Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

Environmental Statement

Volume 4

Appendix 7.1: Water Framework Directive Assessment

June 2021

Water for the North West

Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

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Executive Summary

This report comprises a Water Framework Directive compliance assessment for the Haweswater Aqueduct Resilience Programme, specifically relating to the Proposed Bowland Section.

The assessment comprises a screening exercise to identify which activities within the enabling works/construction, operation, commissioning and decommissioning phases could lead to effects on WFD water bodies, and therefore require further assessment. These include site compounds, open cut trenches, permanent new overflows and tunnelling (including shaft construction).

Scoping has identified 17 WFD water bodies (15 surface water and two groundwater) within close proximity of the Proposed Bowland Section. Of these, four WFD water bodies were identified as requiring further assessment:

- Hindburn WFD surface water body (GB112072066050)
- Hodder – confluence Easington Brook to confluence Ribble WFD surface water body (GB112071065560)
- Lune and Wyre Carboniferous Aquifers WFD groundwater body (GB412012G102700)
- Ribble Carboniferous Aquifers WFD groundwater body (GB41202G103000).

The last section provides a site-specific assessment of the relevant water bodies against the relevant activities, and includes additional environmental control measures, including a monitoring plan and adaptive management strategy for the overflow discharges, where necessary. All activities are considered to meet the WFD objectives at this stage.

1. Introduction

1) This Water Framework Directive (WFD) compliance assessment report has been prepared for the Haweswater Aqueduct Resilience Programme (HARP) and forms an appendix to support the HARP Environmental Statement. This report assesses the Proposed Bowland Section, which is outlined in Section 1.1.

1.1 Overview of the Proposed Bowland Section

2) The existing Haweswater Aqueduct, built between 1933 and 1955, has successfully served customers in Cumbria, Lancashire, and Greater Manchester for sixty years.

3) The existing Aqueduct takes raw water from Haweswater Reservoir in the Lake District National Park along a 16 km section of the aqueduct to a water treatment works (WTW) near Kendal for treatment. From this WTW, the aqueduct conveys treated water to customers in Greater Manchester, Cumbria, and Lancashire through water mains which branch off the main aqueduct.

4) The existing aqueduct comprises six single line tunnels and conduit sections (generally 2.6 m internal diameter) in addition to multi-line sections (MLS)[1]. The flow of water along the entire length of the aqueduct is achieved under the influence of gravity; there are no energy-consuming pumps involved in supplying the water from north to south. Out of the total 110 km length of the aqueduct, the Proposed Programme of Works on the single line sections accounts for just under half this distance, about 53 km.

5) To maintain the integrity of the network, United Utilities are proposing the replacement of all six tunnel sections along the length of the aqueduct, as part of HARP. The tunnel sections from north to south are named as follows (see Figure 1):

- Docker Section
- Swarther Section
- Bowland Section (the subject of this assessment)
- Marl Hill Section
- Haslingden and Walmersley Section.[2]

6) Replacement of the Proposed Programme of Works is required to replace part of an ageing asset to secure a water supply serving Cumbria, Lancashire and Greater Manchester, and to mitigate potential risks to drinking water quality. The proposed baseline solution is to provide a full replacement of the six existing tunnel sections with five single line tunnel sections as illustrated in Figure 1. A brief description of the Proposed Bowland Section is provided in the following paragraphs.

7) Approximately 16 km in length, the Proposed Bowland Section stretches from the Lower Houses Compound in the north (approximately 14 km east of Lancaster) to the Newton-in-Bowland Compound at the southern end.

8) Between the Lower Houses Compound (north end) and Newton-in-Bowland Compound (south end), the existing aqueduct would be replaced with a single tunnel. It would be constructed by tunnel boring below ground level. Short lengths of open-cut pipe laying would be required at each end of the tunnel, making the connection back to the existing infrastructure. The new tunnel would be driven from the south to north, from a portal within the Newton-in-Bowland Compound to a reception shaft at the Lower Houses Compound. Further details on the tunnel boring and associated works are provided within Volume 2 Chapter 3: Design Evolution and Development Description.

9) Following completion and commissioning of the new aqueduct (potentially requiring discharge of treated water to surrounding watercourses at the Lower Houses and Newton-in-Bowland Compounds), sections of the existing aqueduct would be taken out of service. A future maintenance and usage strategy

[1] The multi-line sections comprise four parallel pipes referred to as 'siphons', each of which is around 1.6 m internal diameter.

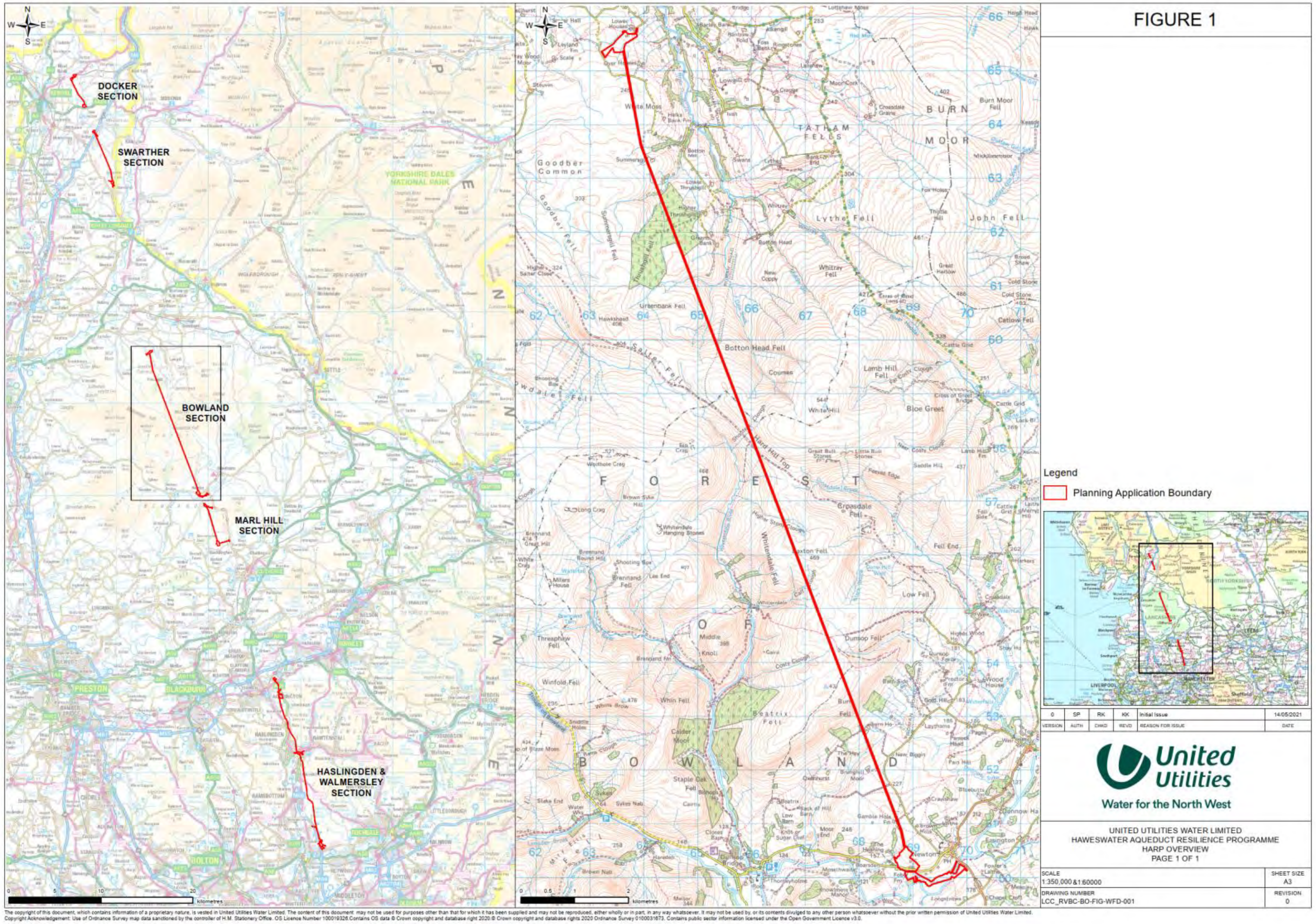
[2] The existing aqueduct presently comprises two tunnels in the Haslingden and Walmersley area. These would be replaced by one tunnel, making a total of five across the Proposed Programme of Works.

