Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

Proposed Bowland Section Environmental Statement Volume 2 Chapter 15: Major Accidents

June 2021

Water for the North West

Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

Project No:	B27070CT
Document Title:	Proposed Bowland Section Environmental Statement Volume 2 Chapter 15: Major Accidents
Document Ref.:	LCC_RVBC-BO-ES-015
Revision:	0
Date:	June 2021
Client Name:	United Utilities Water Ltd

Jacobs U.K. Limited

5 First Street
Manchester M15 4GU
United Kingdom
T +44 (0)161 235 6000
F +44 (0)161 235 6001
www.jacobs.com

Contents

15. Major Accidents 1
15.1 Introduction 1
15.2 Scoping and consultations 1
15.3 Key Legislation and Guidance 1
15.4 Assessment Methodology and Assessment Criteria 2
15.5 Baseline Conditions 7
15.6 Likely Significant Effects 10
15.7 Essential Mitigation and Residual Effects 18
15.8 Cumulative Effects 19
15.9 Conclusion 19
15.10 Glossary and Key Terms 20

15. Major Accidents

15.1 Introduction

1) This chapter presents an assessment of the potential for a major accident or disaster to result in a risk of a significant effect on the environment. The term 'major accident' in this context is an undesirable extreme event resulting in damage or harm, such as a major pollution incident. The term 'disaster' in this context is taken to be extremes of natural occurrences, such as a major flood event or earthquake.

2) The assessment of major accidents and disasters considers the occurrence of extreme and highly unlikely incidences. As such, whilst this chapter uses baseline information relevant to other environmental topic chapters of this ES, it considers scenarios that would not reasonably be covered by the other topic assessments.

3) The assessment considers two aspects: the vulnerability of the Proposed Bowland Section to a major accident or natural disaster, and the potential for the Proposed Bowland Section to cause a major accident. Additionally, in the interests of avoiding duplication of much of the content contained in this chapter, the corresponding vulnerability and risks associated with the Proposed Off-site Highways Works (Volume 5) and the Proposed Ribble Crossing (Volume 6) are also incorporated within this chapter.

15.2 Scoping and consultations

15.2.1 Scoping

4) A major accidents section was included within the EIA Scoping Report, which was submitted to the relevant planning authorities for comment in October 2019. Scoping comments and responses are outlined in Appendix 4.1; however, no comments were received in relation to major accidents.

5) An Addendum to the EIA Scoping Report was submitted in February 2021 due to design changes, refinements and the need for alternative methodologies; however, there were no implications in terms of the assessment of major accidents.

15.2.2 Consultation

6) During the course of this assessment, consultation has taken place with relevant statutory and non-statutory consultees, stakeholders and third parties, through both email correspondence and telephone calls. This has been summarised in Appendix 4.1; however, there is no information of specific relevance to this chapter.

15.3 Key Legislation and Guidance

7) The requirement to consider major accidents and disasters as part of the EIA process was established by the amended EIA Directive 2014/52/EU. This is transposed into UK law by the 2017 EIA Regulations.

8) Table 15.1 introduces relevant major accidents legislation and guidance. As major accident assessment for EIA is a relatively recent requirement, there is currently no prescribed assessment method for this topic.

Table 15.1: Major Accidents Key Legislation and Guidance

Applicable Legislation	Description
EIA Directive 2014/52/EU	Paragraph 15 of the Directive states that: '*to ensure a high level of protection of the environment, precautionary actions need to be taken for certain projects which, because of their vulnerability to major accidents, and/or natural disasters (such as flooding, sea level rise, or earthquakes) are likely to have significant adverse effects on the environment. For such projects, it is important to consider their vulnerability (exposure and resilience) to major accidents and/or*

Applicable Legislation	Description
	disasters, the risk of those accidents and/or disasters occurring and the implications for the likelihood of significant adverse effects on the environment.'
The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended)	Regulation 5, part 4 of the regulations state that: state that: '*the significant effects to be identified, described and assessed … include, where relevant, the expected significant effects arising from the vulnerability of the proposed development to major accidents or disasters that are relevant to that development.*'
Health and Safety at Work etc. Act 1974 (HSWA)	The primary piece of legislation covering occupational health and safety in the UK. It sets out the general duties which employers have towards employees and members of the public.
Construction (Design and Management) Regulations 2015	Regulations for managing the health, safety and welfare of construction projects. CDM applies to design, construction, operation and maintenance.
EU Guidance: Environmental Impact Assessment of Projects[1]	This guidance includes a brief reference to major accidents and disasters, noting that the focus should be on '*significant risk and/or a risk that could cause significant environmental effects*.'

9) National and Local Planning Policies are covered in Chapter 5: Planning Policy and Context.

15.4 Assessment Methodology and Assessment Criteria

15.4.1 Assessment Methodology

10) The assessment of major accidents differs from the standard EIA methodology approach described in Chapter 4: EIA Methodology, as it focuses on the risk of extreme incidences and the potential for significant environmental effects as a result of those extreme incidences (i.e. those that could result in serious environmental effects to human health, welfare and/or the environment).

11) There is currently no standard approach to assessing major accidents as part of the EIA process. However, the Institute of Environmental Management and Assessment (IEMA) and Arup (2020)[2] have prepared a Primer to guide the consideration of this topic in EIA: 'Major Accidents and Disasters in EIA Guide' (hereafter referred to as 'the Primer').

12) Risk assessment and management in the UK is typically based on risk tolerability, with the focus on risk being '*as low as reasonably practicable*'. In the context of this assessment, the Primer (IEMA and Arup, 2020) identifies this as being when a risk is controlled, taking into account 'the trouble, time and money needed to control it'.

13) The Primer (IEMA and Arup, 2020) recognises that the UK has a structured framework of risk management legislation in place and as such, a signposting approach can be an efficient way of making use of existing data and processes to avoid duplicating any risk quantification and management already being undertaken during construction and operation of the project.

