



**Haweswater Aqueduct Resilience Programme - Proposed Bowland
Section**

Volume 6

Proposed Ribble Crossing

Chapter 11: Soils, Geology and Land Quality

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Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

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11. Soils, Geology and Land Quality

11.1 Introduction

- 1) This chapter presents an assessment of the likely significant effects of the Proposed Ribble Crossing on Soils, Geology and Land Quality.
- 2) The chapter begins by discussing the scoping and consultation work undertaken to support the assessment. The nature, value and sensitivity of the existing baseline environment are then identified before an assessment is made of the potential effects on the Soils, Geology and Land Quality of the Proposed Ribble Crossing. Embedded and good practice mitigation measures relevant to Soils, Geology and Land Quality are summarised in Section 11.4.2 and have been taken into account in the assessment in Section 11.6.
- 3) The legislation and planning policies relevant to Soils, Geology and Land Quality are considered in Volume 2 Section 11.3 of the Proposed Bowland Section ES and are therefore not repeated here.
- 4) The Soils, Geology and Land Quality topic is broken down into the following sub-topics:
 - Land contamination, comprising the receptor types of human health and infrastructure (land contamination effects in relation to the Water Environment are discussed in Chapter 7)
 - Geologically designated sites
 - Ecologically designated sites (only where relevant to Soils, Geology or Land Quality)
 - Mineral resources
 - Soil quality.
- 5) The assessment area generally comprised the area bounded by the planning application boundary with a further 250 m buffer applied beyond. The minerals assessment area comprised a 500 m buffer to allow for any potential future expansion of existing minerals or quarry operations.

11.2 Scoping and consultations

11.2.1 Scoping

- 6) The scope of this assessment broadly followed the approach described in Volume 2 Chapter 11: Soils, Geology and Land Quality. Minor updates to the methodology were subsequently presented in the EIA Scoping Report Addendum dated February 2021.

11.2.2 Consultation

- 7) During the course of the assessment, consultations took place with relevant statutory and non-statutory consultees, stakeholders and third parties, through written correspondence and by telephone. These have been summarised in Volume 4: Appendix 4.1. Stakeholders contacted in connection with this work were:
 - Ribble Valley Borough Council, Lancashire County Council – human health (in relation to land contamination)
 - GeoLancashire - geologically designated sites
 - Lancashire County Council - mineral resources.

11.2.3 Scoping Update

- 8) An initial assessment of environmental baseline information for the identified sub-topics within Soils, Geology and Land Quality was completed to refine the scope of the assessment. Upon review of this information, the following sub-topics were discounted from the EIA process:

- Infrastructure (in relation to land contamination): no infrastructure of relevance to Soils, Geology and Land Quality was identified within the assessment area
 - Ecologically designated sites: no ecologically designated sites of relevance to Soils, Geology and Land Quality were identified.
- 9) The sub-topics taken forward for impact assessment therefore were land contamination, in relation to human health, geologically designated sites, mineral resources and soil quality.

11.3 Key Legislation and Guidance

- 10) Key legislation and guidance consulted in connection with this assessment are identified in Volume 2 Chapter 11 Table 11.1 of the Proposed Bowland Section ES.

11.4 Assessment Methodology and Criteria

11.4.1 Assessment Methodology

- 11) The assessment methodology broadly followed the approach described in Volume 2 Chapter 11: Soils, Geology and Land Quality. Minor updates to the methodology were subsequently presented in the EIA Scoping Report Addendum dated February 2021.

11.4.2 Embedded and Good Practice Mitigation

- 12) The assessment of likely significant effects in Section 11.6 takes into account the application of both embedded and good practice mitigation measures. Embedded mitigation is inherent to the design, and good practice mitigation measures are those which are standard industry practice used to manage commonly occurring environmental effects. These measures are set out in full within the Construction Code of Practice (CCoP) – Volume : Appendix 3.2, but the main measures of relevance to this chapter can be summarised as follows.