for the redundant sections of aqueduct is being prepared. This strategy would include protection of existing structures above the redundant sections, with any flows arising from the decommissioned aqueduct allowed to discharge into the River Hodder *via* the existing overflow pipe at the southern end of the Proposed Bowland Section.

10) To summarise, the Proposed Bowland Section would require the following activities to be undertaken:

- Boring of a tunnel (including construction of launch portal / reception shaft) approximately 16 km long
- Open cut sections of pipework at either end to enable connection of the MLS and the single line tunnel
- Creation of two main construction compounds (there being in addition satellite compounds remote from the main compounds)
- Connection of the existing highways network to construction compounds *via* access roads. This would include a clear span bridge crossing of the River Hodder
- Discharge of water used in the commissioning of the Proposed Bowland Section to local watercourses
- Discharge of groundwater ingress from the existing aqueduct to the River Hodder, once the Proposed Bowland Section has been commissioned and is operational. This would make use of existing overflow infrastructure.

Figure 1: HARP overview including planning application boundary for the Proposed Bowland Section



1.2 Background to the Water Framework Directive

11) The WFD, transposed into English legislation as the Water Environment Regulations (Water Framework Directive) 2017, requires all-natural water bodies to achieve both good chemical status and good ecological status. For each River Basin District, a River Basin Management Plan (RBMP) outlines the actions required to enable natural water bodies to achieve this.

12) Water bodies that are designated in the RBMP as Heavily Modified Water Bodies (HMWB) or Artificial Water Bodies (AWB) may be prevented from reaching good ecological status by the physical modifications for which they are designated, or purpose for which they were constructed (e.g. navigation, flood defence, urbanisation). Instead, they are required to achieve good ecological potential through implementation of a series of mitigation measures outlined in the applicable RBMP (and in some cases updated since the publication of the RBMP).

13) The WFD requires that environmental objectives are set for all surface and groundwater bodies:

- Member States shall implement the necessary measures to prevent deterioration of the status of all bodies of surface water
- Member States shall protect, enhance, and restore all bodies of surface water, subject to the application of subparagraph (iii) for artificial and heavily modified bodies of water, with the aim of achieving good surface water status by 2015
- Member States shall protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status by 2015. Where this is not possible, and subject to the criteria set out in the Directive, aim to achieve good status by 2021 or 2027
- Progressively reduce pollution from priority substances and cease, or phase out emissions, discharges, and losses of priority hazardous substances.

14) Prevent Deterioration in Status and prevent or limit input of pollutants to groundwater. Where there are sites protected under EU legislation, the Directive aims for compliance with any relevant standards, or objectives for these sites. For the Proposed Bowland Section, this relates to designated sites that are within the assessment area (see Section 4.1), and designated under Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora), and transposed as the Conservation of Habitats and Species Regulations 2017.

15) Member States must meet the conditions of the Directive unless they meet the criteria laid out in Article 4(7). Where a development is unable to, because of disproportionate cost or technical infeasibility, considered to cause deterioration, or where it could contribute to a failure of the water body to meet Good Status/Potential, then an Article 4(7) assessment is required.

2. Methodology

2.1 WFD Assessment Methodology

16) The stages for undertaking compliance are outlined below. The methodology is based on Environment Agency guidance (Environment Agency, 2016[3]):

2.1.1 Screening

17) Screening provides an initial overview of the Proposed Bowland Section, outlining the activities in the enabling works/construction (including commissioning) and operation (including decommissioning of the existing pipeline) phases. These are either screened in for further assessment or screened out.

2.1.2 Scoping

18) Scoping identifies the relevant River Basin Management Plans (RBMPs) and WFD water bodies within the assessment area. The potential generic impacts are identified, establishing the risks from the Proposed Bowland Section activities to the WFD water bodies and their quality elements, scoping out those activities and WFD water bodies that do not require further assessment.

19) An assessment area has been defined for the WFD assessment as a 500 m buffer around the Proposed Bowland Section, capturing any WFD water bodies within, and immediately up- and downstream.

2.1.3 Assessment of the Proposed Bowland Section

20) The assessment follows five steps for the WFD water bodies and activities carried forward from the screening and scoping stages, including:

- Site specific assessment of the Proposed Bowland Section against WFD quality elements
- Assessment of the Proposed Bowland Section against RBMP Mitigation Measures
- Cumulative impact assessment with other proposed developments planned on the WFD water body
- Assessment of the Proposed Bowland Section against WFD status objectives
- Assessment of the Proposed Bowland Section against other EU legislation (Protected Areas).

2.2 Data Collection

2.2.1 Desk-based Study

21) A desk-based study has been carried out to inform this assessment, reviewing existing information for the assessment area to develop an initial baseline for the WFD water bodies. The following are the key data sources:

- Environment Agency Catchment Data Explorer (CDE) (Environment Agency, 2020a)[4]
- North West River Basin Management Plan (Environment Agency, 2018)[5]
- MAGiC MAP (Natural England, 2019)[6]

[3] Environment Agency (2016). Protecting and improving the water environment: Water Framework Directive compliance of physical works in rivers. 11pp.

[4] Environment Agency (2020a) *Catchment Data Explorer*. [Online] Available from: http://environment.data.gov.uk/catchment-planning/. [Accessed: 01/11/2020].

[5] Environment Agency (2018) *North West River Basin Management Plan (RBMP)*. [Online]. Available from: https://www.gov.uk/government/publications/north-west-river-basin-district-river-basin-management-plan. [Accessed: 01/04/2020].

[6] Natural England (2019) *Multi-Agency Geographic Information for the Countryside (MAGIC) Interactive Mapper*. [Online]. Available from: http://www.magic.gov.uk/MagicMap.aspx. [Accessed: 16/08/2020].

- Ecological datasets for the period 2009 – 2019 obtained via the Environment Agency Ecology and Fish Data Explorer website[7].

2.2.2 Field Surveys

22) Field survey data collected to inform the Environmental Statement have been used within this assessment also. These include:

- White-clawed Crayfish surveys
- Aquatic walkover surveys - establishing habitat for fish (including salmonids), obstructions/barriers to fish passage, sightings of fish, presence, and distribution of macrophytes
- Geomorphological walkover surveys gathering information on flow, channel width and depth, bed substrate, and features of the riparian zone
- Surveys to determine the presence of groundwater dependent terrestrial ecosystems (GWDTEs), and if present, the degree of groundwater dependency of each GWDTE.