14) To identify whether an incident has the potential to be a major accident or disaster with the potential for a significant adverse effect on the environment, three components are required: a source, a pathway (between source and receptor) and a receptor. This informed a methodology comprising two stages:

- Stage 1: identifying the potential sources of a hazard that could result in a major accident, whether there are potential pathways to receptors that could cause a significant environmental effect and

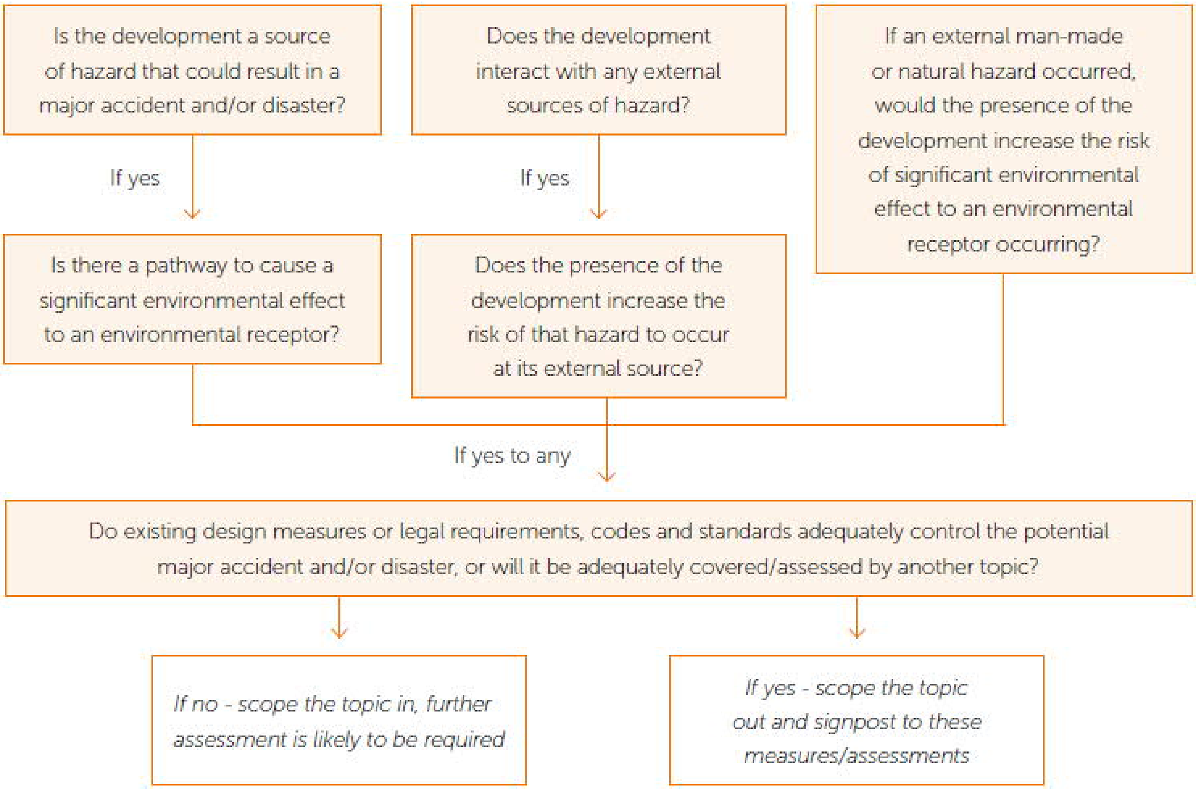
[1] European Union (2017). Environmental Impact Assessment of Projects - Guidance on Screening.
[2] Institute of Environmental Management and Assessment (IEMA) and Arup (2020). Major Accidents and Disasters in EIA: A Primer.

finally, whether existing design measures, legal requirements, codes and standards adequately control the potential major accident

- Stage 2: assessing each hazard in turn to identify whether the development was a potential source of hazard that could result in a major accident or disaster, or whether the development could interact with any external source of hazard. This stage considered environmental risks and whether these could be resolved through design, procedures and/or mitigation.

15) The above aligns with the scoping approach set out within Figure 1 of the Primer (IEMA and Arup, 2020) and is replicated in Illustration 15.1 for information.

Illustration 15.1: Scoping Decision Process Flow



15.4.2 Assessment Criteria

16) The assessment of major accidents differs from the standard EIA approach described in Chapter 4: EIA Methodology, as it focuses on risk. The intention of this assessment is to identify any major risks in the context of potential for significant environmental effects.

17) As noted in paragraph 2, this assessment considers the occurrence of extreme incidences and considers scenarios that would not reasonably be covered by the other environmental topic assessments of this ES.

18) This assessment considers a significant effect in the context of a major accident to be a low likelihood but high consequence extreme event that may result in:

- Serious damage to human populations (multiple serious injuries and/or requirements for medical attention, or death) and/or
- Serious damage to the environment (based on extent, severity and duration).

15.4.3 Baseline Environment

19) The baseline for the assessment of major accidents was established as follows:

- *Potential Environmental Receptors:* receptors that could be vulnerable to a major accident or disaster as a result of the Proposed Bowland Section
- *Nearby Major Accident Installations:* potential linkages to other projects that could increase the risk of a major accident within the study area (major accident installations)
- *Natural Hazards:* a review of existing baseline data relating to natural hazards/ disasters, which can inform the likelihood of a natural disaster occurring within the study area.

Potential Environmental Receptors

20) The primary sources of information to identify potential major accident and disaster sources and receptors were the environmental topic chapters of this ES. No additional receptors that would be relevant to the major accidents chapter have been identified outside of those set out within the other topic chapters of this ES.

Nearby Major Accident Installations

21) For the purposes of this assessment, a wider study area was considered to identify any sites categorised by HSE[3] as major accident installations (sites or pipelines), as follows:

- Facilities subject to the Control of Major Accident Hazard (COMAH) Regulations 2015 within 2 km
- Major Accident Hazard Pipelines (MAHPs) within 2 km.

