement Pylon 4ZO157R

A new Tension Pylon 4ZO157R will be constructed to replace Pylon 4ZO157, including the replacement of conductors and connection to the SEC.

Further details of the Proposed Project during operation are presented in Figure 2.3 of the EAR.

1.3 Report Objectives and Structure

This report has been prepared in accordance with the requirements of the (NPPF) and the PPG as described in Section 4.1 below. The objectives of this report are to, a) quantify the flood risk to the Proposed Project; b) demonstrate that the Proposed Project will remain operational and safe for its users during flood conditions over its intended lifetime taking climate change into consideration; and c) demonstrate that the Proposed Project will not increase flood risk elsewhere and will seek to reduce flood risk overall where possible.

This FRA covers the flood risk issues associated with the construction, operational and decommissioning phases of the Proposed Project.

The report is structured as follows:

- Section 1 describes the existing site and its physical characteristics such as topography, hydrology, hydrogeology, soils and land use. This section also describes the different elements of the Proposed Project;
- Section 2 assesses the risk of flooding to the Proposed Project from all potential sources. This section also presents the results of detailed 1D/2D flood risk modelling undertaken to help avoid and/or minimise the flood risk impacts of the Proposed Project;
- Section 3 covers the relevant planning policies related to the preparation of FRAs including the requirements of the NPPF and the PPG, relevant local flood risk policies, as well as the requirements of the Sequential and Exception Tests;
- Section 4 covers the key flood risk considerations that need to be addressed in order for the Proposed Project to comply with the requirements of the NPPF and PPG. This section also covers the implications of Climate Change;
- Section 5.3 provides details of the flood risk management measures and recommendations to reduce or limit flood risk to and from the Proposed Project; and
- Section 6 presents the conclusions of this FRA.

1.4 Available Information

This FRA is based on the following available information and reports:

- [Barnsley Strategic Flood Risk Assessment Level 1](#), September 2010;
- Barnsley Metropolitan Borough Council, [Preliminary Flood Risk Assessment Report](#), July 2011;
- Barnsley Metropolitan Borough Council, [Local Flood Risk Management Strategy](#), September 2017;
- [Protocol for Arrangements to Deal with Sustainable Drainage Systems Used on New Major Developments](#), Barnsley Metropolitan Borough Council; and
- 1D/2D flood risk modelling outputs for the River Don produced by Stantec.

Information on historical flood events was requested from Barnsley Metropolitan Borough Council and the Environment Agency, however, both organisations were unable to provide such information with respect to the Proposed Project boundary.

1.5 1D/2D Flood Modelling of the River Don and its tributaries

One of the elements of the Proposed Project which required careful consideration in terms of flood risk was the Trans Pennine Trail diversion. The existing Trans Pennine Trail is to be temporarily diverted during the construction phase from its current route alongside the River Don to a new route that traverses the river and its floodplain in two locations, in addition to running closely parallel to the River Don in places. The design of the Trans Pennine Trail diversion required careful consideration to ensure that its users (i.e. the general public) will not be exposed to greater levels of flood risk.

Furthermore, the Proposed Project will inherently involve some construction activities within areas of the floodplain of the River Don and so detailed information on flood risk was required to help ensure the safety of construction staff.

These flood risk considerations are presented and assessed in more detail in Section 5.

Detailed 1D/2D flood risk modelling of the River Don was, therefore, undertaken to address the above considerations. The results have been used to support the Proposed Project in the following ways:

- To design the Trans Pennine Trail diversion so that it is located outside of the 1 in 100 year (plus climate change) modelled flood outline wherever possible;
- To safely design the new permanent and temporary bridges along the Trans Pennine Trail diversion and other areas of the Proposed Project that cannot avoid flood risk areas;
- To provide detailed information on the frequency of flooding, flood depth, velocity and hazard to people for any element of the Proposed Project that interacts with the flood risk areas;
- To assess the impact of the diverted Trans Pennine Trail on the floodplain of the River Don and, if necessary, help to design mitigation measures;
- To provide information on construction phase flood risk and health and safety considerations for construction staff;
- To help to reduce the environmental impact of the construction, operational and decommissioning phase activities;
- To provide information to support the planning application and any subsequent land drainage consent applications that may be required for the new permanent and temporary bridge crossings on the River Don; and
- To help to answer questions raised by the potential users of the diverted Trans Pennine Trail e.g. during public consultation events.

A Technical Note describing the flood risk modelling methodology is presented in Appendix 9I.A and the 1 in 100 year (plus climate change) flood outline for the Proposed Project is presented in Figure 9.1 of the EAR.

2 DESCRIPTION OF THE EXISTING SITE AND PROPOSED PROJECT

2.1 Existing Site Description

The extent of the Proposed Project is defined by the site boundary as shown in Figure 2.3 of the EAR. This section provides information on the site location and a description of the

physical characteristics of the existing site. This description includes the site topography, hydrology, hydrogeology, soils and land use, which are some of the main physical characteristics affecting flood risk.

2.1.1 Site location

The Proposed Project is located within the Barnsley Metropolitan Borough Council area, which is part of South Yorkshire County Council. The following description of the existing site is from West to East.

The Proposed Project starts west of Dunford Bridge, by the Woodhead Tunnel (disused) (Eastings=415,798.5; Northings=402,402), which is an existing National Grid site.

The proposed cable route starts at the existing Trans Pennine Trail car park (Eastings=415,570; Northings=402,266) and follows the route of the existing Trans Pennine Trail over 1.8km running parallel to the southern bank of the River Don to end in the Wodgen Foot LWS. The Trans Pennine Trail will be diverted north of the River Don. The temporary Trans Pennine Trail diversion will run parallel to the northern bank of the River Don from the first crossing of the river (Eastings=416,195; Northings=402,420) to the second crossing at the Wodgen Foot LWS (Eastings=417,236.5; Northings=402,685.5), and will follow an existing farm track where possible. The first crossing will involve the permanent replacement of an existing bridge and the second crossing will involve the construction of a new temporary bridge. The proposed new SEC required to connect the cable route to the existing overhead line will be located in the Wodgen Foot LWS, between the south bank of the River Don and the northern side of the existing Trans Pennine Trail.

The replacement terminal pylon (i.e. Pylon 4ZO157R) is located to the north of the River Don with its replacement conductor line crossing the watercourse at a high level.

The Proposed Project layout and site boundary for the permanent operational elements are presented in Figure 2.3 of the EAR.

A photographic log is included in Appendix 9K of the EAR, which shows the site and its associated water features.

2.1.2 Topography

The site is located within the Peak District National Park, which is characterised by the presence of steep embankments and narrow valleys. The elevation at the Woodhead Tunnel is 291m AOD and 278m AOD at the proposed new SEC. Appendix 9I.B shows the topography of the existing site¹.

2.1.3 Hydrology

The Proposed Project is located within the upper reaches of the River Don, which rises in the moorlands of the Pennines.

The River Don passes through the Proposed Project area, flowing west to east from the Winscar Reservoir. At this location, the River Don is classed as an Ordinary Watercourse, only becoming a Main River after passing beneath the A628 at Millhouse Green approximately 1.7km to the east of the Proposed Project.

¹ LiDAR Digital Terrain Model (DTM) data provided by 3D Engineering (Aerial), in March 2017.

There are a number of small tributaries that flow into the River Don, mainly from the south. These include the Smallden Clough, Clough Beck, Short Grain and Wodgen Foot. These streams, with the exception of Smallden Clough, are culverted under the Trans Pennine Trail before flowing into the Upper Don. Smallden Clough is culverted under Dunford Bridge. Town Brook flows from the north into the River Don.

To the east of the project and the A6106, the Sledbrook Dike joins the River Don. After this, the River Don flows generally in an easterly direction, passing to the south of the village of Millhouse Green some 1.7km to the east.

Many drains (small streams), plus 'issues' and 'grains' (i.e. natural channels or fissures in a peat moor), flow in a northerly direction into the River Don, from Thurlstone Moors. These streams are culverted under the Trans Pennine Trail. Small streams, plus 'issues' and 'sinks' also flow in a southerly direction into the River Don, from Sand Ridge and Cocker Edge, through farmland adjacent to the river and around Town Head.

A waterfall feature is present along the Trans Pennine Trail, which has been highlighted as locally important from a visual perspective.

There are a number of impounding reservoirs located in the west of the site boundary. These are the Snailsden and Harden reservoirs on the northern tributary of the River Don, the Winscar Reservoir, which is on the River Don itself, and the Upper and Lower Windleden reservoirs located on a southern tributary of the River Don.

The reservoirs are operated by Yorkshire Water Services Limited (YWSL) and have a significant impact on river flows entering the Study Area from the west, given that these upstream flows will predominantly reflect compensation and regulated releases from these reservoirs, supplemented by spills when the reservoirs are full.

Figure 9.2 of the EAR shows the watercourses described above.

Table 1 presents the key hydrological characteristics of the River Don catchment to a location just downstream of the Proposed Project. These hydrological characteristics were extracted from the Flood Estimation Handbook (FEH)².

Table 1 Key hydrological characteristics of the River Don catchment, to a location just downstream of the Proposed Project (extracted from the FEH)

FEH Catchment Descriptor	Upper part of River Don catchment just downstream of the Proposed Project
Catchment area (km ²)	18.7
BFIHOST ³	0.298

² <https://fehweb.ceh.ac.uk/>

³ This base flow index is a measure of catchment responsiveness derived using the 29-class Hydrology Of Soil Types (HOST) classification.