[7] Environment Agency (2020b) *Environment Agency Ecology and Fish Data Explorer* [Online]. Available from: https://environment.data.gov.uk/ecology-fish/. [Accessed 07/05/2020]

3. Screening

3.1 Screening of Activities

23) The main activities of the Proposed Bowland Section are presented in Table 1, alongside a screening assessment as to whether further assessment would be required of the activity.

Table 1: Screening of the Proposed Bowland Section activities

Stage	Activity	WFD Water Body Type	Screened In or Out?	Justification
Enabling works and construction (including commissioning)	Access track (including bridge over the River Hodder)	Surface water	In	Potential impact on WFD surface water bodies by crossing or discharge from track drainage (i.e. an outfall) to the watercourses, leading to changes in biological, chemical, and hydromorphological quality elements.
		Groundwater		Potential impact from excavation/ soil compaction and groundwater flow disturbance.
	Site compound (impacts relating to soil storage areas, material laydown areas, hard standing areas, turning areas, attenuation ponds, construction of temporary overflow, and site drainage including outfalls)	Surface water	In	Potential impact on WFD water bodies due to discharge from the site to watercourses (i.e. an outfall), changes in overland flow pathways, removal/partial loss of riparian vegetation, channel realignment, and excavation below ground.
		Groundwater		Potential impact from excavation / soil compaction and groundwater flow disturbance.
	Tunnel (including the creation of the shaft and portal)	Surface water	Out	Due to the depth of the tunnel, and distance of shafts from watercourses, dewatering of surface waters is not anticipated.
		Groundwater	In	Potential impact from boring, excavation below ground level, dewatering and displacement of groundwater.
	Open cut pipe laying	Surface water	Out	No connectivity with surface waters.
		Groundwater	In	Potential impact from dewatering and excavation below ground level. This includes open cut trenches for the construction of connections and buried overflows.

Stage	Activity	WFD Water Body Type	Screened In or Out?	Justification
	Commissioning of pipeline	Surface water	In	Potential impact on WFD water bodies due to moderate to 'increases over base flows' discharge rates of flows to watercourses.
		Groundwater	Out	No discharge to ground.
Operational (including decommissioning of existing aqueduct)	Tunnel (including the shaft and portal)	Surface water	Out	Due to the depth of the tunnel, and distance of shafts from watercourses, dewatering of surface waters is not anticipated.
		Groundwater	In	Potential impact due to permanent structures altering groundwater flow paths.
	Overflow (continuous discharge of groundwater ingress from decommissioned aqueduct to watercourses)	Surface water	In	Potential impact from constant flow discharging from existing outfall (currently only used for emergency discharges), with unknown water quality, to watercourses.
		Groundwater		Dewatering of groundwater aquifers around the existing pipeline.

4. Scoping

4.1 Identification of WFD Water Bodies

24) The Proposed Bowland Section is located within the North West River Basin District (RBD). Management of the water environment within the RBD is supported by the North West RBD River Basin Management Plan (RBMP).

25) Scoping has identified the WFD water bodies directly linked to the Proposed Bowland Section, and therefore potentially impacted, in addition to those up-and downstream within the assessment area. An assessment has then been made to determine whether the WFD water bodies should be scoped in for further assessment or whether, due to likelihood of limited impacts/lack of impact pathway, they can be scoped out.

26) Tables 2 and 3 outline the water body characteristics of each water body scoped in for further assessment, which are also shown in Figures 2a and 2b and Figures. 3a to 3h. These are:

- Hindburn WFD surface water body (GB112072066050)
- Hodder – confluence Easington Brook to confluence Ribble WFD surface water body (GB112071065560)
- Lune and Wyre Carboniferous Aquifers WFD groundwater body (GB41202G102700)
- Ribble Carboniferous Aquifers WFD groundwater body (GB41202G103000).

27) The WFD surface water bodies scoped out due to distance, and therefore unlikely to be impacted, are:

- Brennand (GB112071065400)
- Croasdale Beck (GB112071065410)
- Dunsop (GB112071065360)
- Hodder – headwaters to Stocks Reservoir (GB112071065430)
- Hodder - Stocks Reservoir to confluence Croasdale Beck (GB112071065390)
- Langden Brook (GB112071065370)
- Loud - Lower (GB112071065340)
- Ribble downstream Stock Beck (GB112071065612)
- Roeburn (GB112072066020)
- Wenning - Lower (GB112072065990)
- Whitendale River (GB112071065420).

28) Easington Brook (GB112071065380) and Hodder - confluence Croasdale Beck to confluence Easington Brook (GB112071065350) WFD surface water bodies have also been scoped out. Whilst these WFD water bodies are located within 500 m of proposed access roads, they are located upstream of these activities. Therefore, there would not be a clear impact pathway between the Proposed Bowland Section, and these WFD water bodies.

Table2: Scoped in WFD surface water body parameters (Cycle 2 (2019) data, Environment Agency 2020)

Water body name	Hindburn	Hodder – confluence Easington Brook to confluence Ribble
Water body ID	GB112072066050	GB112071065560
Catchment size (km^2)	49.12	69.32
Hydromorphological designation	Not designated artificial or heavily modified	Not designated artificial or heavily modified
Overall status/potential	Moderate	Moderate
Chemical status	Fail	Fail
Biological quality elements		
Fish	Moderate	Not recorded
Invertebrates	Good	High
Macrophytes and phytobenthos (combined)	Good	Good
Hydromorphological quality elements		
Hydrological Regime	High	Supports Good
Morphology	Supports Good	Supports Good
Physico-chemical and Chemical (SW) quality elements		
pH	High	High
Ammonia (total as N)	High	High
Phosphate	High	High
Dissolved oxygen	High	High
Specific pollutants	High	High
Priority substances	Good	Good
Other pollutants	Good	Does not require assessment
Priority hazardous substances	Fail	Fail
Additional observations		
Protected areas	Bowland Fells (UK9005151) Special Protection Area (SPA) – Conservation of Wild Birds Directive, located approximately 4 km south of the Lower Houses Compound	Bowland Fells (UK9005151) Special Protection Area (SPA) – Conservation of Wild Birds Directive, located approximately 3 km north of the Newton-in-Bowland Compound
Reasons for not achieving good status	No data available	No data available

Table3: Scoped in WFD groundwater body parameters (Cycle 2 (2019) data, Environment Agency 2020)

Water body name	Lune and Wyre Carboniferous Aquifers	Ribble Carboniferous Aquifers
Water body ID	GB41202G102700	GB41202G103000
Catchment size	1396.90	828.55
Overall Status/Potential	Good	Poor
Quantitative status		
Quantitative dependent surface water body status	Good	Good
Quantitative GWDTEs test	Good	Good
Quantitative saline intrusion	Good	Good
Quantitative water balance	Good	Good
Chemical (GW) status		
Chemical dependent surface water body status	Good	Good
Chemical drinking water protected area	Good	Poor
Chemical GWDTEs test	Good	Good
Chemical saline intrusion	Good	Good
General chemical test	Good	Good
Additional observations		
Reasons for not achieving Good status	Not applicable (already achieving good status)	Not specified
GWTDEs	Three GWDTEs have been identified at the Lune and Wyre Carboniferous Aquifers groundwater body within the Proposed Bowland Section development assessment area. None of these GWDTEs have a statutory designation, and their presence and location have been determined by a site walkover. Further details of the GWDTEs are provided in "T03 GWDTE Assessment" produced for the HARP Environmental Statement (Document Reference Number LCC_RVBC-BO-TA-007-002).	Four GWDTEs have been identified at the Ribble Carboniferous Aquifers groundwater body within the Proposed Bowland Section development assessment area. None of these GWDTEs have a statutory designation, and their presence and location have been determined by a site walkover. Further details of the GWDTEs are provided in "T03 GWDTE Assessment" produced for the HARP Environmental Statement (Document Reference Number LCC_RVBC-BO-TA-007-002).