Natural Hazards

22) Information on natural hazards was collated from relevant topic chapters of this ES (refer to topic areas in Table 15.2), and augmented by meteorological data from the UK Met Office. UK Cabinet Office guidance[4] (2011) and the Primer (IEMA and Arup (2020) were also consulted to define the main natural hazards that can disrupt infrastructure in the UK.

15.4.4 Assumptions and Limitations

23) The assessment was based on a qualitative review of existing data sources, with no additional surveys required. There were no identified gaps in the baseline data needed to inform the level of assessment reported in this chapter.

24) Environmental effects associated with unplanned events that do not meet the definition of a major accident and or disaster (such as minor spills that can be contained by typical good construction practice) are considered within the respective chapters of this ES and are not within the scope of this assessment.

15.4.5 Embedded Mitigation and Good Practice

25) Embedded mitigation is inherent to the design, and good practice measures are standard industry methods and approaches used to manage commonly occurring environmental effects. The assessment presented in Section 15.6 of this chapter is made taking into account embedded mitigation and the implementation of good practice measures, as summarised under the subheadings below.

26) The need for any additional topic-specific essential mitigation (generally for effects likely to be significant in the context of the EIA Regulations) identified as a result of the assessment in Section 15.6 is then set out separately in Section 15.7.

---

[3] https://www.hse.gov.uk/comah/comah-establishments.htm

[4] UK Cabinet Office (2011). Keeping the Country Running: Natural Hazards and Infrastructure.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/61342/natural-hazards-infrastructure.pdf

Embedded Mitigation

27) Chapter 3: Design Evolution and Development Description explains the evolution of the design with input from the environmental team, including mitigation workshops and the use of GIS based constraints data.

Design Considerations

28) In the context of both 'vulnerability to' and 'potential to cause' a major accident or disaster, it is important to note that the Proposed Programme of Works has been designed to United Utilities' standard engineering specifications and asset standards including the Civil Engineering Specification for the Water Industry[5] (CESWI), and applicable British Standards / Eurocodes.

29) The project also falls under the Construction (Design and Management) Regulations 2015 (CDM Regulations). These place specific duties on clients, designers and contractors so that health and safety is considered throughout the life of a project, from its inception to its subsequent final demolition and removal. Under the CDM Regulations, designers are required to avoid foreseeable risks so far as reasonably practicable, by eliminating hazards from the construction, maintenance, and proposed use and demolition of a structure, reducing risks from any remaining hazard, and giving collective safety measures priority over individual measures.

30) The development would be constructed and operated in accordance with applicable health and safety legislation and all aspects of the work would comply with the provisions of the Health and Safety at Work etc. Act 1974 and all relevant subordinate legislation.

31) Above ground installations required as part of the development are proposed to utilise locations of existing United Utilities assets where feasible, and are outside any areas of flood risk. The installations are identified as:

- Valve house building at the Lower Houses Compound
- Valve house building at the Newton-in-Bowland Compound
- Ground level raised chambers at Lower Houses Compound and Newton-in-Bowland Compound.

32) There are also a number of underground structures, principally a new flow distribution structure (buried) to allow water flows to pass through existing buried infrastructure to an existing overflow weir, and air valves within buried chambers with localised ground raising and grass banking around an access cover.

33) The development includes various measures embedded into the design specifically to reduce risk and effects on sensitive human and environmental receptors. Of particular relevance are:

- The replacement of the existing deteriorating tunnel with the proposed tunnel, which would enhance and protect safe water supply
- The decommissioned tunnel would be reinforced under shallow cover below key assets such as building and highways
- The risk of ground gas would be managed through appropriate monitoring and mitigation measures during the tunnelling and operational phases.

Pipeline Commissioning

34) Measures would be taken to provide long term safety of the pipeline and associated infrastructure. During manufacture, the components would be subjected to rigorous testing before being certified as fit for use.

35) A range of tests would also be employed to check the integrity of the pipeline as part of the commissioning process. Typical safety measures that may be employed at the time of construction include:

[5] *Civil Engineering Specification for the Water Industry (7th Edition).* UKWIR Ltd., 2011

- Pressure testing of open cut pipelines
- Water quality tests
- Limits on allowable ingress into the completed tunnel.

Operation and Maintenance

36) Pipelines are considered one of the safest modes of transport for conveying potable water. The pipeline would be operated in accordance with strict and comprehensive standard operating procedures (SOPs). The replacement pipeline would be buried underground over its length, and is therefore resilient to most forms of major accident or disaster.

37) The operational pipeline route would be subject to regular inspections, and would identify for example any surface works in the vicinity of the tunnel, or any surface signs of settlement on shallow sections of the pipeline as there would not be any surface issues visible for deeper tunnel sections.

Good Practice Measures

38) Good practice measures are contained in Appendix 3.3: Construction Code of Practice (CCoP). The CCoP presents measures in relation to each environmental topic, and of particular relevance to the consideration of major accidents is:

- Flood Risk during construction: Preparation of a Flood Response Plan, and implementation of measures to ensure that temporary works are protected from, or resilient to, flooding during a high-risk event, and that the risk of flooding beyond the site is not increased during a similar event
- Fuel storage: diesel is the primary construction fuel, and would be managed on site in accordance with the CCoP, which sets out good practice measures for storage and use of fuels.

39) The project team would prepare and maintain a health and safety policy and a detailed, site-specific health and safety plan. Method statements, accompanied by safety risk assessments, would be produced to cover the construction activities.

Existing Underground Utilities

40) The Proposed Bowland Section is not in proximity to any known notable underground utilities, or major accident installations notified by HSE as a major accident hazard. Minor underground services are present at, or in proximity to, the compound locations, including potable water assets and communications infrastructure

41) In terms of existing underground utilities in proximity to the Proposed Off-site Highways Works (Volume 5) and the Proposed Ribble Crossing (Volume 6), an existing ethylene pipeline crosses the alignment of the Proposed Ribble Crossing. The pipeline, owned and operated by SABIC, is identified as a Major Accident Hazard Pipeline (MAHP), and follows a trans-Pennine route conveying ethylene from a production facility in the North West region to customers nationally.