FEH Catchment Descriptor	Upper part of River Don catchment just downstream of the Proposed Project
DPSBAR ⁴	114.9
FARL ⁵	0.822
PROPWET ⁶	0.57
SAAR ⁷	1404
SPRHOST ⁸	52.99
URBEXT2000 ⁹	0.0004

The BFIHOST or Baseflow Index represents the contribution of groundwater to river flow based on a specific soil type (HOST) classification. According to

Table 1, the ratio of baseflow compared to total stream flow for the upper part of the River Don catchment is 0.298, meaning that baseflow is a small contributor to the total river flow confirming that this catchment is mainly fed by surface water runoff.

The DPSBAR index is a representation of the mean drainage path slope and helps to describe catchment topography. According to

Table 1, the DPSBAR value is 114.9 for the River Don catchment. This value reflects the slopes and steep embankments found within this part of the Peak District National Park.

The FARL value is 0.822 meaning that the reservoirs located in the upper reaches provide significant flood attenuation within this catchment.

The PROPWET value represents the proportion of time where soils are saturated. A PROPWET value of 0.57 suggests that soils within this catchment are saturated on average 57% of the time.

The SAAR (Standardised Average Annual Rainfall) value is 1404mm, which is representative of a relatively wet catchment.

The SPRHOST value shows the percentage of rainfall that is converted into runoff based on soil class (HOST). According to

⁴ This landform descriptor (mean Drainage Path Slope) provides an index of overall catchment steepness. The index is expressed in metres per kilometre with values ranging from >300 in mountainous terrain to <25 in the flattest parts of the country.

⁵ The Flood Attenuation by Reservoirs and Lakes (FARL) index provides a guide to the degree of flood attenuation attributable to reservoirs and lakes in the catchment above a gauging station.

⁶ Dry soils tend to inhibit flood formation whilst, in contrast, saturated soil conditions precede and contribute to many large flood events. PROPWET values range from over 80% in the wettest catchments to less than 20% in the driest parts of the country.

⁷ Average annual rainfall in the standard period (1961-1990) in millimetres.

⁸ Standard percentage runoff (%) associated with each HOST soil class.

⁹ Extent of urban and suburban land cover in 2000 expressed as a fraction.

Table 1, the SPRHOST value for the River Don catchment is 52.99% showing that more than half of the proportion of rainfall falling in this catchment produces runoff. This value, alongside the BFIHOST of 0.298, is characteristic of an impermeable catchment where a large proportion of rainfall produces runoff.

The URBEXT2000 value of 0.0004 is representative of an essentially rural catchment.

2.1.4 Hydrogeology

The bedrock geology within and neighbouring the Proposed Project is relatively complex and dominated by the mudstones, siltstones and sandstones associated with the Millstone Grit Group present within the central, north western and southern portions of the Study Area. This transitions to the Pennine Lower Coal Measures Formation (which includes mudstones, siltstones, sandstones, coal, ironstone and ferricrete), and the South Wales Lower Coal Measures Formation, which are both present across the north eastern and parts of the south eastern areas neighbouring the Study Area. A fault oriented in a northwest-southeast direction crosses the central area of the Study Area. This fault extends from the west of Flint Lane, the B6106, to the A628, where it meets another perpendicular fault, running approximately 1.4km south of the Study Area. In neighbouring areas to the north, west and south, superficial deposits of peat are found, with peat soils located within the Study Area. There are also alluvium deposits found in the base of the valley. With respect to aquifers within and neighbouring the Proposed Project, there are “Secondary A” bedrock and superficial aquifers associated with the Millstone Grit Group.

The geology and hydrogeology of the site are presented in Figure 10.2 and Figure 10.3 respectively.

2.1.5 Soils

The LandIS soilscape map¹⁰ was used to identify the soil types within the site boundary. According to this map, the western and eastern parts of the site are within *soilscape 19* which is defined by slowly permeable, wet and very acid upland soils with a peaty surface impeding drainage. The middle section of the site is *soilscape 16* which is defined by very acid and loamy upland soils with wet peaty surface supporting surface wetness.

These soils are characteristics of the type of soils expected in the upland Peak District National Park.

2.1.6 Land use

The Proposed Project covers mainly land used for grazing and recreational purposes (i.e. the Trans Pennine Trail).

2.2 Details of the Proposed Project

Detailed of the proposed project can be found in Chapter 2 (Project Description) of the EAR.

3 FLOOD RISKS TO THE PROPOSED PROJECT

3.1 Potential Sources of Flooding

Flooding can occur from a number of sources as presented in Table 2.

¹⁰ Developed by Cranfield University and sponsored by DEFRA

Table 2 Possible sources of flooding identified in the Planning Practice Guidance (PPG)

Source	Description
Flooding from rivers (or fluvial flooding)	River flows which exceed the flow capacity of the river channel (or culverts) and causes overtopping or a breach can cause flooding from rivers. It can happen for example, when heavy rain falls on an already waterlogged catchment. A blockage caused by natural material or manmade objects/litter can also cause rivers to overtop their banks.
Flooding from the sea (or coastal and tidal flooding)	High tides and/or storm surges which lead to overtopping of existing defences (if any) can cause flooding from the sea.
Flooding from surface water (or pluvial flooding)	Intense rainfall that cannot soak into the ground or enter drainage systems can quickly run off the land and result in local flooding. This type of flooding is typically localised and happens very quickly after the rain has fallen.
Flooding from groundwater	Groundwater flooding occurs when water levels in the ground rise above surface elevations. It is most likely to occur in areas underlain by permeable rocks or granular layers called aquifers.
Flooding from sewer	Sewer flooding can occur when piped systems are overwhelmed by heavy rainfall, when sewers become blocked or when sewers are of inadequate capacity.
Flooding from reservoirs, canals and other artificial sources	Non-natural or artificial sources of flooding can include reservoirs, canals and lakes where water is retained above natural ground level.

3.2 Flood Map for Planning

3.2.1 Planning Practice Guidance (PPG) Flood Zones

The Planning Practice Guidance (PPG) defines three flood zones as shown in Table 3. The following section presents the PPG Flood Zone classification for the various components of the Proposed Project based on the Environment Agency's Flood Map for Planning. The Flood Map for Planning is shown in Figure 9.6 of the EAR.

Table 3 PPG Flood Zones

Flood Zone	Description
1	Low probability – less than 1 in 1,000 year (<0.1%) for river or sea flooding.
2	Medium probability – between 1 in 1,000 year (0.1%) and 1 in 100 year (1%) for river flooding or between 1 in 1,000 (0.1%) and 1 in 200 year for sea flooding.
3a	High probability – 1 in 100 year (1%) or greater for river flooding or 1 in 200 year (0.5%) or greater for sea flooding.
3b	The Functional Floodplain – land where water has to flow or be stored in times of flood. There is not a strict definition of the annual probability of flooding in this zone, but the 1 in 20 year (5%) or greater return period should provide a starting point for consideration.

In addition to the Environment Agency's Flood Map for Planning, detailed 1D/2D flood risk modelling of the River Don has been undertaken to assess the flood risk to the Proposed Project from this source in detail. The 1 in 100 year (plus climate change) flood outline is presented in Figure 9.1 of the EAR and a technical note describing the river modelling process is presented in Appendix 9I.A. The results of which are discussed in this section.

3.2.2 Trans Pennine Trail diversion to the North of the River Don

The temporary Trans Pennine Trail diversion has been designed to be located outside the floodplain of the River Don wherever possible. The Environment Agency's Flood Map for Planning confirms that the Trans Pennine Trail diversion will be located in Flood Zone 1 over the majority of its route (see Figure 9.6 of the EAR). Flood Zone 1 is associated with a Low probability of flooding as described in Table 3.

The first ca.400m of the Trans Pennine Trail diversion on the western side will be located within Flood Zones 2 and 3. In this area, the existing Trans Pennine Trail is also located within Flood Zones 2 and 3 and, as such, there will be no relative increase in flood risk to its users along this first stretch. The Trans Pennine Trail diversion will also need to cross the River Don in two locations, and these new crossings have been designed using the results of the detailed flood risk modelling to ensure that they will remain safe and flood-free under the 1 in 100 year (plus climate change) event.

The detailed flood risk modelling confirms that the Trans Pennine Trail diversion will be located on land outside the 1 in 100 year (plus climate change) floodplain of the River Don over much of its route (see Figure 9.1 of the EAR). However, the Trans Pennine Trail diversion will need to interact with the floodplain of the River Don in the following locations:

1. At its first crossing point with the River Don, where the permanent bridge (i.e. Bridge 1) will be constructed. This new bridge has been designed using the results of the detailed flood modelling to ensure that it will remain operational and safe for its users over the duration of its intended design life;
2. At a location ca.100m to the east of Bridge 1: the presence of a steep embankment on the northern side of the River Don restricts available space and means that ca.100m

- of the Trans Pennine Trail diversion will need to be located in the 1 in 100 year (plus climate change) modelled floodplain of the River Don; and
3. At its second crossing point with the River Don, where the temporary bridge (i.e. Bridge 2) will be constructed. This new bridge has been designed using the results of the detailed flood modelling to ensure that it will remain operational and safe for its users over the duration of its intended design life.