Figure 2a: Scoped in WFD surface water bodies within the Proposed Bowland Section

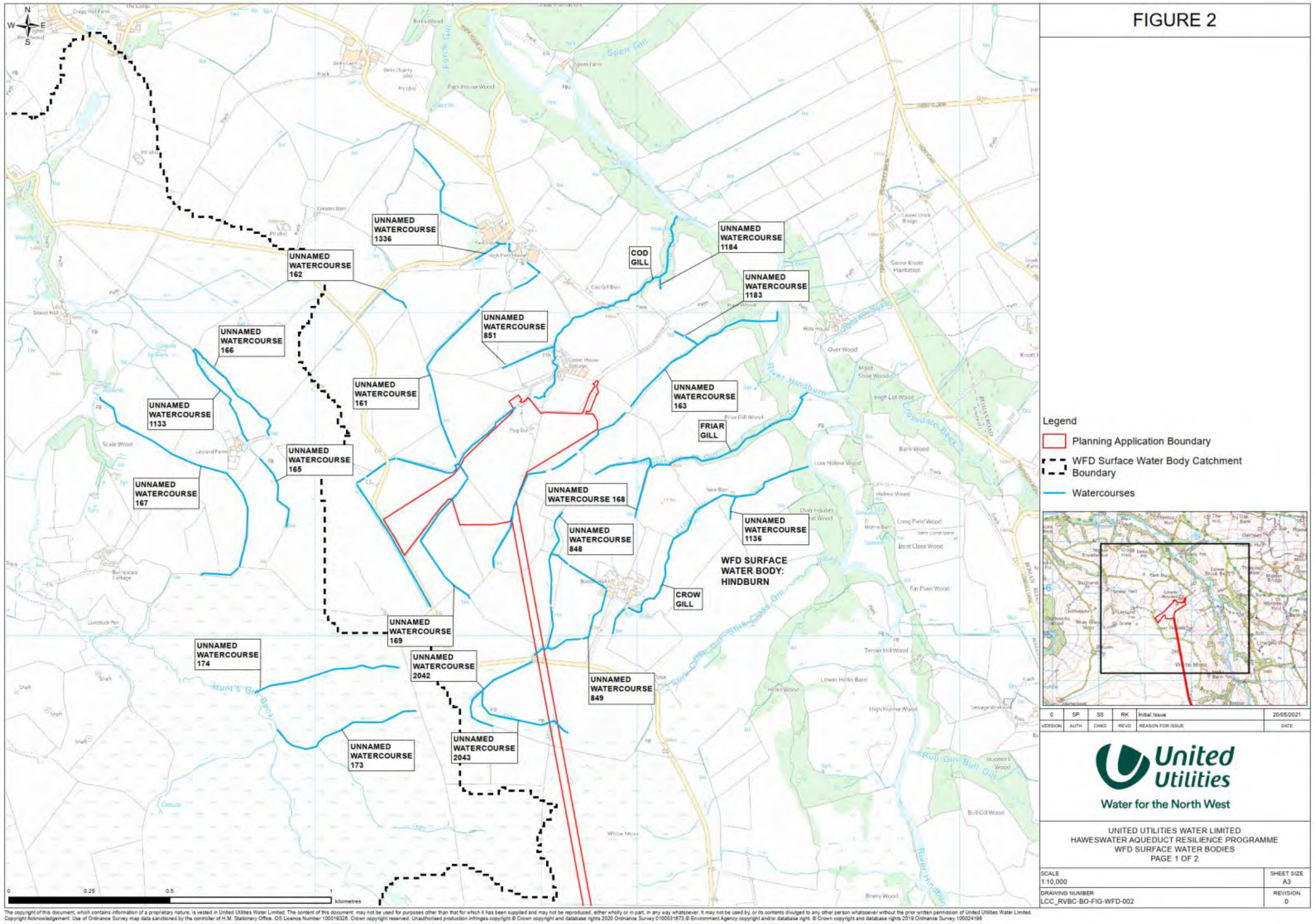


Figure 2b: Scoped in WFD surface water bodies within the Proposed Bowland Section