42) Existing buried services would be covered by protective provisions with the relevant undertakers. Standard controls are likely to include:

- Liaising with owners/operators of each pipeline
- Obtaining service records prior to commencement of excavation
- Completion of risk assessments
- Scanning excavations.

43) HSE guidance HSG47: Avoiding danger from underground services[6] would also be followed. This guidance outlines the potential risks of working near underground services and provides advice on how

[6] Health and Safety Executive (2014). *Avoiding danger from underground services. HSG47 (Third Edition)*. www.hse.gov.uk/pubns/books/hsg47.htm

to reduce any direct risks to people's health and safety, as well as the indirect risks arising through damage to services.

Existing Overhead Utilities

44) The Proposed Bowland Section is also in proximity to a low voltage (11 kV) overhead line at the proposed location of the Newton-in-Bowland compound, operated by Electricity North West Ltd. It is proposed to divert this overhead line as close to the existing alignment as possible. Overhead line services would be covered by protective provisions with the owner/operator. The overhead line is not identified as a major accident hazard installation.

15.5 Baseline Conditions

Potential Environmental Receptors

45) Receptors that could potentially be affected by a major accident have been identified within the specific environmental topic chapters of this ES, and as part of maintaining a proportionate assessment, are not duplicated here. Table 15.2 sets out key ES information sources, signposting to information regarding the receptors that could be vulnerable to a major accident in relation to the project.

Table 15.2: Major Accidents and Disasters – ES Information Sources

Data Source	Information
Chapter 3: Design Evolution and Development Description	▪ Construction activities ▪ Design measures.
Chapter 7: Water Environment Chapter 8: Flood Risk Appendix 8.1: Flood Risk Assessment (FRA)	▪ Surface water ▪ Flooding ▪ Water quality.
Chapter 9: Ecology	▪ Protected species (terrestrial and aquatic) ▪ Protected sites and habitats.
Chapter 10: Cultural Heritage	▪ Historic buildings.
Chapter 11: Soils, Geology and Land Quality	▪ Land instability ▪ Groundwater ▪ Soil.
Chapter 14: Communities and Health	▪ Population and human health.

46) It is considered proportionate to exclude certain receptor groups from the outset of major accident assessment. Construction workers, as a receptor, are excluded from the assessment, as existing legal protection is considered appropriate to minimise any risk from major accidents to a reasonable level. Legislation in force to ensure the protection of workers in the workplace includes CDM Regulations (HMSO,2015) and the HSWA (HMSO, 1974), as well as:

- The Management of Health and Safety at Work Regulations (HMSO, 1999)
- The Workplace (Health, Safety and Welfare) Regulations (HMS0, 1992).

15.5.1 Nearby Major Accident Installations

47) There are no identified major accident installations identified within 2km of the Proposed Bowland Section route or site compounds.

48) Two major accident installations were identified within 2km of the Proposed Off-site Highways Works (Volume 5) and/or the Proposed Ribble Crossing (Volume 6):

- An ethylene pipeline (MAHP) crosses the alignment of the Proposed Ribble Crossing, as previously explained in paragraph 41.
- A Johnson Matthey site in Clitheroe producing catalyst products for use in the chemicals, oil, gas and agrochemicals industries is notified as a COMAH site by HSE. This is within 2 km of Clitheroe Park and Ride Facility and the HGV holding area at Ribblesdale Cement Works forming part of the Proposed Off-site Highways Works, and is also within 2 km of the Proposed Ribble Crossing.

15.5.2 Natural Hazards

49) Cabinet Office guidance[7] indicates that the main natural hazards that can disrupt infrastructure in the UK are hydrological (e.g. drought, floods), geological (e.g. earthquakes, landslides) and climatic and atmospheric (e.g. extremes of heat and cold, windstorm). UK Cabinet Office guidance lists natural hazards in the UK and their potential consequences as follows:

- Storms and gales (flooding, land instability, wildfire)
- Prolonged hot weather (thunderstorms, drought, dust/smog/haze/fog, land instability, wildfire)
- Prolonged dry weather (dust/smog/haze/fog, reduced ground water flow, water quality, land instability, drought)
- Excessive cold with snow (ice/ice accretion, wind chill, fog, flooding - snow melt).

50) This section covers the baseline conditions in relation to potential disasters due to natural hazards, as considered relevant to this area of the UK.

Flooding

51) Environment Agency flood zone definitions are set out in the National Planning Policy Guidance (2014), as follows:

- Flood Zone 1 – land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1 %)
- Flood Zone 2 – land assessed as having between a 1 in 100 and 1 in 1,000 year probability of river flooding (1 % – 0.1 %), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5 % – 0.1 %)
- Flood Zone 3 – land assessed as having a 1 in 100 or greater annual probability of river flooding (>1 %), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5 %).

52) The Proposed Bowland Section is at very low risk of flooding (Flood Zone 1) except for where the construction access road would cross the River Hodder, and in areas with a low probability of flooding from other sources. The floodplain of the River Hodder is classified as Flood Zone 3 indicating a high probability of flooding. This is fully assessed in Chapter 8: Flood Risk, and supporting Appendix 8.1: Flood Risk Assessment (FRA), which supports the planning application.

Land Instability

53) The Proposed Bowland Section passes through a rural area of generally undulating topography, predominantly used for agriculture (grazing). Land instability for the purposes of this assessment was considered in terms of extensive ground movement due to natural hazards, principally an earthquake. Existing land instability due to previous human activity is considered separately to natural hazards in Table 15.3.

[7] UK Cabinet Office (2011). *Keeping the Country Running: Natural Hazards and Infrastructure.* [Accessed: December 2020] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/61342/natural-hazards-infrastructure.pdf

54) Earthquakes severe enough to cause damage are rare in the UK, and the route passes through areas considered to be of very low seismicity. The British Geological Survey data[8] indicates that the Proposed Bowland Section is located within areas with a Peak Ground Acceleration (PGA, g) of 0.004 to 0.006. This is the third lowest of the nine BGS seismicity categories for the UK.