3.2.3 Proposed Sealing End Compound and Access Road

The Flood Map for Planning confirms that the proposed new SEC and its access road will both be located within Flood Zone 1 (Figure 9.6 of the EAR). Flood Zone 1 is associated with a Low probability of flooding as described in Table 3. Figure 9.1 of the EAR also confirms that these components of the Proposed Project will be located outside the modelled 1 in 100 year (plus climate change) flood outline for the River Don.

3.2.4 Temporary Construction Elements (Including Access Point 7 and Northern Access Road)

According to the Flood Map for Planning, the majority of the temporary construction areas, laydown areas and access roads are located within Flood Zone 1 as shown in Figure 9.6 of the EAR. Flood Zone 1 is associated with a Low probability of flooding as described in Table 3. Some temporary elements will be partially located within Flood Zones 2 and 3.

This finding is supported by the results of the detailed flood outline mapping shown in Figure 9.1 of the EAR.

3.2.5 400kV Cable (Undergrounding)

According to the Environment Agency's Flood Map for Planning (presented in Figure 9.6 of the EAR), the cable route is mainly located in Flood Zone 1, which is associated with a low probability of flooding as detailed in Table 3.

However, limited sections of the proposed cable route of approximately 420m and 240m in length cross Flood Zones 2 and 3 respectively of the River Don. Flood Zones 2 and 3 are associated with a Medium and High probability of flooding respectively.

Additionally, the Flood Map for Planning mapping service¹¹ confirms that there are no flood defences or flood storage areas in the vicinity of the Proposed Project.

The modelled 1 in 100 year (plus climate change) flood outline is presented in Figure 9.1 of the EAR. The modelled results show that the first ca.350m of the cable route is located within the 1 in 100 year (plus climate change) flood outline, whilst the remainder of the cable route is located outside this high probability flood zone (see Figure 9.1 of the EAR).

3.2.6 Removal of existing infrastructure (VIP subsection), including the overhead line (OHL) removal, the dismantling of pylon structures and the removal of pylon foundations

According to the Flood Map for Planning, all existing pylons to be removed (except Pylon 4ZO157) are located in Flood Zone 1 as shown in Figure 9.6 of the EAR. Flood Zone 1 is

¹¹ <https://flood-map-for-planning.service.gov.uk/summary/362179/90219>

associated with a Low probability of flooding as described in Table 3. Pylon 4ZO157R is located in Flood Zone 3, which is associated with a High probability of flooding.

Figure 9.1 of the EAR also confirms that all pylons (except Pylon 4ZO157R) are located outside the modelled 1 in 100 year (plus climate change) flood outline for the River Don.

3.2.7 Construction of Pylon 4ZO157R, including replacement of conductors and connection to the new SEC

According to the Flood Map for Planning provided by the Environment Agency (Figure 9.6 of the EAR), the replacement Pylon 4ZO157R will be located in Flood Zone 1, which describes land with a low probability of flooding. The new overhead line will also be located mainly in Flood Zone 1 but crosses by necessity Flood Zones 2 and 3 of the River Don. By definition, however, the new overhead line will not interact with the floodplain and as such does not require further consideration. Figure 9.1 of the EAR also confirms that Pylon 4ZO157R will be located outside the modelled 1 in 100 year (plus climate change) flood outline for the River Don.

3.3 Flooding from Surface Water

The Environment Agency defines four levels of flood risk associated with flooding from surface water¹² which are described below:

- High: each year, the area has a chance of flooding of greater than 1 in 30 (3.3%);
- Medium: each year, the area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%);
- Low: each year, the area has a chance of flooding between 1 in 1,000 (0.1%) and 1 in 100 (1%); and
- Very Low: each year, the area has a chance of flooding of less than 1 in 1,000 (0.1%).

3.3.1 Trans Pennine Trail diversion to the North of the River Don

Based on the Environment Agency map showing the risk of flooding from surface water (Figure 9.7 in the EAR), the majority of the Trans Pennine Trail diversion is located within areas with a Very Low risk of flooding from surface water. This means that every year, these areas have a probability of flooding of less than 1 in 1,000 (0.1%).

However, the Trans Pennine Trail diversion also crosses limited areas with a higher risk of flooding from surface water and more specifically:

- The Trans Pennine Trail diversion crosses three (3) areas with a High risk of flooding from surface water. This means that each year, these areas have a probability of flooding of greater than 1 in 30 (3.3%);
- The Trans Pennine Trail diversion crosses four (4) areas with a Medium risk of flooding from surface water meaning that each year, these areas have a probability of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%); and
- The Trans Pennine Trail diversion crosses eight (8) areas with a Low risk of flooding from surface water meaning that each year, these areas have a probability of flooding

¹² <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?easting=417845.06&northing=403349.11&address=10032787916&map=Surface Water>

between 1 in 1,000 (0.1%) and 1 in 100 (1%). These crossings correspond to the tributaries flowing south into the River Don.

3.3.2 Proposed Sealing End Compound

According to the Environment Agency map showing flooding from surface water, the central part of the proposed new SEC (ca.15% of its total footprint) intersects an area associated with a Low risk of flooding from surface water as shown in Figure 9.7 in the EAR. This means that every year, the area has a chance of flooding between 1 in 1,000 (0.1%) and 1 in 100 (1%). According to the Environment Agency 'Long term flood map for planning', the surface water depth at this location is below 300mm. The remainder of the new SEC and the proposed permanent access road are located in an area with a Very Low risk of flooding from surface water which means that every year, the area has a chance of flooding of less than 1 in 1,000 (0.1%).

3.3.3 Temporary Construction Elements (Including Access Point 7 and Northern Access Road)

The majority of the temporary work areas, laydown areas and the access tracks are located within an area with a Very Low risk of surface water flooding as shown in Figure 9.7 of the EAR with short sections of the temporary elements located in areas associated with a High, Medium and Low risk of surface water flooding.

3.3.4 400kV Cable (Undergrounding)

Based on the Environment Agency map showing the risk of flooding from surface water (Figure 9.7 in the EAR), the majority of the cable route will be located within areas with a Very Low risk of flooding from surface water. This means that every year, these areas have a probability of flooding of less than 1 in 1,000 (0.1%).

However, the cable route also crosses limited areas with a higher risk of flooding from surface water and more specifically:

- The cable route crosses two (2) areas associated with a High risk of flooding from surface water. This means that each year, these areas have a probability of flooding of greater than 1 in 30 (3.3%). These areas coincide with the first 260m section of the cable route and the crossing between the cable route and the Short Grain watercourse;
- The cable route crosses two (2) areas with a Medium risk of flooding from surface water meaning that each year, these areas have a probability of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%). These areas correspond to the crossings described above; and
- The cable route crosses four (4) areas with a Low risk of flooding from surface water meaning that each year, these areas have a probability of flooding between 1 in 1,000 (0.1%) and 1 in 100 (1%). These areas correspond to the crossings described above in addition to the drain crossing between the Clough Beck and the Short Grain and a small area of surface water flooding to the south of the proposed SEC.

3.3.5 Removal of existing infrastructure (VIP subsection) including the overhead line (OHL) removal, the dismantling of pylon structures and the removal of pylon foundations

All of the pylons, except Pylons 4ZO159 and 4ZO157, to be removed are located within an area with a Very Low risk of surface water flooding (Figure 9.7 in the EAR). Pylon 4ZO159 is

located in an area associated with a Low risk of surface water flooding, while Pylon 4ZO157 is located in an area associated with a High risk of surface water flooding.

The existing overhead line crosses areas with a High, Medium, Low and Very Low risk of flooding from surface water (Figure 9.7 in the EAR). However, the overhead line to be removed will not interact with these areas of surface water flood risk and as such does not require further consideration.

3.3.6 Construction of Pylon 4ZO157R

According to the Environment Agency flooding from surface water map, the new Pylon 4ZO157R is located in an area with a Very Low risk of flooding from surface water as shown in Figure 9.7 in the EAR. This means that every year, the area has a chance of flooding of less than 1 in 1,000 (0.1%).

The new overhead line is mainly located within an area with a Very Low risk of surface water flooding, however, it also crosses areas with a High, Medium and Low risk of flooding from surface water, which coincide with the crossing of the River Don (Figure 9.7 in the EAR). However, the new overhead line will not interact with these areas of surface water flood risk and as such does not require further consideration.

3.4 Flooding from Reservoirs, Canals and Other Artificial Sources

Due to the presence of multiple upstream reservoirs, the whole Proposed Project is at risk of flooding in the event of a reservoir breach. However, since the likelihood of such an event is extremely low, this risk is not assessed any further in this report. Figure 9.8 in the EAR shows the risk of flooding from reservoirs, canals or other sources.

With the exception of the aforementioned reservoirs, there are no canals or other artificial water bodies in the vicinity of the Proposed Project.

3.5 Flooding from Groundwater

The 5m resolution JBA Groundwater Flood Map (see Figure 9.9 of the EAR) was used to estimate the flood risk to the Proposed Project from groundwater. The JBA Groundwater Flood Map shows the estimated depth of groundwater below the corresponding ground elevation under a 1 in 100-year event. For the purposes of this FRA, areas where groundwater is predicted to be at or very near to the existing ground elevation are considered to be those with the highest risk of groundwater flooding under a 1 in 100-year event (i.e. land where the predicted groundwater level is either at or within 0.025m of, or between 0.025 to 0.5m below the corresponding existing ground elevation). Those areas where the predicted groundwater level is more than 0.5m below the corresponding existing ground elevation are considered to be at a lower risk of groundwater flooding under this event.