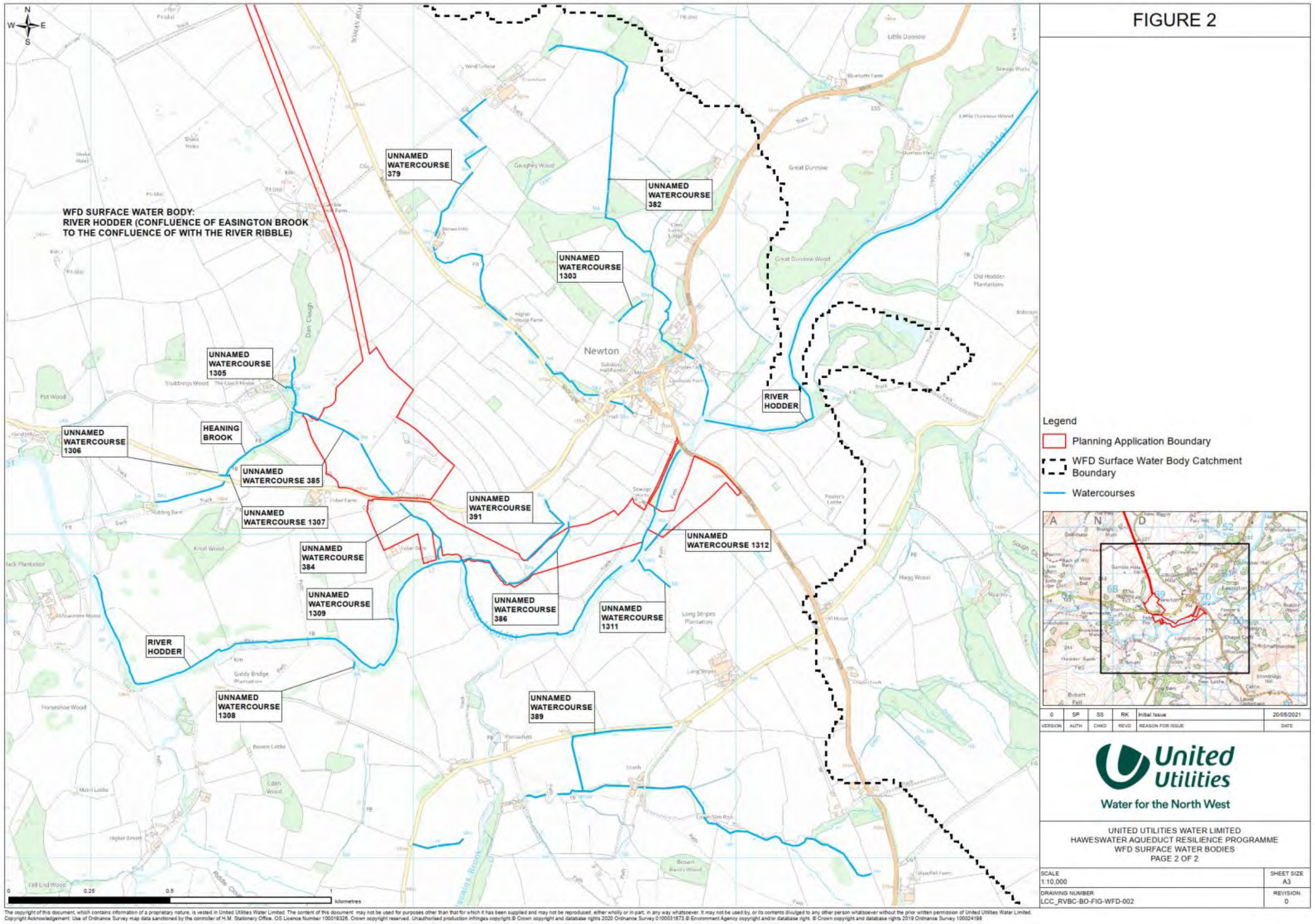


Figure 3a: Scoped in WFD groundwater bodies within the Proposed Bowland Section

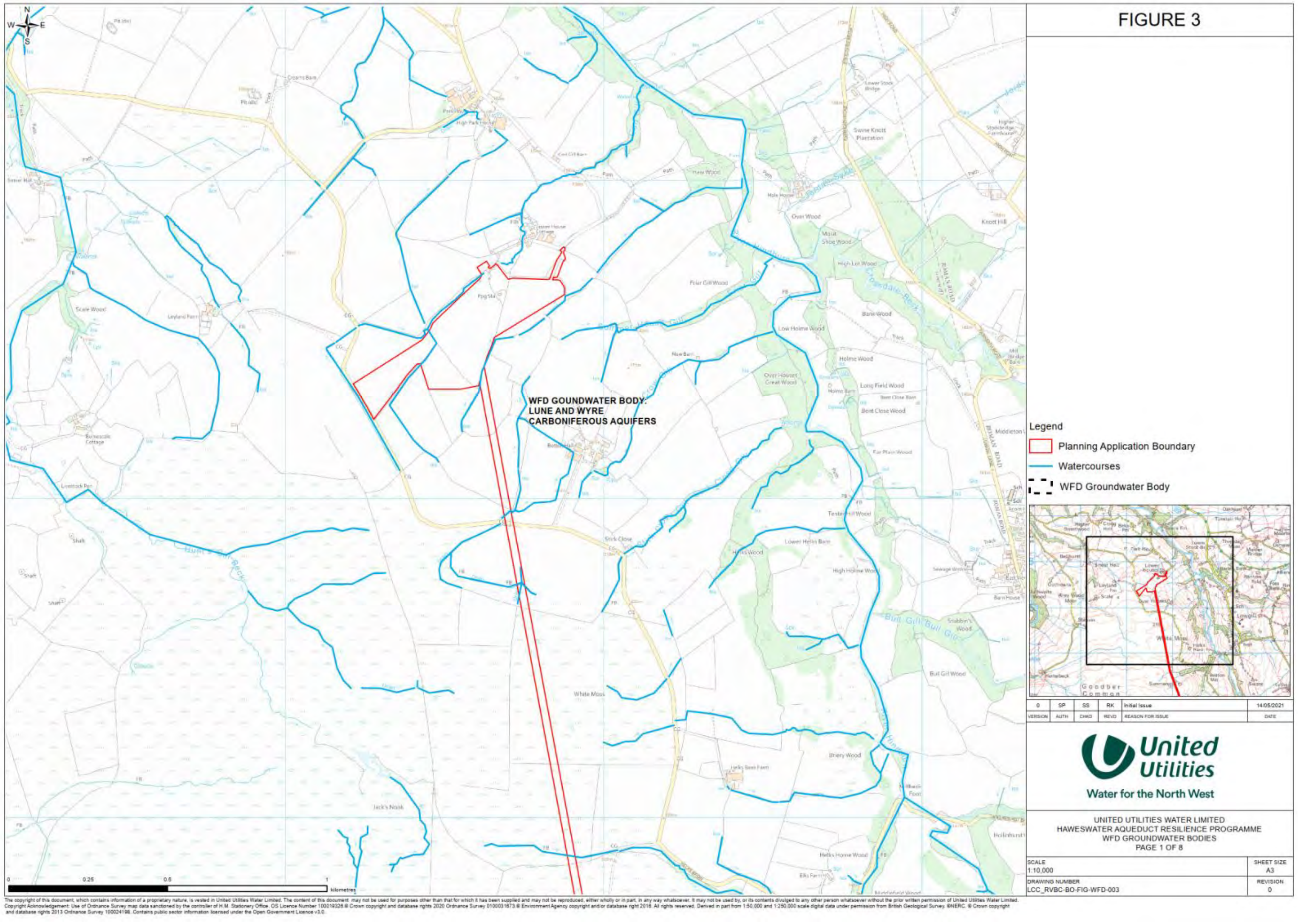


Figure 3b: Scoped in WFD groundwater bodies within the Proposed Bowland Section