Climate

55) The UK is not subject to extremes of hot or cold weather. The highest daily maximum temperature on record in the UK is 38.5°C, recorded in August 2003 in Kent. The lowest daily minimum temperature on record in the UK is -26.1°C, recorded in 1982 in Shropshire (UK Met Office data). Based on available data (1981–2010) from the nearest UK Met Office climate station at Stonyhurst, approximately 10 km south of the southern extent of the Proposed Bowland Section, average annual temperature data are as follows:

- Max. monthly average temperature: 19.7°C
- Min. monthly average temperature: 1.2°C
- Max. temperature range between months: 13.2°C (Jan vs. July)
- Min. temperature range between months: 10.6°C (Feb vs. July)
- Days of air frost per year: 45.2 (occurs when temperature 1.25 m above the ground falls below 0°C).

56) The area through which the replacement pipeline passes has relatively high rainfall in a UK context. Based on available data (1998–2010) from the UK Met Office climate station at Stonyhurst, rainfall data are as follows:

- Annual rainfall: 1294.2 mm
- Min. monthly rainfall: 66.6 mm (April)
- Max. monthly rainfall: 141.6 mm (Dec)
- Days of rainfall >1 mm: 167.8.

57) The occurrence of snow is linked closely with temperature, with falls rarely occurring if the temperature is higher than 4°C, and temperatures below this are generally required for snow to lie for any length of time. UK Met Office information indicates than on average, snow falls around 20 days per year over lower lying areas of north west England, but as much as 50 days over the highest ground (an increase of approximately 5 days of snow falling per year per 100 m increase in altitude is typical).

58) The north west of England is one of the more exposed parts of the UK, due to relative proximity to the Atlantic and the presence of large upland areas. The strongest winds are associated with the passage of deep areas of low pressure close to or across the UK. The frequency and strength of these depressions is greatest in the winter half of the year, especially from December to February, and this is when mean speeds and gusts (short duration peak values) are strongest.

59) There are no mean wind speed data available from the UK Met Office climate station at Stonyhurst, or from the closest alternative climate station at Malham Tarn. Gales (a mean windspeed of 34 knots or more over any 10 consecutive minutes) only occur occasionally, with less than five gales per year in low-lying areas of north west England. Extreme storms are very rare in the UK, but can have significant implications when they do occur. In January 2021 for example, Storm Christoph brought significant rain and widespread flooding across the UK, and led to hundreds of properties being evacuated in Great Manchester.

60) In a UK context, the north west of England has a low susceptibility to the effects of droughts, which result in dry ground conditions. Water company supply areas in the UK are assessed in terms of 'water stress'.

[8] *British Geological Survey: A Revised Seismic Hazard Map for the UK.* http://earthquakes.bgs.ac.uk/hazard/uk_hazard_map.html [Accessed: December 2020]

The Proposed Bowland Section is located within an area of low water stress (Environment Agency, 2013[9]).

Wildfire

61) The UK has a temperate climate that is not usually associated with wildfire, however wildfires do occur annually. In 2018, there were several relatively large wildfires in the UK, following an extended period of hot and dry weather. Two of these were classified as major incidents (located in Greater Manchester and Lancashire). Wildfires generally start from human error, such as discarded cigarettes or barbeques, when ground conditions are dry after extended periods of hot, dry weather, and vegetation may have increased susceptibility to fire.

15.6 Likely Significant Effects

62) The following section considers the potential for, and environmental risk of, major accidents and disasters in relation to the Proposed Bowland Section during the construction and operational phases. As noted in paragraph 3, the chapter also considers the vulnerability and risks associated with the Proposed Off-site Highways Works (Volume 5) and the Proposed Ribble Crossing (Volume 6).

63) As explained in paragraph 11, this chapter differs from the other ES chapters which report potential impacts for each topic area, as it instead focusses on environmental risk.

64) This section sets out any likely significant effects of the project in relation to potential for major accidents, following the general approach set out within the Primer (IEMA and Arup, 2020). It assumes that the relevant embedded measures and good practice measures are in place before assessing the effects, in accordance with guidance from the IEMA for delivering a proportionate assessment (IEMA, 2016). However, it highlights the relevant documents that support this, to aid communication of the matters and to provide transparency in the conclusions drawn.

65) Table 15.3 sets out the assessment of potential for major accidents (approach informed by the Hazard Identification Record Template in IEMA and Arup, 2020).

[9] *Water stressed areas – final classification*. https://www.gov.uk/government/publications/water-stressed-areas-2013-classification [Accessed: February 2021]

Table 15.3: Major Accidents and Natural Disasters Assessment

Hazard / Event	Project Phase	Reasonable worst consequence if event did occur	Review of risk, and embedded / good practice measures already in place	Potential major accident or disaster with existing measures in place?
Manmade Hazards				
Ground instability	Construction	Potential for surface settlement.	No historical or contemporary mine workings or other mineral sites were identified within the assessment area, and no land instability issues are identified within Chapter 11: Soils, Geology and Land Quality.	No
Human error (buried strike to existing overhead lines)	Construction	Damage to an overhead line is unlikely to affect environmental receptors, but poses a health and safety risk and could result in temporary power failure while the overhead line is repaired.	One low voltage overhead line has been identified in proximity to the proposed works (at the location of the proposed Newton-in-Bowland Compound). However, this will be diverted prior to commencement of works at this location, which would remove any potential risk.	No
Human error (buried strike to existing buried services)	Construction	If a third party buried service were to be struck by the project during construction it could cause harm to the workforce, and/or could result in another undesirable event depending on the type of service affected (loss of water supply, pollution incident from fuel pipeline etc).	The protection of buried services is achieved through existing safety controls embedded during the design and construction stages. These would include analysis of up to date service information to identify the location of services, holding discussions with service providers to agree protective provisions and managing the risks to services through the project risk register. Measures to manage risk include undertaking service location surveys to track where services are located on the ground. Works would also take into consideration HSE (2014) guidance, which provides advice on how to reduce any direct risks to people's health and safety, as well as the indirect risks arising through damage to services. These existing measures reduce the risk to as low as low as reasonably practicable for the project to cause a service strike through human error.	No