Land Contamination (Human Health)

- Land contamination would be assessed and managed in accordance with *Land Contamination: Risk Management*¹
- Assessment would include ground investigation, followed by human health risk assessment and remediation where required, which would be agreed with Ribble Valley Borough Council and the Environment Agency
- A plan dealing with unexpected occurrences of contamination would be put in place to deal with unforeseen contamination, including measures to manage immediate risks to human health and prevent the further spread of contamination
- A construction environmental management plan would be developed with pollution prevention measures and environmental controls detailed to prevent the creation of any new contamination during works.

Soil Quality

- An Environmental Clerk of Works would be employed to oversee the management of soil during stripping, handling, storage and reinstatement

¹Environment Agency (2019) *Land Contamination: Risk Management* [Online] Available from: <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm> [Accessed 16-03-2021]

- The contractor would follow guidance within *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*² and *Good Practice Guide for Handling Soils*³ with regards to soil management
- Soil resource surveys would be undertaken and a soil resource plan produced incorporating the results of these surveys
- The full depth of topsoil would be stripped from areas to be disturbed by construction, such as where haul roads, compounds and subsoil stockpiles are to be located, and from areas where topsoil would otherwise be sealed by development
- Subsoils would be stripped as required for restoration in agricultural land, where the designs necessitate subsoil stripping, or the suitably qualified and experienced person determines it to be necessary to mitigate impacts on the resource during construction.

11.4.3 Assumptions and Limitations

- 13) The following topic-specific limitations, assumptions and data deficiencies apply to the assessment:
- The Initial Conceptual Model Report (Appendix 11.1) has provided the baseline for geology and the initial ground model for the Proposed Ribble Crossing
 - At the time of reporting, there was no ground investigation data available either from recent ground investigation or historical borehole data from the British Geological Survey (BGS). Information regarding ground conditions was limited to BGS published geological maps
 - Due to the absence of ground investigation data, uncertainties remain regarding assessments dependent on ground data such as soil or groundwater chemical condition, or soil and rock physical characteristics. These would be addressed in subsequent work by undertaking ground investigation and further risk assessment as required.

11.5 Baseline Conditions

- 14) This section details the Soils, Geology and Land Quality baseline for the assessment area and identifies receptors where there is potential for significant effects to arise.
- 15) Baseline data were collated from a variety of desk-based studies available at the time of writing. Detailed technical reviews of the baseline conditions are presented in Appendix 11.2A, B and C, with summaries presented below.
- 16) The baseline conditions presented below are those taken forward for assessment following the Scoping Update as discussed in Section 11.2.3.

11.5.1 Land Contamination (Human Health)

- 17) A review of historical mapping shows that the assessment area has not been significantly developed since the first available historical maps. There are several historical features identified within the assessment area that could present potential risks to human health receptors, namely:
- The site of the former Waddington Brickworks, located approximately 60 m north of the Proposed Ribble Crossing, has been identified as a historical landfill that accepted household waste. At the time of writing, the deposition dates of this historical landfill were unknown; however, historical mapping suggests that landfilling took place between 1966 and 1993. This site has also been subject to various groundworks and had associated tanks (no longer present)

² Department for Environment, Food & Rural Affairs (2009) *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*. [Online] Available from: <https://www.gov.uk/government/publications/code-of-practice-for-the-sustainable-use-of-soils-on-construction-sites> [Accessed: 16-03-2021]

³ Ministry of Agriculture, Fisheries and Food (2000) *Good Practice Guide for Handling Soils*. [Online] Available from: <https://webarchive.nationalarchives.gov.uk/20090317221756/http://www.defra.gov.uk/farm/environment/land-use/soilguid/index.htm> [Accessed 16-03-2021]