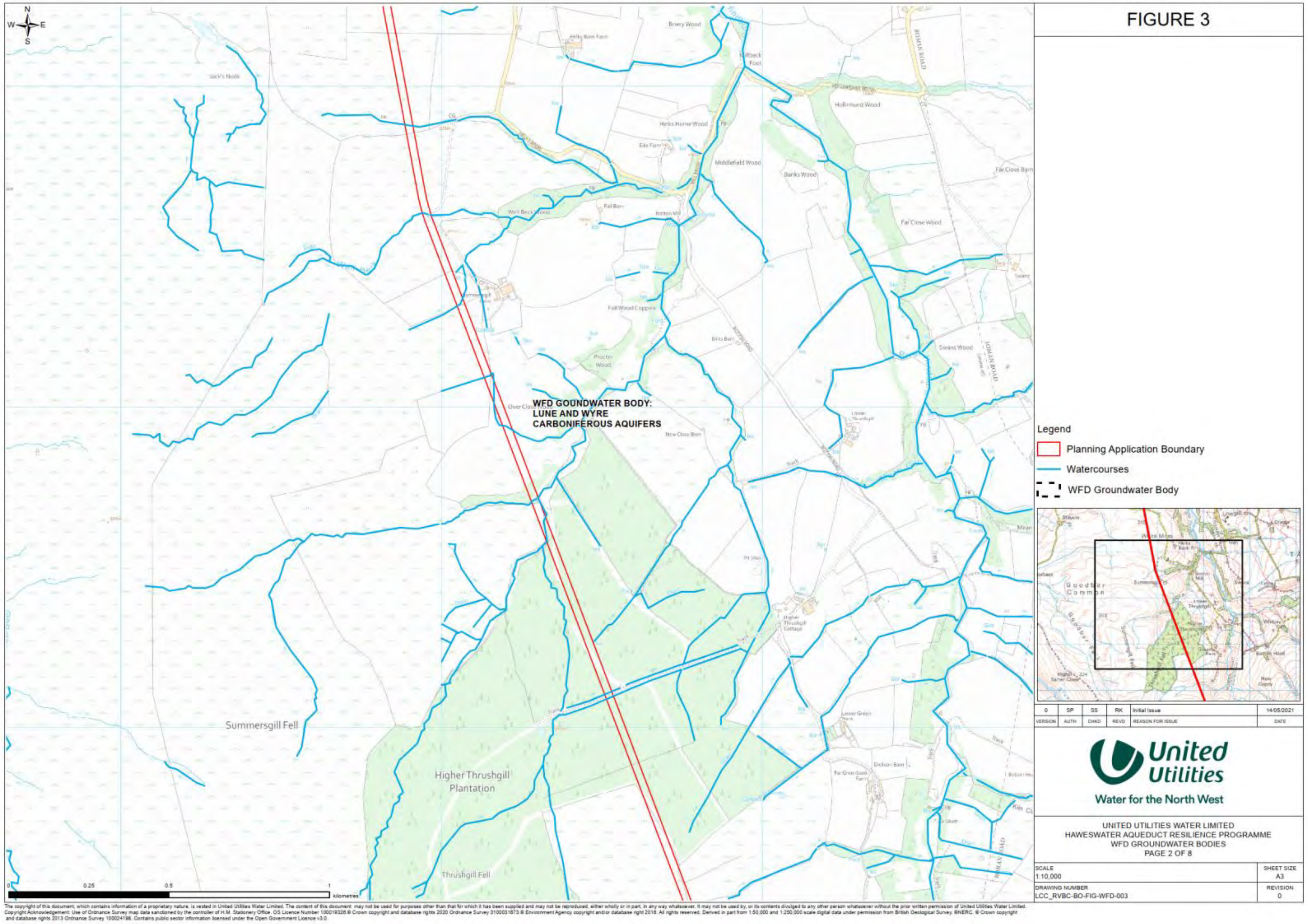


Figure 3c: Scoped in WFD groundwater bodies within the Proposed Bowland Section

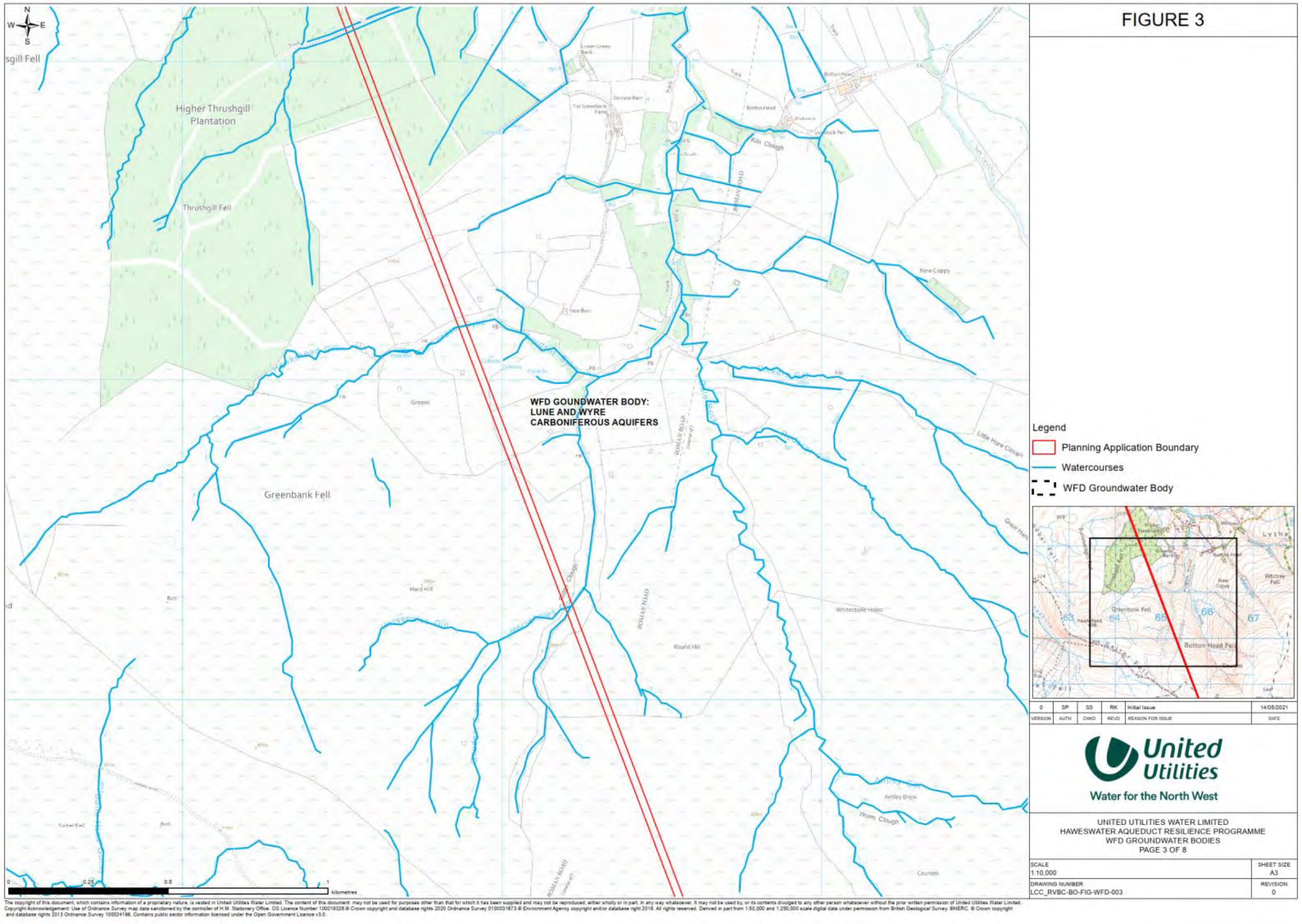


Figure 3d: Scoped in WFD groundwater