3.5.1 Trans Pennine Trail diversion to the North of the River Don

According to the JBA Groundwater Flood Map, the Trans Pennine Trail diversion is mainly located within an area associated with a lower risk of flooding from groundwater. However short disjointed sections of the Trans Pennine Trail diversion are located within areas with a higher risk of flooding from groundwater where levels are predicted to be between ground level and 0.5m below ground level under a 1 in 100-year event. Figure 9.9 of the EAR shows the risk of flooding from groundwater in relation to the Proposed Project.

3.5.2 Proposed Sealing End Compound

According to the JBA Groundwater Flood Map, the proposed SEC and its access road are located within an area associated with a lower risk of flooding from groundwater where groundwater levels are predicted to be more than 0.5m below ground level under a 1 in 100-year event. Figure 9.9 of the EAR shows the risk of flooding from groundwater in relation to the Proposed Project.

3.5.3 Temporary Construction Elements (Including Access Point 7 and Northern Access Road)

Most of the temporary elements of the Proposed Project are located in areas associated with a lower risk of flooding from groundwater under a 1 in 100-year event. However, some of the temporary construction areas are located in areas associated with a higher risk of groundwater flooding where levels are predicted to be between ground level and 0.05m below ground level under a 1 in 100-year event.

3.5.4 400kV Cable (Undergrounding)

As shown in Figure 9.9 of the EAR, the proposed cable route is mainly located within an area with a lower risk of flooding from groundwater i.e. an area where groundwater levels are predicted to be more than 0.5m below ground level under a 1 in 100-year event. However, the first 170m of the cable route crosses an area with a higher risk of groundwater flooding where the groundwater level is predicted to be either at or 0.025m below ground level under a 1 in 100-year event.

3.5.5 Removal of existing infrastructure (VIP subsection) including the overhead line (OHL) removal, the dismantling of pylon structures and the removal of pylon foundations

Six out of the eight pylons to be removed are located in an area associated with a lower risk of flooding from groundwater (i.e. an area where groundwater levels are predicted to be more than 0.5m below ground level under a 1 in 100-year event). However, Pylons 4ZO157 and 4ZO160 are located in areas associated with a higher risk of flooding from groundwater where levels are predicted to be at or close to existing ground levels.

Consequently, the existing overhead line mainly crosses areas associated with a lower risk of groundwater flooding although interacts with limited areas associated with a higher risk of flooding from groundwater under a 1 in 100-year event. However, by its nature, the overhead line does not interact directly with groundwater and as such this risk has not been assessed any further. Figure 9.9 of the EAR shows the risk of flooding from groundwater in relation to the Proposed Project.

3.5.6 Construction of Pylon 4ZO157R, replacement of conductors and connection to the SEC

According to the JBA Groundwater Flood Map, the new Pylon 4ZO157R is partially located within an area associated with a higher risk of flooding from groundwater where groundwater levels are predicted to be between 0.025m and 0.5m below ground level under a 1 in 100-year event. Figure 9.9 of the EAR shows the risk of flooding from groundwater in relation to the Proposed Project. The remainder of the new pylon is within an area associated with a lower risk of flooding from groundwater.

The replacement connection line crosses areas associated with a higher risk of flooding from groundwater, although by its nature, the overhead line will not interact with groundwater and as such, this risk not assessed further for this element of the Proposed Project.

Figure 9.9 of the EAR shows the risk of flooding from groundwater in relation to the Proposed Project.

3.6 Flooding from Sewers

The Environment Agency surface water flood map provides a useful indication of the flood risk to the Proposed Project from surcharging surface water sewers; coverage of which is provided above. The Proposed Project is mainly located in a rural setting where the risk of foul water sewer flooding will be low. However, the potential risk of flooding from both foul and surface water sewers in the areas in vicinity of Dunford Bridge will need to be acknowledged and accommodated during the construction phase of the Proposed Project.

3.7 Site-Specific Flooding History

Information on historical flood events was requested from Barnsley Metropolitan Borough Council and the Environment Agency, however, both organisations were unable to provide such information with respect to the Proposed Project boundary.

3.8 Summary of flood risks

Table 4 provides a summary of the flood risks to the Proposed Project.

Table 4 Summary of flood risks to the Proposed Project

Elements of the Proposed Project	Flood Zone (based on the Flood Map for Planning)	Modelled 1 in 100-year + Climate change flood outline	Flooding from Surface Water	Flooding from Reservoirs, Canals and Other Artificial Sources	Flooding from Groundwater	Flooding from Sewers
Trans Pennine Trail Diversion	Mainly Flood Zone 1, but crosses Flood Zones 2 and 3 in two instances	Mainly in Flood Zone 1, but crosses 1 in 100-year + CC flood outline in three instances	Mainly at Very Low risk, but crossing areas at High risk three times, Medium risk four times and Low risk eight times	At risk of flooding from reservoir	Mainly at Lower risk with short disjointed sections at Higher risk (i.e. groundwater levels between ground level and 0.05m below ground level)	Flooding records not available, refer to flooding from surface water
SEC	Flood Zone 1	Outside the 1 in 100-year + CC flood outline	Low and Very Low risk	At risk of flooding from reservoir	Lower risk (i.e. areas where groundwater levels are greater than 0.5m below ground elevation)	Flooding records not available, refer to flooding from surface water

Elements of the Proposed Project	Flood Zone (based on the Flood Map for Planning)	Modelled 1 in 100-year + Climate change flood outline	Flooding from Surface Water	Flooding from Reservoirs, Canals and Other Artificial Sources	Flooding from Groundwater	Flooding from Sewers
Temporary Construction Elements (Including Access Point 7 and Northern Access Road)	Mainly in Flood Zone 1	Mainly outside the 1 in 100-year + CC flood outline	Mainly Low risk	At risk of flooding from reservoir	Mainly Lower risk but temporary elements in Dunford Bridge are at Higher risk (i.e. groundwater levels between ground level and 0.05m below ground level)	Flooding records not available, refer to flooding from surface water
Cable Route	Mainly in Flood Zone 1, a section of 420m located in Flood Zone 2 and a section of 240m located in Flood Zone 3	Mainly in Flood Zone 1, a section of 340m located within the 1 in 100-year + CC flood outline	Mainly at Very Low risk, but crossing areas at High and Medium risk two times and Low risk three times	At risk of flooding from reservoir	Mainly at Lower risk with a section of 170m at Higher risk (i.e. groundwater levels between ground level and 0.05m below ground level)	Flooding records not available, refer to flooding from surface water
Removal of Existing Infrastructure (VIP subsection)	Flood Zone 1 for all pylons except Pylon 4ZO157 - Pylon 4ZO157 is partially located in Flood Zones 2 and 3	Outside the 1 in 100-year + CC flood outline except Pylon 4ZO157	Pylon 4ZO159 at Low risk, Pylon 4ZO157 at High, Medium and Low risk, remaining pylons at Very Low risk	At risk of flooding from reservoir	Pylons 4ZO157 and 4ZO160 are at Higher risk (i.e. groundwater levels between ground level and 0.05m below ground level) with remaining pylons at Lower risk	Flooding records not available, refer to flooding from surface water

Elements of the Proposed Project	Flood Zone (based on the Flood Map for Planning)	Modelled 1 in 100-year + Climate change flood outline	Flooding from Surface Water	Flooding from Reservoirs, Canals and Other Artificial Sources	Flooding from Groundwater	Flooding from Sewers
Construction of Pylon 4ZO157R, replacement of conductors and connection to the SEC	Flood Zone 1	Outside the 1 in 100-year + CC flood outline	Very Low	At risk of flooding from reservoir	Pylon 4ZO157R partially located in an area at Higher risk (i.e. groundwater levels between ground level and 0.05m below ground level)	Flooding records not available, refer to flooding from surface water

4 FLOOD RISK AND PLANNING POLICY OVERVIEW¹³

4.1 National Planning Policy Framework and Planning Practice Guidance

The national policy on flood risk and flood prevention is contained in the National Planning Policy Framework (NPPF) and its accompanying Planning Practice Guidance (PPG). The NPPF and PPG set strict criteria to protect people and property from flooding which all local planning authorities are expected to follow. Where these tests are not met, national policy is clear that new development should not be allowed. The main steps, mentioned below, should be followed to ensure that if there are reasonably available alternative sites with a lower flood risk, or if a Proposed Project cannot be made safe, it should not be permitted. Those steps comprise:

- Assess the flood risk with the help of a Strategic Flood Risk Assessment to fully understand the flood risk. For sites of 1ha or more, or for any development located within PPG Flood Zones 2 and 3 or within a Critical Drainage Area, developers must undertake a site-specific flood risk assessment to accompany applications for planning permission;
- Avoid flood risk by applying a sequential approach to site selection so that development is, as far as reasonably possible, located where the risk of flooding from all sources is lowest. This should also take into account climate change and the vulnerability of future land uses to flood risk; and
- Manage and mitigate flood risk where development needs to be in a location where there is a risk of flooding as alternative sites are not available. Development should be appropriately flood resilient, resistant, remain operational in times of flooding, remain safe for its users, and should not increase flood risk overall.