- The northern extent of the former Cross Hill Quarry is located approximately 250 m south of the eastern extent of the Proposed Ribble Crossing. This area has been designated as an Unspecified Heap and Unspecified Ground Workings and as a historical landfill and is now used as a nature reserve and Local Geological Site
 - Contaminants associated with agricultural land use such as animal burials, disposal of farm wastes, including agrichemicals and asbestos containing materials may be present.
- 18) The assessment area is within four different radon potential areas as described by the BGS and Public Health England. The majority of the assessment area is within an area whereby the maximum radon potential is 1-3 %. Areas in the north and southeast of the assessment area are within an area whereby the maximum radon potential is 3-5 % and 5-10 % respectively. An area surrounding the River Ribble is within an area of elevated radon potential whereby the maximum radon potential is 10-30 %.
- 19) Appendix 11.1 presents an Initial Conceptual Model for the Proposed Ribble Crossing.

11.5.2 Geology and Ground Model

- 20) A summary of the geology and ground model for the Proposed Ribble Crossing is presented below and shown in Figure 11.1 and 11.2. For further information, reference should be made to the Initial Conceptual Model Report (Appendix 11.1).

Artificial Geology

- 21) No artificial geology is identified on BGS 1:50,000 maps covering the assessment area. Given the relatively undeveloped nature of the Proposed Ribble Crossing, any unmapped made ground deposits are likely to be localised and associated with agricultural development and land use, and the construction of surrounding roads. Any made ground would be expected to be limited in lateral and vertical extent.

Superficial Geology

- 22) BGS maps (reproduced on Figure 11.1) show that the superficial deposits vary across the Proposed Ribble Crossing assessment area, but mainly comprise glacial and alluvial deposits. These are mapped as follows:
- Alluvium is mapped in the vicinity of the Coplow Brook and River Ribble watercourses, which run north to south, and east to west, respectively, through the assessment area; additionally, unmapped isolated and limited deposits of alluvium may be present associated with other watercourses in the assessment area
 - River terrace deposits are mapped in the north-east of the assessment area
 - Hummocky glacial deposits are mapped in the north and central extents of the assessment area
 - Glacial till is mapped in the northern and southeast extents of the assessment area
 - Glaciolacustrine deposits are recorded across the assessment area in western and central extents.

Bedrock Geology

- 23) BGS maps (reproduced on Figures 11.2) show that the bedrock underlying the majority of the assessment area comprises Carboniferous limestone and mudstone of the Clitheroe Limestone Formation and Hodder Mudstone Formation. A small area in the south-east of the assessment area is underlain by Carboniferous limestone bedrock of the Chatburn Limestone Formation.

11.5.3 Geologically Designated Sites

- 24) To identify any Geologically Designated Sites, the Lancashire County Council Maps & Related Information Online (MARIO) application was consulted alongside available information from the GeoLancashire website.

- 25) The majority of the Proposed Ribble Crossing is located within a Local Geodiversity Site (LGS), namely Bashall Brook, which is located to the north of the River Ribble. The spatial extent of this LGS spans approximately 390 ha. It is designated as it shows an excellent exposure of esker features in glacial/fluvioglacial deposits. Although the mapped extent of the LGS includes the area of the Proposed Ribble Crossing, the location of the Bashall Brook watercourse itself is approximately 3-4 km west of the study area. It is understood that the LGS is most likely associated with geomorphological exposures in the banks of the watercourse, and this will be confirmed through ongoing discussions with GeoLancashire.
- 26) The northern extent of the Cross Hill Quarry LGS, cited due to an exposure of Chatburn Limestone, is located approximately 250 m south of the eastern extent of the Proposed Ribble Crossing.
- 27) Further information regarding these LGS sites is presented in Appendix 11.2C and Figure 11.3.

11.5.4 Mineral Resources

- 28) Central, northern and southern parts of the Proposed Ribble Crossing are within a Lancashire County Council Mineral Safeguarding Area (MSA) for sand and gravel.
- 29) Two active limestone quarries, namely Bankfield Quarry and Lanehead Quarry, were highlighted by Lancashire County Council during consultation; however, these are located approximately 600 m east / south-east of the Proposed Ribble Crossing and are therefore outside the study area. Lancashire County Council stated that there are no plans to extend the current quarrying activities at these locations. These quarries have therefore not been considered further within this assessment.
- 30) For more information on these quarries and historical quarries within the minerals assessment area, reference should be made to Appendix 11.2B and Figure 11.3.