Hazard / Event	Project Phase	Reasonable worst consequence if event did occur	Review of risk, and embedded / good practice measures already in place	Potential major accident or disaster with existing measures in place?
Ground subsidence due to tunnelling	Construction and Operation	Settlement of land and potential for damage to buildings, structures, highways or other infrastructure	The detailed design of the tunnel would ensure that any settlement would not result in damage to surface features. Pre- and post-construction surveys would be carried out and surface settlement would be closely monitored during construction for shallower sections of tunnel.	No
Malicious damage	Construction and Operation	If the project were to be subject to wilful damage to the tunnel or above ground installations, this could result in harm or disruption to water supply.	The project is designed to avoid the risk of damage through sabotage and arson. The materials are resistant to damage and are not at risk of catching fire. During construction, the working area would have security fencing around the site and only authorised personnel would be admitted to the site. Outside of working hours the construction compounds would have a security presence to check for trespassers that could result in sabotage or arson. During operation, the above ground installations would be surrounded by security fencing to prevent trespass. Wilful sabotage of buried pipelines is very rare, and difficult to enact.	No
Pollution	Construction and Operation	During construction, a major accidental release of diesel fuel could cause harm to local sensitive environments including terrestrial habitats and watercourses. If a water quality issue occurred during operation, water supply could be temporarily disrupted.	During construction, diesel would be stored on site to fuel generators, on-site plant and equipment. The quantities of diesel that would be stored at the Lower Houses Compound would be relatively small due to it functioning as a reception site that would not need to provide an electrical power supply for the tunnel boring machine (TBM). The quantities of diesel that would need to be stored at the Newton-in-Bowland Compound drive site would be much larger than would be required at the Lower Houses Compound reception site, due to the drive site having the important function of providing all of the electrical power needed to run the TBM. It is therefore anticipated that the much larger volumes of diesel would be stored in two bunded fuel tanks. At	Further consideration required (construction). Refer to Section 15.7. No (operation)

Hazard / Event	Project Phase	Reasonable worst consequence if event did occur	Review of risk, and embedded / good practice measures already in place	Potential major accident or disaster with existing measures in place?
			this stage of design development, daily volumetric requirements for fuel cannot be confirmed, as this will be heavily influenced by aspects such as fuel/power source for the selected TBMs. In a precautionary worst-case scenario, a maximum capacity of circa 40,000 litres per fuel tank is considered possible. Diesel can be harmful to the environment, and may be ingested by wildlife and be toxic to aquatic organisms if it reaches watercourses. Harm to humans (during construction) would require either ingestion or repeated skin contact of diesel, neither of which would be expected to occur from release due to existing health and safety processes. The CCoP identifies that the contractor would be required to develop a Pollution Incident Control Plan as part of the Construction Environmental Management Plan (CEMP). This would include an assessment of the risk of contamination and set out specific measures relating to the storage and use of hazardous materials, with the aim of preventing and containing spills and releases. The Pollution Incident Control Plan would also set out procedures to be adopted in the event of a pollution incident, to contain and limit any adverse effects. During operation, water supply is subject to regular quality testing. Drinking water quality in the new aqueduct would be subject to stringent testing to Drinking Water Inspectorate standards at various points in the supply network. United Utilities works to established emergency procedures in the highly unlikely event that testing highlights a potential problem with water quality. These procedures enable affected supplies to be prevented from entering customers' homes and businesses, and allow for alternative supplies to be provided with the minimum of service disruption.	

Hazard / Event	Project Phase	Reasonable worst consequence if event did occur	Review of risk, and embedded / good practice measures already in place	Potential major accident or disaster with existing measures in place?
Nearby high hazard assets	Construction and Operation	▪ Proposed Bowland Section: none ▪ Offsite Highways Works (Volume 5): One major accident installation identified in the Clitheroe area – Johnson Matthey's facility produces catalyst products for use in the chemicals, oil, gas and agrochemicals industries. Major accident risks comprise fire and accidental release of dangerous substances which could temporarily impact on construction and operation activities on the Ribble Crossing. Access to the Clitheroe Park and Ride facility and HGV holding area could be temporarily suspended ▪ Proposed Ribble Crossing (Volume 6): Ethylene pipeline identified within the development footprint of the Proposed Ribble Crossing. Rupture of the pipeline would cause the release of hazardous substance, and requiring temporary suspension of construction or operation activities on the Ribble Crossing. The Johnson Matthey site (see above) is also within 2km of the Proposed Ribble Crossing.	The Johnson Matthey site in Clitheroe is located within 2 km of the Proposed Ribble Crossing, and of the proposed Park and Ride Facility and separate HGV holding area at the Ribblesdale Cement Works. It is anticipated that the planning authority will consult with the Health and Safety Executive in connection with the planning application for the Proposed Bowland Section and its relationship with this COMAH site. United Utilities will also enter into consultations with Johnson Matthey. The ethylene pipeline is within the development footprint of the Proposed Ribble Crossing, and a design solution would be required to mitigate this risk. This is considered in Section 15.7.	Further consideration required (construction and operation). Refer to Section 15.7.