4.2 Local Flood Risk Policy

Barnsley Metropolitan Borough Council is the Lead Local Flood Authority (LLFA), responsible for managing flood risk from local sources such as ordinary watercourses (not main rivers), surface water and groundwater. The Local Flood Risk Management Strategy (LFRMS, September 2017¹⁴) sets out the vision for managing local flood risk across the Barnsley area and includes an objective (Objective 1) to: promote appropriate development within and outside areas at risk of flooding; and to include effective and maintainable methods for the management of surface water, drainage systems, SuDS and watercourses throughout the Borough. More specifically, the Local Flood Risk Management Strategy sets out that developers are to ensure that drainage on proposed developments is effectively managed and does not cause adverse flooding impacts on the area surrounding their site. Under this strategy, the LLFA has the responsibility to assess SuDS and the drainage implications of new developments.

Some of the objectives of the LFRMS are to:

- Promote appropriate development within and outside areas at risk of flooding;
- Improve flood resilience in Barnsley; and
- Promote sustainability through all flood risk work.

¹³ <https://www.gov.uk/guidance/flood-risk-and-coastal-change#flood-zone-and-flood-risk-tables>

¹⁴ <https://www.barnsley.gov.uk/media/7196/flood-risk-management-strategy.pdf>

Barnsley Metropolitan Borough Council adopted its Local Plan in January 2019.

Relevant policies within the Core Strategy include:

- CSP 1: Climate Change – states that development will be expected to ensure existing and new communities are resilient to climate change, and that the council will take action to adapt to climate change by locating and designing development to reduce the risk of flooding and promoting the use of sustainable drainage systems.
- CSP 3: Sustainable Drainage Systems (SuDS) – this policy states that all development will be expected to use Sustainable drainage systems (SuDS). Only in exceptional circumstances, where it can be demonstrated that all types of SuDS are impractical, will other drainage management systems be permitted. Planning applications must include an assessment to show that SuDS will work and will be maintained, with measures taken to avoid water contamination and the safeguarding of groundwater supply. Developers will also be required to contribute to the maintenance of SuDS.
- CSP 4: Flood Risk – states that new development will not be permitted where it would be at an unacceptable risk of flooding or would give rise to flooding elsewhere. It requires site-specific Flood Risk Assessments (FRAs) for proposals over 1 hectare in Flood Zone 1 and all proposals in Flood Zones 2 and 3, and the use SuDS in accordance with Policy CSP 3. It also states that the extent and impact of flooding will be reduced by avoiding culverting or building over watercourses and encouraging the removal of existing culverts wherever practicable. It also requires the use of flood resilient design in areas of high flood risk.
- CSP 40: Pollution Control and Protection – states that development will be expected to demonstrate that it is not likely to result, directly or indirectly, in an increase in surface water and groundwater pollution, which would unacceptably affect or cause a nuisance to the natural and built environment or to people. Developers will be expected to minimise the effects of any possible pollution and provide mitigation measures where appropriate.

The Local Plan Publication Draft 2016 (published 30 June 2016) contains the following relevant policies:

- Policy CC3: Flood Risk – states that the extent and impact of flooding will be reduced by:
 - not permitting new development where it would be at an unacceptable risk of flooding from all sources, or would give rise to flooding elsewhere, and not allowing development in the Functional Floodplain (Flood Zone 3b) unless it can be demonstrated that there would not be a harmful effect on the ability of this land to store floodwater;
 - requiring developers with proposals in Flood Zones 2 and 3 to provide evidence of the sequential test and exception test where appropriate;
 - requiring site-specific Flood Risk Assessments (FRAs) for proposals over 1 hectare in Flood Zone 1 and all proposals in Flood Zones 2 and 3;
 - expecting proposals over 1000m² floor space or 0.4 hectares in Flood Zone 1 to demonstrate how the proposal will make a positive contribution to reducing or managing flood risk;
 - expecting all development proposals on brownfield sites to reduce surface water runoff by at least 30% and development on greenfield sites to maintain or reduce existing runoff rates;

- requiring development proposals to use Sustainable Drainage Systems (SuDS) in accordance with policy CC4; and
- using flood resilient design in areas of high flood risk.
- Policy CC4: Sustainable Drainage Systems (SuDS) – states that all major development will be expected to use Sustainable Drainage Systems (SuDS) to manage surface water drainage, unless it can be demonstrated that all types of SuDS are inappropriate. The use of SuDS on minor development is also encouraged. To determine the suitability of a proposed SuDS scheme, all Outline Planning applications must be supported by a conceptual drainage plan and SuDS design statement, with Detailed Planning applications supported by a detailed drainage plan and SuDS design statement, which should contain information on how the SuDS will operate, be managed and maintained for the lifetime of the development.
- Policy CC AC1: Water Resource Management – states that to conserve and enhance water resources, proposals will be supported which:
 - dispose of surface water appropriately and improve water quality through the incorporation of SuDS, in accordance with Policy CC4.
- Policy Poll1: Pollution Control and Protection – states that development will be expected to demonstrate that it is not likely to result, directly or indirectly, in an increase in surface water and groundwater pollution, which would unacceptably affect or cause a nuisance to the natural and built environment or to people. Developers will be expected to minimise the effects of any possible pollution and provide mitigation measures where appropriate.

The above considerations are covered by the SuDS Strategy included in Appendix 9J of the EAR.

The Peak District National Park Local Development Framework Core Strategy document, adopted in October 2011, sets out the vision, objectives and spatial strategy for the national park, and core policies to guide development and change in the National Park to 2026. The Peak District National Park Development Management Policies document, adopted in May 2019, will also guide and manage development across the National Park alongside the Core Strategy up to 2026. Relevant policies include:

- Policy CC1: Climate change mitigation and adaptation – states that development must be directed away from flood risk areas, and seek to reduce overall risk from flooding within the National Park and areas outside it, upstream and downstream, and achieve the highest possible standards of water efficiency.
- Policy CC5: Flood risk and water conservation – states that:
 - Development proposals which may have a harmful impact upon the functionality of floodwater storage, or surface water conveyance corridors, or which would otherwise unacceptably increase flood risk, will not be permitted unless net benefits can be secured for increased floodwater storage and surface water management from compensatory measures;
 - Where flood management schemes are proposed to reduce the risk of flooding to established material assets, they should wherever possible secure wider benefits for the natural environment, such as habitat creation or landscape enhancement;
 - Development which increases roof and hard surface areas must include adequate measures such as Sustainable Drainage Systems to deal with the

- runoff of surface water. Such measures must not increase the risk of a local water course flooding; and
- New development must allow an appropriate set-back distance for adequate maintenance of watercourses.

The Local Plan for the Peak District National Park (2001) contains a number of extant operational policies that have yet to be replaced by the Local Development Framework Core Strategy. Although Policy LC23 (Flood risk areas) has been replaced relevant policies that remain valid include:

- Policy LC21: Pollution and disturbance – states that development that presents a risk of pollution or disturbance that could adversely affect water supply, groundwater resources and the water environment will not be permitted unless adequate measures to control emissions within acceptable limits are put in place and (when the permitted use finishes) appropriate removal of any pollutants from the site is assured.
- Policy LC22: Surface water runoff – states that development will be permitted provided that adequate measures are included to deal with the runoff of surface water from the site. Such measures must not increase the risk of a local water course flooding.

The area of the Peak District (East) Project is not covered by an Internal Drainage Board (IDB).

4.3 PPG Requirements

4.3.1 Sequential Test

New development should always to be steered to areas with the lowest flood risk where possible. The Sequential Test aims to ensure this and requires justification to be provided when new development cannot be located in the lowest flood risk zone.

The alignment of the Proposed Project shown in Figure 2.3 of the EAR has been developed iteratively over a considerable period through consultation with regulators and interested stakeholders. This consultation considered a wide range of socio-economic and environmental constraints, one of which was flood risk. The final alignment shown in Figure 2.3 of the EAR represents the most practical and cost-effective alignment with the least overall environmental impact based on the information available to date. It also seeks to avoid interacting with flood risk areas where possible. Despite this, it is necessary for the Proposed Project to interact with limited areas of Flood Zones 2 and 3 given the current alignment and location of the existing pylons and the Trans Pennine Trail.

As such, for the purpose of this FRA, it can be considered that the PPG Sequential Test has been appropriately applied and successfully passed.

4.3.2 Flood Risk Vulnerability Classification

The requirement for the provision of FRAs is explained within the NPPF, and the PPG provides advice on which land uses are appropriate in areas at risk of flooding.

The Proposed Project is classified as 'Essential Infrastructure' land use, which is defined under Table 2¹⁵ of the PPG as '*Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; [...] that need to remain operational in times of flood.*' According to the PPG, this would mean that the Proposed Project is considered appropriate for location within Flood Zones 1 and 2¹⁶. However, part of the Proposed Project crosses Flood Zones 3a and 3b, which means that the PPG Exception Test also needs to be applied and passed (see Footnote 16).

4.3.3 Exception Test

Table 5 of the PPG explains the relationship between flood risk vulnerability and flood zone 'compatibility' and is reproduced here as Table 5 below. This matrix provides information on when a development is appropriate, when a development should not be permitted, and when the Exception Test is required.