11.5.5 Soil Quality

- 31) To assess which soil types would be affected by the Proposed Ribble Crossing, national soil map data⁴ were obtained, which provide the location of 297 soil associations (types) at a 1:250,000 scale. From these mapped data, it was found that the assessment area traverses the following soil associations:
- Brickfield 3 – underlying the majority of the assessment area. This soil association comprises slowly permeable seasonally wet acid loamy and clayey soils
 - Alun – underlying the north-east extent of the assessment area. This soil association comprises freely draining, fine loamy soils over gravel in places
 - Crwbin – underlying the south-east extent of the assessment area. This soil association comprises very shallow and shallow well drained loamy soils over limestone, often steep slopes.
- 32) To evaluate the agricultural value of the soils, ALC data were consulted^{5 6}. The Proposed Ribble Crossing is located on Grade 3 land (good to moderate quality). Subgrades 3a and 3b are not differentiated in the Provisional ALC data, so to make a conservative assessment it was assumed that this is Subgrade 3a land. Consequently, the soils within the Proposed Ribble Crossing are considered as having high sensitivity.

11.6 Assessment of likely significant effects

- 33) The following section describes the effects of the Proposed Ribble Crossing on Soils, Geology and Land Quality during the enabling, construction, operational and decommissioning phases.

⁴ Cranfield University (2020) *National soil map data*. [Online] Available from: <https://cranfield.blueskymapshop.com/> [Accessed: 16-03-2020]

⁵ Natural England (2020) *Provisional Agricultural Land Classification (ALC)*. [Online] Available from: <https://data.gov.uk/dataset/952421ec-da63-4569-817d-4d6399df40a1/provisional-agricultural-land-classification-alc> [Accessed: 16-03-2020]

⁶ Natural England (2020) *Agricultural Land Classification (ALC) Grades – Post 1988 Survey (polygons)*. [Online] Available from: <https://data.gov.uk/dataset/c002ceea-d650-4408-b302-939e9b88eb0b/agricultural-land-classification-alc-grades-post-1988-survey-polygons> [Accessed: 16-03-2020]

11.6.1 Enabling Works Phase

- 34) Enabling works are those works required to prepare the site for the haul road and bridge construction activities, such as vegetation clearance, installation of stock proof fencing, minor reprofiling and laying down of stone, temporary bridge access and formation of the bridge construction working areas.
- 35) The potential for adverse impacts on Soils, Geology and Land Quality to arise during the enabling works phase of the Proposed Ribble Crossing is discussed in the following sections.

Land Contamination (Human Health)

- 36) The disturbance of contamination during enabling works could result in risks to construction workers and adjacent land users *via* acute exposure to contaminants. Relevant exposure pathways include accidental ingestion, dermal contact and/or inhalation of soil particles (following airborne dispersion for adjacent land users).
- 37) Construction workers are considered to have a very high sensitivity. Users of adjacent sites are considered to have a low sensitivity.
- 38) The presence of land contamination across the Proposed Ribble Crossing as a whole is considered unlikely; however, the historical landfill at Waddington Brickworks is a potential source of contamination, albeit off-site to the north. The effects upon the development site from groundwater or ground gas migration from this off-site historical landfill should be established by undertaking a ground investigation and subsequent risk assessment, with appropriate remedial measures identified if required in order to reduce or remove risks to receptors.
- 39) Should unforeseen contamination be encountered during enabling works, any potential risks to human health would be mitigated by implementation of the unexpected contamination plan (Section 11.4.2). Radon is not considered to represent a viable risk to receptors during enabling works.
- 40) Therefore, assuming the above mitigation is undertaken if required, no effects are predicted to occur on construction workers (high sensitivity) or adjacent land users (low sensitivity) during the enabling works.