Hazard / Event	Project Phase	Reasonable worst consequence if event did occur	Review of risk, and embedded / good practice measures already in place	Potential major accident or disaster with existing measures in place?
Major release of water due to tunnel failure	Operation	Flooding at surface.	The new tunnel is designed with an asset life of 120 years and would reduce the risks of major release of water compared to the existing aqueduct. For the majority of the tunnel, the external ground water pressure would exceed the internal pressure in the pipeline so any leakage would be into the pipeline rather than causing a leakage.	No
Human error (damage to underground tunnel)	Operation	If a third party were to damage the tunnel/aqueduct during operation, this could temporarily disrupt water supply.	The new tunnel and connections to the existing aqueduct would be buried over their entire length. Landowners would be made aware of the route of the tunnel and associated wayleave on their land and the activities that can take place over the tunnel. At its shallowest points (such as the new multi-line connections), it would remain at sufficient depth that it would be unaffected by agricultural activities. In the extremely unlikely event that the tunnel was damaged, the fault would be rapidly reported through the monitoring system and the system would be auto-isolated, making it safe pending investigations.	No
Natural Hazards				
Flooding	Construction and Operation	If serious flooding were to occur during construction it could cause construction materials or plant to get flooded and increase the risk of pollution. If serious flooding were to occur during operation, it could cause above ground installations to be temporarily submerged. Development can also increase the risk of flooding elsewhere due to above ground features affecting floodplain capacity or flows.	An FRA has been undertaken for the development, considering construction and operation of the pipeline in terms of potential to increase flood risk or be susceptible to flooding. This assessment has informed the design development, with embedded mitigation including the siting of works. The FRA considers flood frequency and potential severity (magnitude). This severity is of relevance to the major accidents assessment and is categorised in the FRA on a scale from 'negligible' to 'major'. Of these, the only category that could potentially align with a significant effect in the context of a major accident or disaster would be the highest of these categories, the definition of which includes 'potential change in	No

Hazard / Event	Project Phase	Reasonable worst consequence if event did occur	Review of risk, and embedded / good practice measures already in place	Potential major accident or disaster with existing measures in place?
			risk to life'. The FRA confirms that residual flood risk for all phases of the Proposed Bowland Section is below this level.	
Land Instability	Construction and Operation	Extensive ground movement due to land instability (such as an earthquake) could potentially damage a buried pipeline or above ground installations, resulting in release of water.	The development is located in an area with undulating topography and low seismicity. BGS (2019) estimates that a magnitude 4 earthquake happens somewhere in the UK approximately every two years and a magnitude 5 earthquake approximately every 10–20 years. A magnitude 5 earthquake would generally cause no damage or minimal damage to buildings. Research suggests that the largest possible earthquake anywhere in the UK is around 6.5, which could cause damage to buildings. However, this would generally not be sufficient to cause land instability that presents a risk to buried pipelines.	No
Wildfire	Construction and Operation	There is not considered to be a risk of a significant environmental effect in terms of development vulnerability to wildfire, particularly given that the pipeline is at depth and conveys water.	n/a	No
Storms	Construction and Operation	Lightning could potentially strike above ground installations. Damage to underground installations such as buried pipelines is extremely unlikely.	Thunderstorms may result in heavy rainfall, winds and lightning. Storms of sufficient severity to cause damage to infrastructure are very rare in the UK. Any aspects of above ground installations susceptible to lightning strikes would be assessed for risk of lightning strikes and any necessary earthing protection would be provided.	No
Drought	Construction and Operation	Extended dry (drought) conditions would not affect the pipeline or above ground installations directly. In the context of the development, secondary effects of drought	n/a	No

Hazard / Event	Project Phase	Reasonable worst consequence if event did occur	Review of risk, and embedded / good practice measures already in place	Potential major accident or disaster with existing measures in place?
		could be creation of dry ground and reduced moisture content of vegetation, which can make them more flammable. However, as noted above, the development is not considered to be susceptible to wildfire.		
Dust, Smog, Haze, Fog	Operation	The development is not vulnerable to atmospheric pollutants (dust, smog, haze) or moisture in the air (fog).	n/a	No
Ice, Ice Accretion	Operation	The pipeline is buried and therefore not liable to ice/ice accretion. Above ground installations are not vulnerable to the effects of ice.	n/a	
Wind Chill	Operation	Wind chill is the cooling effect of wind blowing on a surface. Neither the pipeline nor above ground installations are liable to the effects of wind chill.	n/a	No
Reduced Groundwater Flow	Operation	The development comprises a pipeline and associated installations which provide robust sealed containment of potable water. The development would not be vulnerable to reduced groundwater flow.	n/a	No
Water Quality	Operation	The operational development would not use water resources and is therefore not vulnerable to changes in water quality.	n/a	No

66) As set out in Table 15.3, on a precautionary basis diesel storage on site during construction, and risks associated with two high hazard sites have been identified for further consideration.

67) No other risks of major accidents were identified, taking into account embedded mitigation and good practice.

Diesel Storage

68) This was identified on a precautionary basis, reflecting the fact that the volumes of diesel to be stored on site can only be determined once a contractor has been appointed and detailed aspects such as equipment types and power source have been confirmed. For example, depending on the TBM selected, power may be provided by electricity supply from the existing distribution network, instead of diesel powered generating sets.

69) A reasonable worst-case scenario is that two storage tanks (20,000 litres each) at the Newton-in-Bowland Compound would be required for the Proposed Bowland Section, with a maximum anticipated storage requirement at any time of 40,000 litres. Mobile plant would be refuelled using mobile fuel bowsers or at dedicated refuelling points, with appropriate precautions taken to prevent fuel spills.

70) The Chemicals and Downstream Oil Industries Forum (CDOIF) (2016) [10] provides guidance for considering environmental risk tolerability for COMAH establishments. Whilst the proposed diesel storage tanks are not a COMAH establishment, application of this guidance would indicate that the most sensitive receptor class (identified as a Site of Special Scientific Interest) has a threshold for a major accident threat to the environment of 59Te of fuel (approximately 73,000 litres).

71) Even in a worst case scenario, the maximum credible volume release would be below this threshold. There are also conditional modifiers that would further reduce the risk:

- The unlikelihood of a release having a pathway leading to the receptor (e.g. receptor is at higher elevation)
- The unlikelihood of a release actually reaching the receptor even if there is a pathway, and the failure of intervention measures to recover any spill and prevent its propagation to sensitive receptors
- Diesel is biodegradable given the right conditions, including access to oxygen.

72) As noted in paragraph 13, risk assessment and management are typically based on an '*as low as reasonably practicable*' approach. On this basis, and taking into account embedded mitigation and good practice a major accident is considered highly improbable; however, details of these measures would need to be defined when diesel volumetric requirements are known during detailed design.