Table 5 Flood risk vulnerability and flood zone 'compatibility'

Flood Zone	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
1	✓	✓	✓	✓	✓
2	✓	Exception Test required	✓	✓	✓
3a ¹⁷	Exception Test required ¹⁷	X	Exception Test required	✓	✓
3b ¹⁸	Exception Test required ¹⁸	X	X	X	✓ ¹⁸

✓ Development is appropriate for flood zone

X Development should not be permitted

¹⁵ <https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-2-Flood-Risk-Vulnerability-Classification>

¹⁶ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/575184/Table_3_-_Flood_risk_vulnerability_and_flood_zone_compatibility_.pdf

¹⁷ In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

¹⁸ 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.

Section 3.2 explains which components of the Proposed Project will be located in Flood Zones 1 and 2. Given that the Proposed Project is considered 'Essential Infrastructure', it is therefore considered appropriate for location within Flood Zones 1 and 2.

However, limited sections of the Proposed Project (i.e. parts of the cable route and Trans Pennine Trail diversion) will need to cross Flood Zones 3a and 3b. As per Table 5 above, the Exception Test will need to be applied and passed before the Proposed Project can be considered for location within these higher risk Flood Zones.

The Exception Test is a method to demonstrate that flood risk from the Proposed Project to people and property will be managed satisfactorily. The Exception Test requires the Proposed Project to demonstrate that a) it will provide wider sustainability benefits to the community that outweigh flood risk informed by an SFRA where available, and b) through a site-specific FRA, it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.

In order to address the first requirement of the Exception Test, Table 6 demonstrates how the Proposed Project, by removing the existing overhead line and pylons and replacing them with the cable route, will enhance the landscape and environment, thus providing wider sustainable benefits to the community.

Table 6 Sustainability benefits of the Proposed Project to the community

Elements	Benefits
Landscape	Improvement of public visual amenity by improving the skyline and panoramic views along the River Don valley
Socio-economic	No significant effects on tourism nor long-term employment expected
Environment	Localised biodiversity enhancement and conservation due to planting and habitat management enhancement

As such, in light of the above benefits, it is considered that the Proposed Project meets the first requirement of the Exception Test (i.e. point 'a' in the paragraphs above).

In order to address the remainder of the Exception Test, the Proposed Project as a whole (i.e. not just those elements that will interact with Flood Zone 3) has been designed and constructed to:

- Be safe for its users and remain operational for its design lifetime;
- Not increase flood risk elsewhere; and
- Where possible, reduce flood risk overall.

Given the scale and nature of the Proposed Project, the key considerations listed above form the focus of the remainder of this FRA and are presented in Section 0 below.

5 FLOOD RISK CONSIDERATIONS

As detailed in Section 4.3, to meet the PPG requirements, '*Essential Infrastructure*' land use such as the Proposed Project will be considered suitable for its location provided it will:

- Be safe for its users and remain operational for its design lifetime;
- Not increase flood risk elsewhere; and
- Where possible, reduce flood risk overall.

Each of these requirements are discussed in greater detail in relation to the Proposed Project in the following sections.

5.1 Be safe and remain operational for its design lifetime

This section explores whether the Proposed Project will be safe for its users and remain operational during its construction, operational and decommissioning phases.

5.1.1 Flood Risk during Construction

5.1.1.1 Trans Pennine Trail diversion to the North of the River Don

As described in Section 3, the Trans Pennine Trail diversion is mainly located in areas with a low or very low risk of flooding but crosses areas with a higher risk of flooding from rivers, surface water and groundwater.

During construction, flooding from the River Don has the potential to interact with the works and with this in mind, water depths were provided to enable the construction phase of the Trans Pennine Trail diversion to be safely managed. A detailed 1D-2D flood modelling study of the River Don has been undertaken in order to provide information on water depth, direction and velocity in those areas of the Trans Pennine Trail diversion that are predicted to interact with areas at risk of flooding from the river. This information will be used to help to ensure that the construction phase and utilisation phase of the Trans Pennine Trail diversion can be safely managed in these areas. Results from the 1D-2D flood modelling study are presented in Figure 9.1 of the EAR. It is recommended that the contractors make use of this information to help to safely plan and manage the construction phase works in these areas.

For construction phase works located within the modelled flood outline of the River Don, the contractors should consider antecedent conditions on this watercourse, check local and national weather forecasts, and contact the Environment Agency to determine whether it has, or intends to, issue Flood Warnings in the area prior to or during the construction phase. Further mitigation measures are presented in Section 6.

Additionally, as described in Section 3.5.1, the Trans Pennine Trail diversion crosses small areas associated with a higher risk of flooding from groundwater. The groundwater depths at these locations, under a 1 in 100-year event, vary between ground level and 0.5m below corresponding ground elevations. Contractors on site should be aware of the potential groundwater flood risk during the construction stage of the Trans Pennine Trail diversion and plan phasing of works appropriately to ensure safe delivery of the construction phase. Further mitigation measures are given in Section 5.3.

As parts of the diverted Trans Pennine Trail will be located within Flood Zones 2 and 3, it will be raised above modelled flood levels to make it safe for users (albeit this will be temporary and the Trans Pennine Trail diversion will be removed after the construction phase and the land returned to its pre-diversion elevations). In terms of ensuring the safety of members of the public using the Trans Pennine Trail diversion, it is recommended to include appropriate signage along the Trans Pennine Trail diversion to warn users of the potential flood risk in certain areas from the River Don, from overland flow (surface water sources) and from groundwater.

5.1.1.2 Proposed Sealing End Compound

The proposed Southern SEC is not located within an area at risk of flooding from rivers or groundwater meaning that its construction phase will remain safe from flooding these sources.

However, part of the SEC is located in an area associated with a low risk of flooding from surface water. It is therefore recommended that due consideration is given to antecedent surface water conditions prior to undertaking construction activities as required (see Section 5.3 on Flood Risk Mitigation Measures and Recommendations).

5.1.1.1 Temporary Construction Elements (Including Access Point 7 and Northern Access Road)

The majority of temporary elements are located in areas associated with a Very Low or negligible risk of flooding, although some elements are located in areas at higher risk of flooding.

Contractors on site should be aware of the potential flood risk during the construction stage and plan phasing of works appropriately to ensure safe delivery of the construction phase. Further mitigation measures are given in Section 5.3.

5.1.1.1 400kV Cable (Undergrounding)

As described in Section 3, the proposed cable route is mainly located in areas with a low or very low risk of flooding but crosses limited areas with a higher risk of flooding from rivers, surface water and groundwater.

During construction, flooding from the River Don has the potential to interact with the works and with this in mind, water depths were provided to enable the construction phase of the cable route to be safely managed. A detailed 1D-2D flood modelling study of the River Don has been undertaken in order to provide information on water depth, direction and velocity (if required) in those areas of the cable route that are predicted to interact with areas at risk of flooding from the river. This information will be used to help to ensure that the construction phase of the cable route will be safely managed in these areas. Results from the 1D-2D flood modelling study are presented in Figure 9.1 of the EAR. It is recommended that the contractors make use of this information to help to safely plan and manage the construction phase works in these areas.

For the construction phase works located within the modelled floodplain of the River Don, the contractors should consider antecedent conditions on this watercourse, check local and national weather forecasts, and contact the Environment Agency to determine whether it has, or intends to, issue Flood Warnings in the area prior to or during construction phase activities. Further mitigation measures are presented in Section 6.

Additionally, as described in Section **Error! Reference source not found.**, the cable route crosses limited areas associated with a higher risk of flooding from groundwater. The groundwater depths at these locations, under a 1 in 100-year event, vary between 0.025m and 0.5m below corresponding ground elevations. Contractors on site should be aware of the potential groundwater flood risk during the construction stage of the cable route and plan phasing of works appropriately to ensure safe delivery of the construction phase. Further mitigation measures are given in Section 5.3.

5.1.1.1 Removal of existing infrastructure (VIP subsection) including overhead line (OHL) removal, dismantling of pylon structures and removal of pylon foundations

The majority of existing pylons to be removed are located in an area with a Very Low or negligible risk of flooding, although a few pylons are located in areas at higher risk of flooding and the existing overhead line to be removed crosses areas of higher flood risk.

Contractors on site should be aware of the potential flood risk during the construction stage of the existing pylon removal and plan phasing of works appropriately to ensure safe delivery of the construction phase. Further mitigation measures are given in Section 5.3.

However, the methods used to remove the overhead lines will limit direct interaction with these flood risk areas, meaning that flooding is unlikely to affect the safety of the removal phase of this element of the Proposed Project.

5.1.1.2 Construction of Pylon 4ZO157R, replacement of conductors and connection to the SEC

The replacement pylon is located in an area with a Low or Very Low risk of flooding from rivers or surface water respectively meaning that the safety of the construction phase is unlikely to be compromised by flooding from these sources. It is, however, partially located in area at higher risk of flooding from groundwater. It is therefore recommended that due consideration is given to antecedent groundwater conditions prior to undertaking construction activities as required (see Section 6 on Flood Risk Mitigation Measures and Recommendations).

The new overhead line is mainly located in areas with a Very Low risk of flooding but also crosses areas of higher flood risk associated with the River Don and areas of higher risk of surface water flooding. The construction methods used to install the new overhead line will, however, limit direct interaction with these areas at risk of flooding, meaning that flooding is unlikely to affect the safety of the construction phase of the new overhead line.