Geologically Designated Sites

- 41) The Proposed Ribble Crossing is almost entirely within the mapped extent of the Bashall Brook LGS, which is of medium sensitivity.
- 42) Whilst it is expected that the designation of Bashall Brook is based on exposures of glacial/fluvioglacial deposits within the banks of the watercourse approximately 3-4 km west of the Proposed Ribble Crossing, there could be exposures present at the Proposed Ribble Crossing. Therefore, potential adverse effects on the LGS within the Proposed Ribble Crossing cannot be ruled out.
- 43) The magnitude of change on the LGS during the enabling works phase is considered to be negligible on the basis that there could be a temporary loss of a negligible (<15 %) part of the LGS through the laydown of stone and preliminary works on the bridge.
- 44) Accordingly, the significance of effect of the Proposed Ribble Crossing on geologically designated sites was assessed as neutral or slight.

Mineral Resources

- 45) Part of the Lancashire County Council MSA for sand and gravel is located within the central, northern and southern extents of the Proposed Ribble Crossing. However, given that there are no operational mineral extraction activities or known planning applications in process for workings within 500 m of the Proposed Ribble Crossing, the sensitivity / value of the MSA is considered to be medium.
- 46) It is considered that the enabling works would have no effect discernible on the MSA as they would only pose minor temporary access restrictions, if any.

Soil Quality

- 47) The soil quality at the Proposed Ribble Crossing was conservatively identified as Grade 3a (good quality), and therefore the soils are considered to be of high sensitivity.
- 48) Soil quality could be affected by sealing beneath hardstanding e.g. at compounds; compaction and smearing during trafficking, degradation during handling and storage; or degradation through mixing with soils of poorer quality or other materials.
- 49) However, implementation of the measures summarised in Section 11.4.2 would mitigate the potential for these effects to occur through careful planning and consideration of soil resources. Therefore, no effects are predicted to occur on soil quality during the enabling works.
- 50) A summary of the enabling phase effects have been summarised in Table 11.1.

Table 11.1: Summary of Enabling Phase Effects

Environmental / Community Asset	Value / Sensitivity	Magnitude of Change	Nature of Effect	Significance of Effect (Pre-Mitigation)
Lancashire County Council MSA for sand and gravel.	Medium	Negligible	Temporary loss of a negligible (<15 %) part of the resource.	Neutral or slight
Geologically designated sites, Bashall Brook LGS.	Medium	Negligible	Temporary loss of a negligible (<15 %) part of the designated site.	Neutral or slight
ALC Grade 3a (good quality) soils.	High	No change	None identified.	Neutral

11.6.2 Construction Phase

- 51) During the main construction phase of the Proposed Ribble Crossing, the principle activities that could affect Soils, Geology and Land Quality relate to topsoil stripping and stockpiling, minor earthworks, construction of bridges including piling, and reinstatement of laydown areas, compounds and other disturbed areas to return to agricultural use where possible.
- 52) The potential for adverse impacts on Soils, Geology and Land Quality to arise during the construction phase of the Proposed Ribble Crossing is discussed in the following sections, and identified effects are summarised in Table 11.2.

Land Contamination (Human Health)

- 53) Groundworks are anticipated as part of the construction phase; however, the likelihood of construction workers and adjacent land users being exposed to land contamination would be low. This judgement is made taking into account the mitigation measures set out in Section 11.4.2 such as prior ground investigation, risk assessment and remediation, and implementation of an unexpected contamination plan. Radon is not considered to represent a viable risk to any receptors during construction.
- 54) Therefore, no effects are predicted to occur on construction workers (high sensitivity) or adjacent land users (low sensitivity) during the construction phase.