High Hazard Assets

73) Table 15.3 lists the two high hazard assets (COMAH and MAHP) within 2km of the Proposed Off-site Highways Works (Volume 5) and/or Proposed Ribble Crossing (Volume 6). The COMAH site (hazardous materials) is unlikely to be directly affected but will be subject to ongoing consultation. The MAHP (ethylene pipeline) is within the development footprint of the Proposed Ribble Crossing, and a design solution would be required to mitigate risks associated with this.

15.7 Essential Mitigation and Residual Effects

74) Mitigation is most effective if considered as an integral part of design to avoid, reduce or offset any adverse effects on the environment.

75) The potential for major accidents and disasters and consequent environmental risk was considered against the design, construction practice, and proposed mitigation measures presented in the topic chapters of the ES.

[10] Chemicals and Downstream Oil Industries Forum (CDOIF). (2016). Guideline for Environmental Risk Tolerability for COMAH Establishments. Accessed January 2019. https://www.sepa.org.uk/media/219154/cdoif_guideline__environmental_risk_assessment_v2.pdf

76) On a precautionary basis, diesel storage on site was identified for further consideration, as the volumes of diesel to be stored on site are currently not known but could be very large volumes. No other risks of major accidents were identified, taking into account embedded mitigation and good practice.

77) Accordingly, the following additional essential mitigation items are identified:

- The contractor would seek practicable measures through selection of plant and equipment and/or methods of operation to reduce the maximum diesel fuel storage on site (Mitigation Item MA1).
- Estimated fuel storage requirements would be defined during detailed design together with anticipated controls to ensure that risk of a pollution incident is as low as reasonably practicable. These would be submitted and agreed with the Environment Agency (Mitigation Item MA2)
- A design solution would be developed to enable the Proposed Ribble Crossing to be constructed safely over the existing ethylene pipeline without compromising the safe day-to-day operation of the infrastructure. The essential mitigation objective is to develop a design solution and formally agree this with the pipeline operator (Mitigation Item MA3). Once a solution has been formally agreed with the pipeline operator it would be delivered as an integral part of the engineering design of the dedicated haulage route.
- Although it is not anticipated that the Johnson Matthey site in Clitheroe would pose any specific risks to construction, operation or decommissioning of the Park and Ride and HGV holding areas (Volume 5) or the Proposed Ribble Crossing (Volume 6), United Utilities will engage with the site operators to exchange relevant construction and operational data and identify any necessary action plans. This will enable United Utilities to either validate the current working assumption that no embedded mitigation would be required to mitigate risks from the industrial facility, or confirm next steps (Mitigation Item MA4).

15.8 Cumulative Effects

78) The following section provides an overview of the potential cumulative effects from different proposed developments and land allocations, in combination with the Proposed Bowland Section (i.e. inter-project cumulative assessment). Data on proposed third party developments and land allocations contained in development plan documents were obtained from various sources, including local planning authority websites, online searches, and consultations with planning officers. Proposed development data were then reviewed with a view to identifying schemes or land allocations whose nature, scale and scope could potentially give rise to significant environmental effects when considered in combination with the likely effects arising from the Proposed Bowland Section.

79) Intra-project cumulative impacts i.e. two or more types of impact acting in combination on a given environmental receptor, property or community resource are considered in Chapter 14: Communities and Health.

80) The over-arching cumulative effects of the Proposed Programme of Works, i.e. the five proposed replacement tunnel sections in combination, are considered in Chapter 19: Cumulative Effects. Chapter 19 also examines the cumulative effects associated with delivery and operation of the main construction compounds, tunnel and construction traffic routes.

81) This assessment has considered the environmental risk of low likelihood but high consequence major accidents and disasters. As such, these are extreme and rare events of a much greater different scale, type and duration to any other environmental impacts reported in the topic chapters of this ES, and would not be likely to result in a cumulative effect.

15.9 Conclusion

82) This chapter of the ES considered the potential for a major accident or disaster during construction or operation of the Proposed Bowland Section. The assessment considered the risk of highly unlikely or extreme incidences not reasonably covered by other topic chapters of this ES.

83) No natural hazards were identified that could present a risk of a major accident or disaster.

84) Embedded mitigation and good practice have been established which reduce all risks to as low as reasonably practicable. As the exact storage volume requirements for diesel fuel has not been confirmed at this stage, essential mitigation has been proposed on a precautionary basis to ensure that volumes and detail of pollution controls are agreed in advance of construction with the Environment Agency.

85) Taking into account embedded mitigation, good practice and essential mitigation, no major accident threat to the environment has been identified, and no significant residual effects are therefore predicted within the scope of this assessment of environmental risk due to a major accident or disaster.

Design Development

86) As explained in Chapter 1, off-site highways works and the Proposed Ribble Crossing were developed at a late stage in the EIA programme (refer to Volume 5 and Volume 6 respectively). As noted within paragraph 3, to avoid duplication the vulnerability and risks associated with these activities have been incorporated into this chapter. A brief summary is provided below.

<u>Off-site Highways works</u>

87) There is one COMAH major accident installation; a Johnson Matthey facility in Clitheroe, whose consultation zone encompasses the proposed Clitheroe Park and Ride and HGV holding areas at the Ribblesdale Cement Works. No additional potential for major accidents was identified in relation to off-site highways works, however consultation will be undertaken with the site operators.

<u>Ribble Crossing</u>

88) A high pressure ethylene pipeline classified as a MAHP runs along the Ribble Valley and would be crossed by the Proposed Ribble Crossing. Essential mitigation has been identified as set out in Section 15.7. With these measures in place, no additional potential for major accidents was identified.

89) The Ribble Crossing is also within 2km of the COMAH site referred to above; no additional potential for major accidents was identified in relation to the Ribble Crossing, however consultation will be undertaken with the site operators.

15.10 Glossary and Key Terms

90) Key phrases and terms used within this technical chapter relating to major accidents are defined within Appendix 1.2: Glossary and Key Terms.