5.1.2 Flood Risk during Operation

5.1.2.1 Proposed Sealing End Compound

A small proportion of the new SEC footprint will be located within an area with a Low risk of flooding from surface water. According to the Environment Agency 'Long term flood map for planning', the surface water depth at this location is below 300mm. National Grid should ensure that the critical elements of all operational components of the new SEC are set at least 300mm above existing ground level in this area to protect against surface water flooding.

The access road leading to the SEC is located outside areas at risk of flooding and as such would be expected to remain safe and operational over the duration of its intended design life without the requirement for additional mitigation over and above National Grid's standard design.

5.1.2.2 400kV Cable (Undergrounding)

This element of the Proposed Project comprises the underground cable and above-ground Link Pillars. The Link Pillars are required to monitor a selection of protection systems related to the cable. Although only small (each Link Pillar is ca. 0.6m²), the exact locations of the Link Pillars will be determined by the contractors. Each Link Pillar will be spaced along the length of the cable route at distances that will depend on the detailed design but are likely to be at the centre and a distance of 400m either side (i.e. three Link Pillars are envisaged in total).

Once installed, the cable will be located within an underground sealed tube or trough, which will prevent sub-surface water interaction. As such, the proposed underground cable would be expected to remain safe and operational over the duration of its intended design life without the requirement for additional mitigation over and above National Grid's standard cable design.

For the Link Pillars, it is recommended, where possible, that these are located outside the flood risk zones (from all sources) identified within this FRA. This measure will ensure that the proposed Link Pillars would remain safe and operational over the duration of their intended design life without the requirement for additional mitigation over and above National Grid's standard Link Pillar design.

5.1.2.3 Construction of Pylon 4ZO157R, replacement of conductors and connection to the SEC

The new Pylon 4ZO157R will be located outside areas at risk of flooding from river and surface water. As described in section 3.5.4, part of Pylon 4ZO157R is located within an area at higher risk of groundwater flooding, but this is unlikely to affect the operational phase of the pylon, due to its construction.

As such, the proposed replacement terminal pylon would be expected to remain safe and operational over the duration of its intended design life without the requirement for additional mitigation over and above National Grid's standard pylon design.

5.1.3 Flood Risk during Decommissioning

5.1.3.1 Proposed Sealing End Compound

During the decommissioning process, the SEC materials will be removed and recycled. Unless there is a compelling need for the complete removal of the foundations, these would be normally be removed to approximately 1m deep and the subsoil and topsoil reinstated. Flood risk considerations and mitigation would be as per the Construction Phase.

5.1.3.1 400kV Cable (Undergrounding)

Once decommissioned, the cable route will remain buried in perpetuity. The Link Pillars would be removed, and the materials taken for recycling. Subsoil, topsoil and ground

levels would be reinstated to their existing conditions. Flood risk considerations and mitigation would be as per the Construction Phase.

5.1.3.2 Construction of Pylon 4ZO157R, replacement of conductors and connection to the SEC

During the decommissioning phase, the pylon and overhead line will be dismantled, and the concrete pads and foundations will be removed to a depth of up to 1m. Flood risk considerations and mitigation would be as per the Construction Phase.

5.1.4 Climate Change

Climate usually refers to a region's long-term weather patterns. This is measured in terms of average precipitation (i.e. the amount of annual rainfall, snow etc.), maximum and minimum temperatures throughout the seasons, sunshine hours, humidity, the frequency of extreme weather, and so on. Since the last ice age, which ended about 11,000 years ago, Earth's climate has been relatively stable. However, in recent years, the average global temperature has been increasing. Scientific research shows that the average temperature of the planet's surface has risen by 0.89 °C from 1901 to 2012. During this period there have also been measurable changes in UK rainfall patterns and sea level rise.

Potential impacts to the hydrological environment from climate change during the construction, operation and decommissioning phases of the project may include:

- Increased or decreased runoff from the land and the project into the surrounding drainage network;
- Increased rainfall intensity for the lifetime of the development (as presented in Table 7);
- Increased river levels and flows; and
- Rising groundwater levels.

Table 7 presents peak rainfall intensity allowance for climate change. The climate change allowances are based on various climate change projections and scenarios of carbon dioxide (CO₂) emissions to the atmosphere.

Table 7 Peak rainfall intensity allowance in small and urban catchments

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 allowance	10%	20%	40%
Central allowance	5%	10%	20%

The impact of climate change on rainfall intensity will need to be considered in the design of the surface water drainage strategy for the above-ground operational-phase components of the Proposed Project. The construction period of the Proposed Project

is estimated to end by 2022 and the life span of the cable route and SEC are estimated to be approximately 40 to 50 years. Considering this timeframe, as detailed in Table 7, the 'Upper End' and 'Central' climate change allowances for the 2080s will need to be accommodated in the design of the drainage strategy for the Proposed Project (i.e. as per Environment Agency¹⁹ guidance).

5.2 Not increase flood risk elsewhere

This section assesses the potential for the operational phase of the Proposed Project to increase flood risk elsewhere and outlines mitigation measures as appropriate. Section 5.3 provides further details of the potential impacts of the construction phase on flood risk elsewhere and provides details of the associated mitigation.

However, whilst the Trans Pennine Trail diversion is also a temporary element of the Proposed Project, the nature of this component (i.e. a pedestrian trail with two new bridges) and related usage by the general public justify considering the flood risk issues for this temporary element in this section.

5.2.1 No Net Loss of Floodplain Storage

5.2.1.1 Trans Pennine Trail diversion to the North of the River Don

Appendix 9I.D provides details of further flood risk modelling undertaken to test the impact of the Trans Pennine Trail diversion (specifically the two new bridges and associated abutments located within the floodplain of the River Don) on the hydraulics of the floodplain of this watercourse. The two new bridges have been designed to ensure that their respective flow areas have a greater relative capacity than the existing structures that they will replace. The deck and soffit levels of both new structures have also been set above the modelled 1 in 100 year flood levels on the River Don. However, the bridge abutments for both structures will unavoidably need to be located within the floodplain of the River Don.

The additional flood modelling undertaken to test the impact of these structures, however, has confirmed that the increase in effective flow area that both structures will deliver when compared to the baseline scenario outweighs the introduction of the new bridge abutments in the floodplain and demonstrates that the overall impact of these new structures on the floodplain of the River Don is neutral.

The National Grid design team has sought to minimise the extent of ground level raising within the floodplain of the River Don associated with the Trans Pennine Trail diversion, however, there are certain areas where raising of ground levels within the floodplain (when compared to existing) will be unavoidable. As parts of the diverted Trans Pennine Trail will be located within Flood Zones 2 and 3, it will be raised above the modelled flood levels, to make it safe for users. However, this will be temporary and the Trans Pennine Trail diversion will be removed after the construction phase and the land returned to its pre-diversion elevations.

5.2.1.2 Proposed Sealing End Compound

The proposed SEC and its access road are not located within any flood zones hence the presence of the SEC will not result in a loss of floodplain storage.

¹⁹ <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

5.2.1.1 400kV Cable (Undergrounding)

The below ground elements of the proposed cable route would not result in a net loss of floodplain storage. It is recommended, where possible, that the Link Pillars are not located in any of the flood risk zones (from all sources) identified in this FRA.

5.2.1.2 Construction of Pylon 4ZO157R, replacement of conductors and connection to the SEC

The proposed Pylon 4ZO157R is not located within any flood zones hence the presence of the pylon will not result in a loss of floodplain storage.

5.2.2 No impediment to Flood Water Flows

5.2.2.1 Trans Pennine Trail diversion to the North of the River Don

As parts of the diverted Trans Pennine Trail will be located within Flood Zones 2 and 3 and will be raised above the modelled flood levels, it will be used to make it safe for users (albeit this will be temporary and the Trans Pennine Trail diversion will be removed after the construction phase and the land returned to its pre-diversion elevations). Given the temporary nature of the works, the impact of the Trans Pennine Trail diversion on the floodplain of the River Don will be negligible.

5.2.2.2 Proposed Sealing End Compound

The proposed SEC and its access road are not located within any areas at risk of flooding from rivers hence the presence of the SEC will not result in any impediment to flood water flows. The small central area of the SEC shown to be at risk from surface water flooding. According to the Environment Agency 'Long term flood map for planning', the surface water depth at this location is below 300mm. National Grid should ensure that the critical elements of all operational components of the new SEC are set at least 300mm above existing ground level in this area to protect against surface water flooding. The proposed SEC and access road will not be expected to present any significant impediment to overland flow.

5.2.2.1 400kV Cable (Undergrounding)

The below ground element of the proposed cable route will, by its nature, not result in any impediment to above ground flood water flows.

The backfill material used above the cable and trough will be sourced from local arisings generated during the trench excavation. This will help to ensure that groundwater can continue to flow above and below the cable where this currently occurs and will help to prevent the creation of additional linear groundwater flow pathways in areas where these are not currently present.

It is recommended that the Link Pillars are not located in any of the flood risk zones (from all sources) identified in this FRA. Despite this, the Link Pillars are small, meaning that they would not in any case present any significant impediment to flood water flows.

5.2.2.2 Construction of Pylon 4ZO157R, replacement of conductors and connection to the SEC

The proposed Pylon 4ZO157R is not located in an area associated with the risk of flooding from rivers and as a such, it will not result in any impediment to flood water flows.