Geologically Designated Sites

- 55) As per Section 11.6.1 the sensitivity / value of the LGS at Bashall Brook at the Proposed Ribble Crossing is considered to be medium.
- 56) The magnitude of change on the LGS at Bashall Brook is considered to be minor during the construction phase of works on the basis that whilst the Proposed Ribble Crossing is a temporary feature, there are activities which would result in permanent loss of a minor part (<15 %) of the overall 390 ha LGS footprint, such as piling of the bridge structure.
- 57) Accordingly, the significance of effect of the Proposed Ribble Crossing on geologically designated sites was assessed as slight.

Mineral Resources

- 58) As per Section 11.6.1 the sensitivity / value of the MSA at the Proposed Ribble Crossing is considered to be medium.
- 59) The magnitude of change on the MSA is considered to be negligible on the basis that the Proposed Ribble Crossing would impact on a very limited footprint of the resources on a temporary basis during construction.
- 60) Accordingly, the significance of effect of the Proposed Ribble Crossing on mineral resources was assessed as neutral or slight.

Soil Quality

- 61) As per Section 11.6.1, the soil quality across the Proposed Ribble Crossing is of high sensitivity.
- 62) During the construction phase, groundworks, including topsoil stripping and minor earthworks, would be expected. Soil quality could be affected by sealing beneath hardstanding e.g. compounds; compaction and smearing during trafficking, handling and storage; or degradation through mixing with soils of poorer quality or other materials.
- 63) However, implementation of the measures summarised in Section 11.4.2 would mitigate the potential for these effects to occur through careful planning and consideration of soil resources.
- 64) Therefore, no effects are predicted to occur on soil quality (high sensitivity) during the construction works.
- 65) A summary of the construction phase effects have been summarised in Table 11.2.

Table 11.2: Summary of Construction Phase Effects

Environmental / Community Asset	Value / Sensitivity	Magnitude of Change	Nature of Effect	Significance of Effect (Pre-Mitigation)
Lancashire County Council mineral safeguarding area for sand and gravel.	Medium	Negligible	Temporary loss of a negligible (<15 %) part of the resource.	Neutral or slight
Geologically designated site, LGS at Bashall Brook.	Medium	Minor	Permanent loss of a minor (<15 %) part of designated site.	Slight
ALC Grade 3a (good quality) soils.	High	No change	None identified.	Neutral

11.6.3 Operational Phase

- 66) The operational phase accounts for the use of the haulage route serving the Proposed Bowland Section Newton-in-Bowland compound and the security presence at either end of the route to control access onto the haul route.
- 67) The potential for adverse impacts on Soils, Geology and Land Quality to arise during the operation of the Proposed Ribble Crossing is discussed in the following sections.

Land Contamination (Human Health)

- 68) It is considered that there would be no viable risk of encountering land contamination during the operational phase of the Proposed Ribble Crossing given the distance from any potential sources of contamination. Any unexpected contamination would have been identified and managed as per the measures outlined in Section 11.4.2 during the previous enabling and construction phases of work.
- 69) Radon is not considered to represent a viable risk to receptors during operation.
- 70) As such, no effects are predicted to occur on future site users, such as security staff and construction workers (high sensitivity) during the operational phase.

Geologically Designated Sites

- 71) Following construction of the Proposed Ribble Crossing, operational impacts on geologically designated sites is unlikely. Although there is an LGS of medium sensitivity within the footprint of the Proposed Ribble Crossing, it is considered that during operational phase activities (vehicular access to the haul road), there would be no additional effects on the LGS at Bashall Brook.
- 72) As such, no effects are predicted to occur on geologically designated sites during operation.

Mineral Resources

- 73) Following construction of the Proposed Ribble Crossing, operational impacts on mineral resources are unlikely. Although there is a MSA of medium sensitivity/value within the footprint of the Proposed Ribble Crossing, it is considered highly unlikely that the Proposed Ribble Crossing would significantly impede future mineral workings at a regional level.
- 74) As such, no effects are predicted to occur on mineral resources during operation.

Soil Quality

75) There would be no activities during the operational phase that could affect soil quality.