bodies within the Proposed Bowland Section

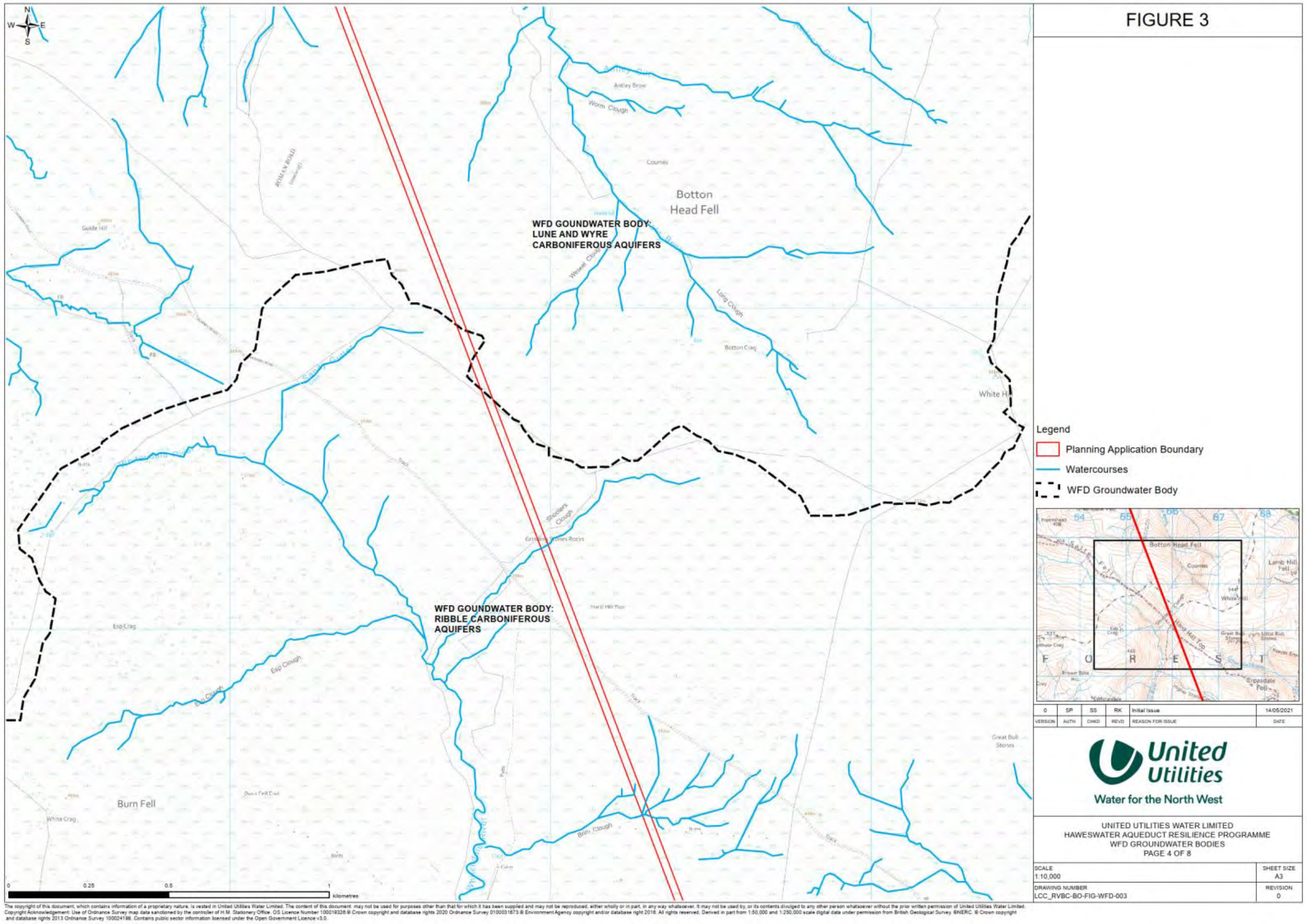


Figure 3e: Scoped in WFD groundwater bodies within the Proposed Bowland Section

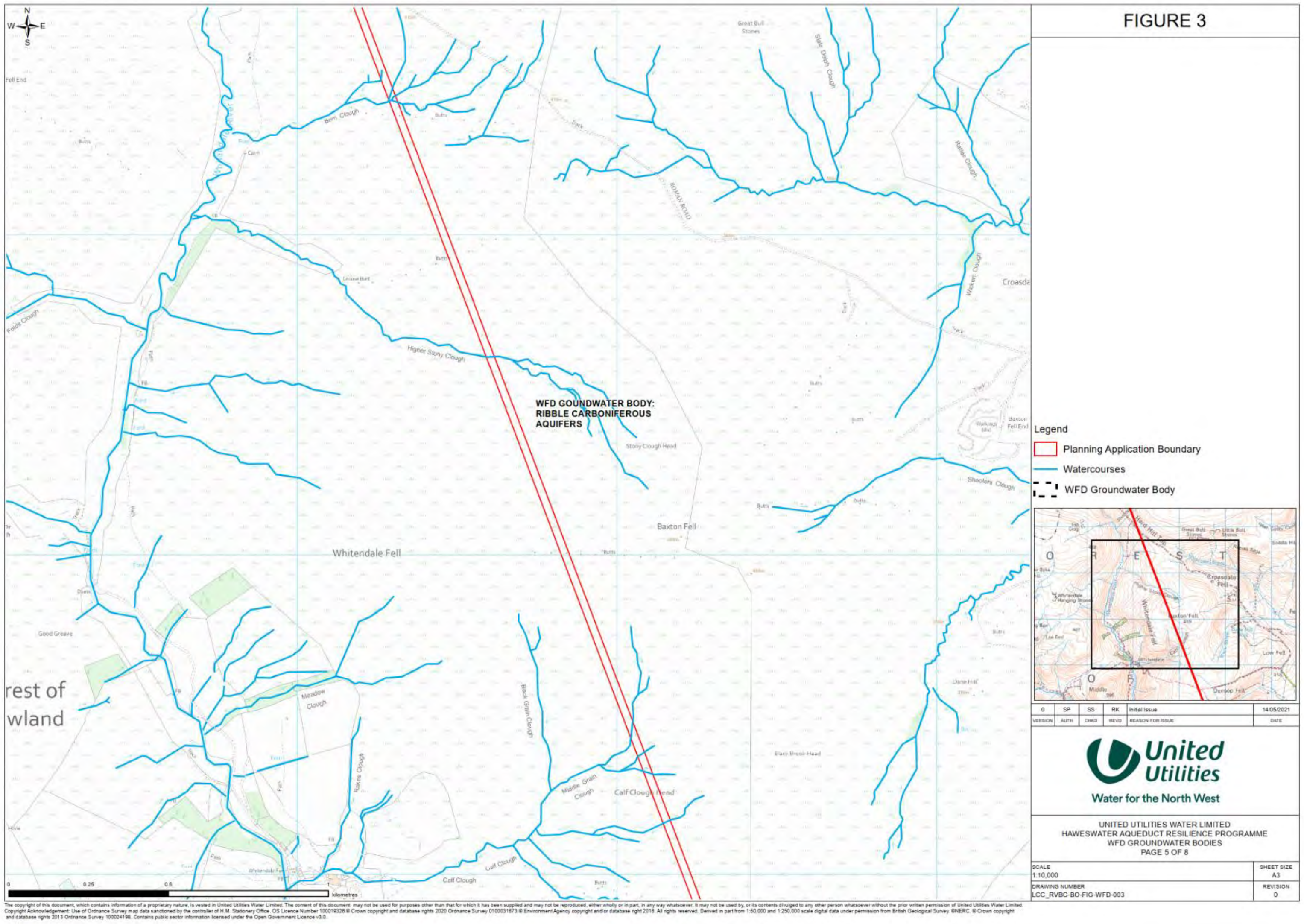