The overhead line crosses an area at risk of flooding from rivers but, due its nature, this will not result in any impediment to flood water flows.

5.2.3 Surface Water Runoff

5.2.3.1 400kV Cable (Undergrounding)

Once constructed, the cable will be buried underground and its land surface reinstated to ensure that it has the same runoff properties and is at the same elevation as existing. As a result, the cable route will not result in an increase in the volume and rate of surface water runoff generated.

The only permanent above ground elements of the cable route will be the Link Pillars, which have the potential to cause a minor increase in the volume and rate of surface water runoff generated across these areas. However, this increase in the volume and rate and volume of surface water runoff will not be significant and as a result, it will not be assessed any further.

5.2.3.2 Trans Pennine Trail diversion to the North of the River Don

This element of the Proposed Project will comprise the construction of a temporary trail and as such has the potential to cause an increase in the volume and rate of surface water runoff generated. The effects will be temporary for the period of the construction works. Although the Trans Pennine Trail diversion will increase surface runoff rate and volume, this will be temporary and only for the duration of the construction works. The diversion will be returned to the existing condition upon completion of the construction phase.

5.2.3.3 Proposed Sealing End Compound

This element of the Proposed Project will comprise the construction of a new SEC and permanent access road and as such has the potential to cause an increase in the volume and rate of surface water runoff generated across these areas, which could potentially increase flood risk elsewhere. Section 6 outlines the proposed mitigation that will ensure that this element of the Proposed Project does not increase flood risk elsewhere.

5.2.3.4 Construction of Pylon 4ZO157R, replacement of conductors and connection to the SEC

This element of the Proposed Project will not introduce any significant new areas of impermeable hardstanding and as such will not have any impacts on surface water runoff and flood risk elsewhere.

5.3 Where possible, reduce flood risk overall

The inclusion of source control techniques for the SEC, its access road and the Trans Pennine Trail diversion will serve to provide a minor reduction in overall flood risk. This is because the current land use cover for these areas would be expected to generate a modest amount of 'Greenfield Runoff' during extreme rainfall events. The inclusion of a replacement gravel cover or hoggin layer with gravel sub-grade will ensure that all runoff generated from these areas would be stored within the gravel layers and eventually infiltrate to ground. This is described in the SuDS Strategy in Appendix 9J and further details are also presented in Section 6. The Proposed Project would, therefore, help to contribute to a minor reduction in overall flood risk.

6 FLOOD RISK MANAGEMENT MITIGATION MEASURES

This section demonstrates how flood risk has been a central consideration in the design of the Proposed Project. It also presents a series of recommendations designed to reduce or mitigate flood risk during the construction, operational and decommissioning phases of the Proposed Project. Finally, it describes the requirements for source control techniques (or SuDS) for each element of the Proposed Project, where appropriate.

6.1 Design of the Trans Pennine Trail Diversion to reduce flood risk during construction

The alignment and design of the Trans Pennine Trail diversion has been informed by the results of the detailed flood risk modelling. More specifically, the detailed modelled flood output was used to:

- Refine the alignment of the Trans Pennine Trail diversion so it avoids areas at risk of flooding from a 1 in 100-year flood event, where possible; and
- Safely design both the permanent and temporary bridges to ensure that they remain safe for their users and do not increase flood risk elsewhere.

Mitigation measures are presented below.

6.2 Measures to mitigate flood risk during construction

The construction phase of the Proposed Project will include the following mitigation measures:

6.2.1 Embedded mitigation during construction

- Following the completion of all construction works, the land within the working width will be fully reinstated as near as practically possible to its former condition, and where possible all reinstated surfaces will have the same runoff properties and elevation as existing or as agreed with landowners and stakeholders in advance (this will include the reinstatement of drainage ditches and existing culverts) and replacement of community/recreational facilities impacted by the Proposed Project;
- Where possible, soils will be stored at least 10m²⁰ away from watercourses, and outside of areas of floodplain. Where this is not possible, gaps will be provided in stored topsoil to prevent the impoundment of flood waters (all year around); best practice measures will be applied where required to ensure that stockpiled soil will not be eroded/ transported by overland flow and will not enter any water bodies (such as berms, vegetated strips and silt traps will be included where required);
- Construction will not be undertaken during extreme wet weather. Contractors to check local and national weather forecasts, and contact the Environment Agency to determine whether it has, or intends to, issue Flood Warnings in the area prior to or during the construction phase;
- The monitoring of groundwater and consultation of the groundwater flood risk mapping for a short period before, during and following construction to a) phase

²⁰Environment Agency PPG5 document,
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/485199/pmho1107bnkg-e-e.pdf

construction stage activities to avoid the need for significant groundwater de-watering as required; and b) assess the impact of the underground assets on the local groundwater levels (assumed as part of the CEMP); and

- The development of a construction phase drainage strategy that may need to include temporary attenuation storage, infiltration drainage, and sediment trapping techniques as appropriate and should be driven by source control techniques where possible (assumed as part of the CEMP) and
- The monitoring of flows in watercourses during the construction phase to avoid impeding flow. This can take the form of regular visual inspections of the temporary crossings. The visual inspections should check that the water levels on both the upstream and downstream faces of the temporary crossings remain similar throughout the duration of the crossing. This will help to confirm that each temporary crossing has been appropriately sized. The visual inspections should also check that each temporary crossing does not become blocked by debris and should be used to trigger immediate remedial action in the event of debris accumulation (assumed as part of the CEMP).

6.2.2 Additional mitigation measures during construction

- The CEMP will ensure that all reinstated channels will have the same hydraulic properties as existing and temporary and permanent structures (culverts, flumes) should be appropriately sized except when alternative options, such as the permanent diversion of the drainage ditch adjacent to the Trans Pennine Trail for example, have been discussed and agreed with the Lead Local Flood Authority;
- Regular monitoring, to be determined by the contractor, will be put in place to ensure that the surface water features function as intended and check on the drainage system including for ensuring that no material from the diverted Trans Pennine Trail falls into the watercourse. If this does occur the material will be removed immediately. Generally, flumes/ bridges will be installed at the start of construction activities and removed during restoration. This mitigation measure would also help to address any increased volume and rate of surface runoff generated;
- Ensure that access roads / routes, parking bays, hardstanding areas (i.e. those that may be required for temporary access, maintenance or repairs) are laid at existing elevations and not raised compared to existing or surrounding ground levels;
- Appropriate signage along the Trans Pennine Trail diversion should be deployed to warn users of the potential flood risk in certain areas from the River Don, from overland flow (surface water sources) and from groundwater;
- Contractors to consider temporary closure of the Trans Pennine Trail diversion in case of flooding; and
- Add a freeboard allowance of 300mm to all above ground assets to allow for uncertainties during the modelling and mapping of the flood risk areas presented in this FRA (although it is anticipated that this freeboard allowance would be inherent in National Grids' standard design of the proposed aboveground assets).

6.3 Measures to mitigate flood risk during operation

The operational phase of the Proposed Project will include the following mitigation:

6.3.1 Embedded mitigation during operation

- The implementation of an Operational Phase SuDS Maintenance and Management Plan for the SEC including the permanent access road. The SEC will be drained using a 75mm layer of gravel (compacted Type 1) and a 300mm free-draining sub-base. The extent, depth and porosity of these layers will be sufficient to allow the volume of runoff generated by the new impermeable hardstanding areas associated with the SEC to be stored within this layer during a 1 in 100-year (6-hour duration) storm event, with a 40% allowance for climate change. The gravel layer and free-draining sub-base will be sufficient to ensure that this attenuation storage is provided although, in reality a degree of infiltration to ground would also occur at the base of this layer given the permeable underlying soils and geology. The permanent access road associated with the SEC will be surfaced with a 75mm grasscrete surface with a 300mm free-draining sub-base to provide the required attenuation and infiltration to ground. Further details are presented in the SuDS Strategy in Appendix 9K; and
- National Grid will be responsible for the management and maintenance of the proposed SuDS solutions for the SEC and its permanent access road over the intended lifetime of the Proposed Project.

6.4 Source Control Measures – (Sustainable Drainage Systems – SuDS)

The SuDS Strategy in Appendix 9J of the EAR provides details of the proposed SuDS commitments for each element of the Proposed Project during the operation phase.

6.5 Measures to mitigate flood risk during decommissioning

It is assumed that relevant best practice construction phase embedded mitigation measures will apply to the decommissioning phase however, detailed decommissioning methodology cannot be finalised until immediately prior to decommissioning but would be in line with relevant best practice and policy at that time.

7 CONCLUSION

This Flood Risk Assessment, part of the Environmental Assessment, has been used to:

- Identify the elements of the Proposed Project at risk of flooding from all sources;
- Ensure that the Proposed Project will meet the requirements of the PPG; and
- Develop flood risk mitigation measures to address any potential flood risk issues during the construction, operational and decommissioning phases of the Proposed Project.

The conclusions of this FRA are, therefore, that the Proposed Project:

- Passes the PPG Sequential Test;
- Passes the first requirement of the PPG Exception Test i.e. it will provide wider sustainability benefits to the community that outweigh flood risk; and
- Through the inclusion of proposed mitigation measures, passes the second requirement of the PPG Exception Test i.e. will remain safe and operational for its lifetime, will not increase flood risk elsewhere and where possible, will reduce flood risk overall.