11.6.4 Decommissioning Phase

76) The decommissioning phase accounts for the deconstruction of the haulage road and road bridge, returning the land to its former use. Reinstatement activities of particular relevance to Soils, Geology and Land Quality include the reinstatement of soils to their original levels and reinstatement of all areas to their original agricultural use.

Land Contamination (Human Health)

77) With respect to land contamination, any contamination present would likely have been encountered and dealt with during the enabling and construction works phases, whilst the unexpected contamination plan (Section 11.4.2) would mitigate the potential for effects from unforeseen contamination sources. Therefore, no effects would occur in respect of land contamination during the decommissioning phase.

Geologically Designated Sites

78) The magnitude of change on the LGS at Bashall Brook during the decommissioning phase is considered to be negligible on the basis that there is the potential for the activities during deconstruction, such as the removal of the haul road and bridge structure to result in a permanent loss of a negligible (<15 %) part of the LGS footprint as a whole (390 ha).

79) Accordingly, the significance of effect of the Proposed Ribble Crossing on geologically designated sites was assessed as neutral or slight.

Mineral Resources

80) No negative effects on mineral resources would occur during the decommissioning phase, and the removal of the haulage road and road bridge would also remove any temporary access constraints on the MSA.

Soil Quality

81) With regards to soil quality, any potential adverse impacts on soils during handling and reinstatement would be mitigated by implementation of the measures set out in Section 11.4.2.

82) A summary of the decommissioning phase effects have been summarised in Table 11.3.

Table 11.3: Summary of Decommissioning Phase Effects

Environmental / Community Asset	Value / Sensitivity	Magnitude of Change	Nature of Effect	Significance of Effect (Pre-Mitigation)
Geologically designated site, LGS at Bashall Brook	Medium	Negligible	Permanent loss of a negligible (<15 %) part of designated site	Neutral or slight

11.7 Mitigation and Residual Effects

- 83) Embedded and good practice mitigation measures were taken into account in determining the significance of potential effects in Section 11.6. No effects were identified for any phase of the Proposed Ribble Crossing requiring additional mitigation.
- 84) The only effects identified were neutral or slight on mineral resources and geologically designated sites during construction, such that there are no significant residual effects.

11.8 Cumulative Effects

- 85) The following section provides an overview of the potential cumulative effects from different proposed developments and land allocations, in combination with the Proposed Ribble Crossing (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 Ribble Crossing.
- 86) 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.
- 87) The over-arching cumulative effects of the Proposed Programme of Works i.e. the five proposed replacement tunnel sections in combination, are considered in Volume 2 Chapter 19: Cumulative Effects. In addition Volume 2 Chapter 19 examines the cumulative effects associated with the outcomes from Volume 2 (delivery and operation of the main construction compounds, tunnel and construction traffic routes), Volume 5 (proposed off-site highways works and satellite compounds), and Volume 6 (Proposed Ribble Crossing).
- 88) Based on professional judgement, no likely significant cumulative effects have been identified for Soils, Geology and Land Quality, either in combination with other elements of the Proposed Programme of Works, or when taking account of unrelated developments in the wider area.

11.9 Conclusion

- 89) This chapter of the ES considered the potential Soils, Geology and Land Quality impacts associated with enabling works, construction, operational and decommissioning phases across the Proposed Ribble Crossing.
- 90) Mitigation measures have been embedded in the design of the Proposed Ribble Crossing. In addition, good practice measures were identified for Soils, Geology and Land Quality within the CCoP and are summarised in Section 11.4.2.
- 91) The baseline conditions at the site were established through a review of desk-based information and consultation responses.
- 92) The potential for adverse impacts to arise on Soils, Geology and Land Quality receptors was considered, but taking into account the embedded and good practice mitigation measures as set out in Section 11.4.2, no adverse effects were identified requiring additional mitigation.

11.10 Glossary and Key Terms

- 93) Key phrases and terms used within this technical chapter relating to Soils, Geology and Land Quality are defined within Appendix 1.2: Glossary and Key Terms.