Figure 3f: Scoped in WFD groundwater bodies within the Proposed Bowland Section

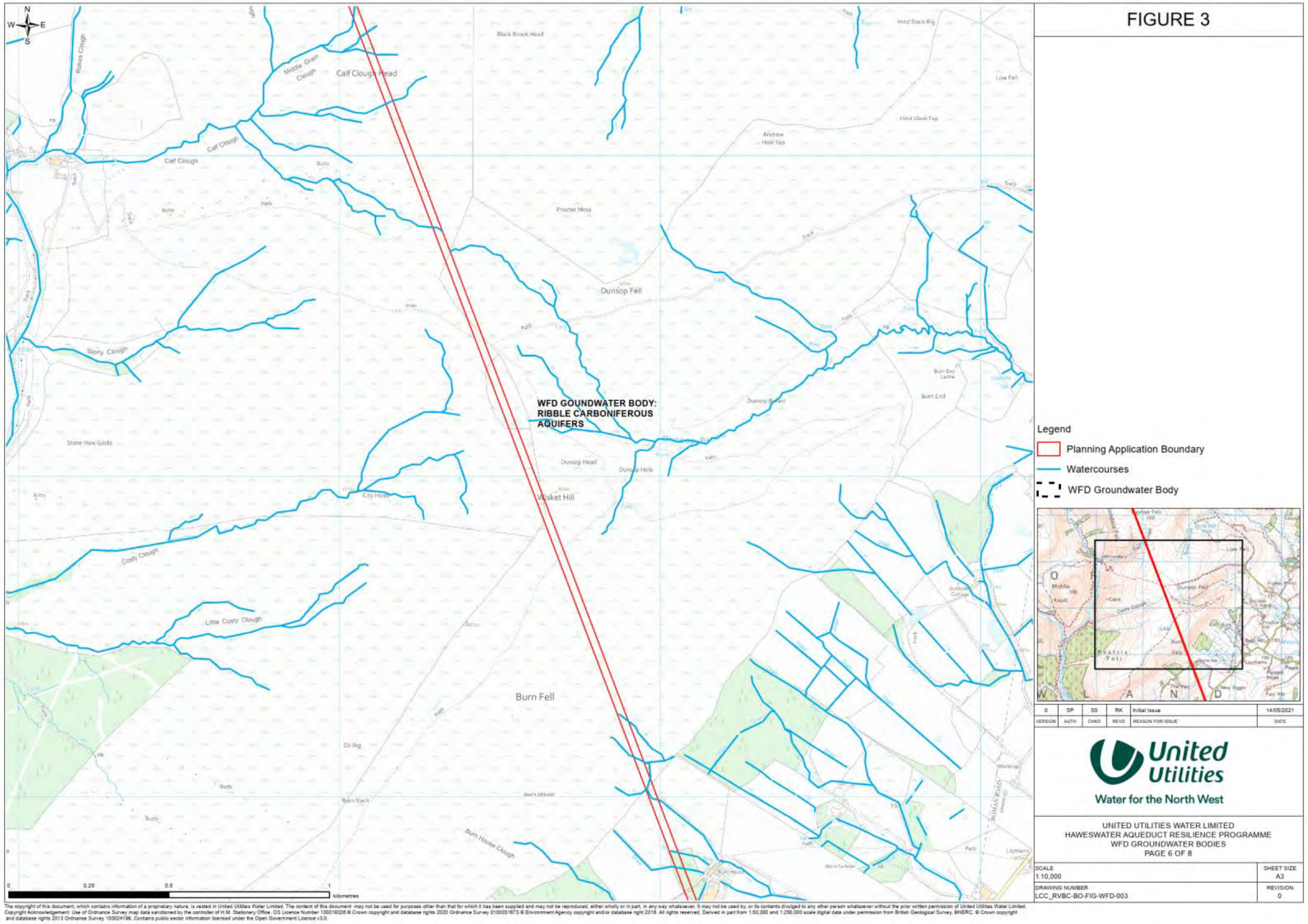


Figure 3g: Scoped in WFD groundwater bodies within the Proposed Bowland Section

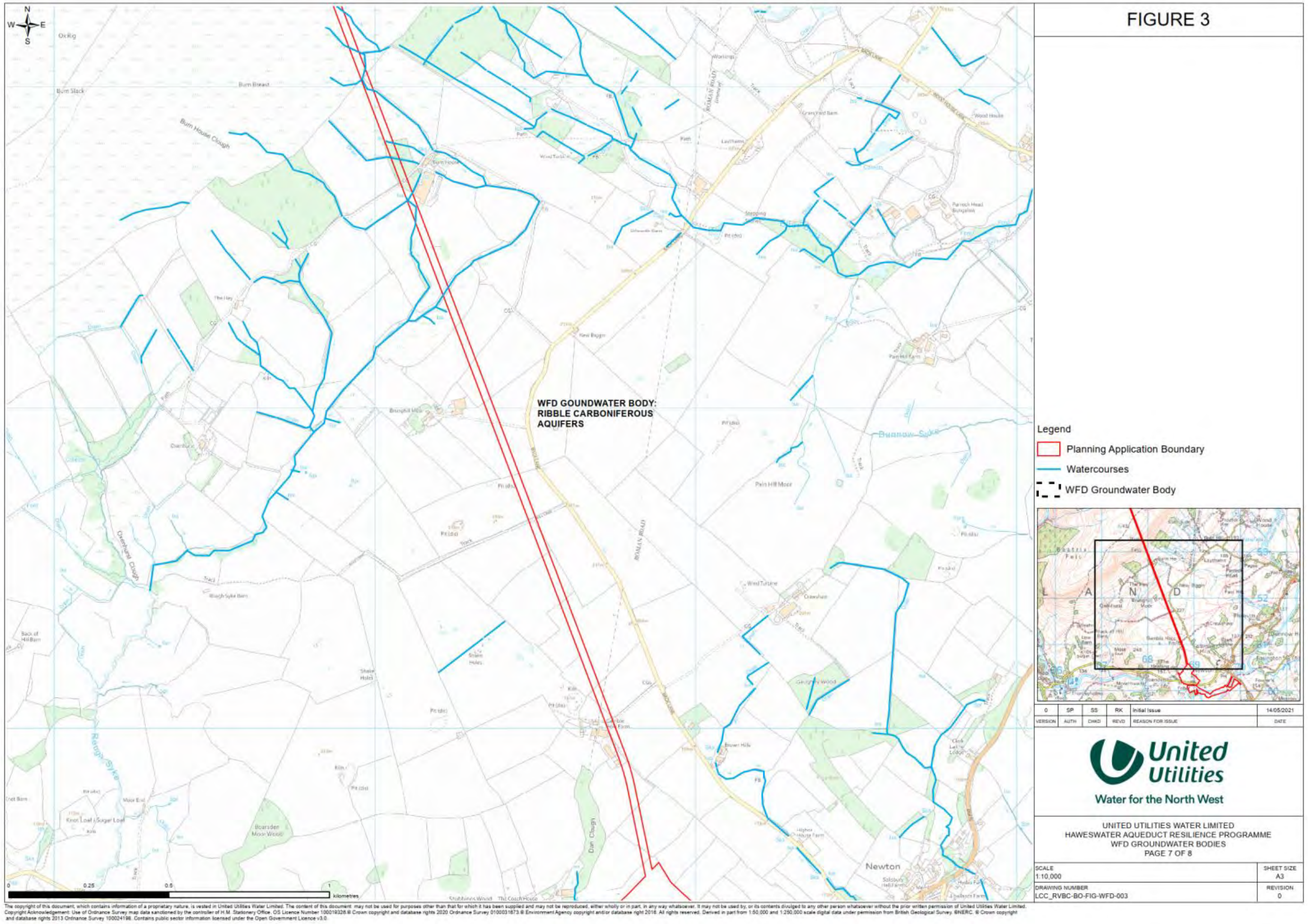
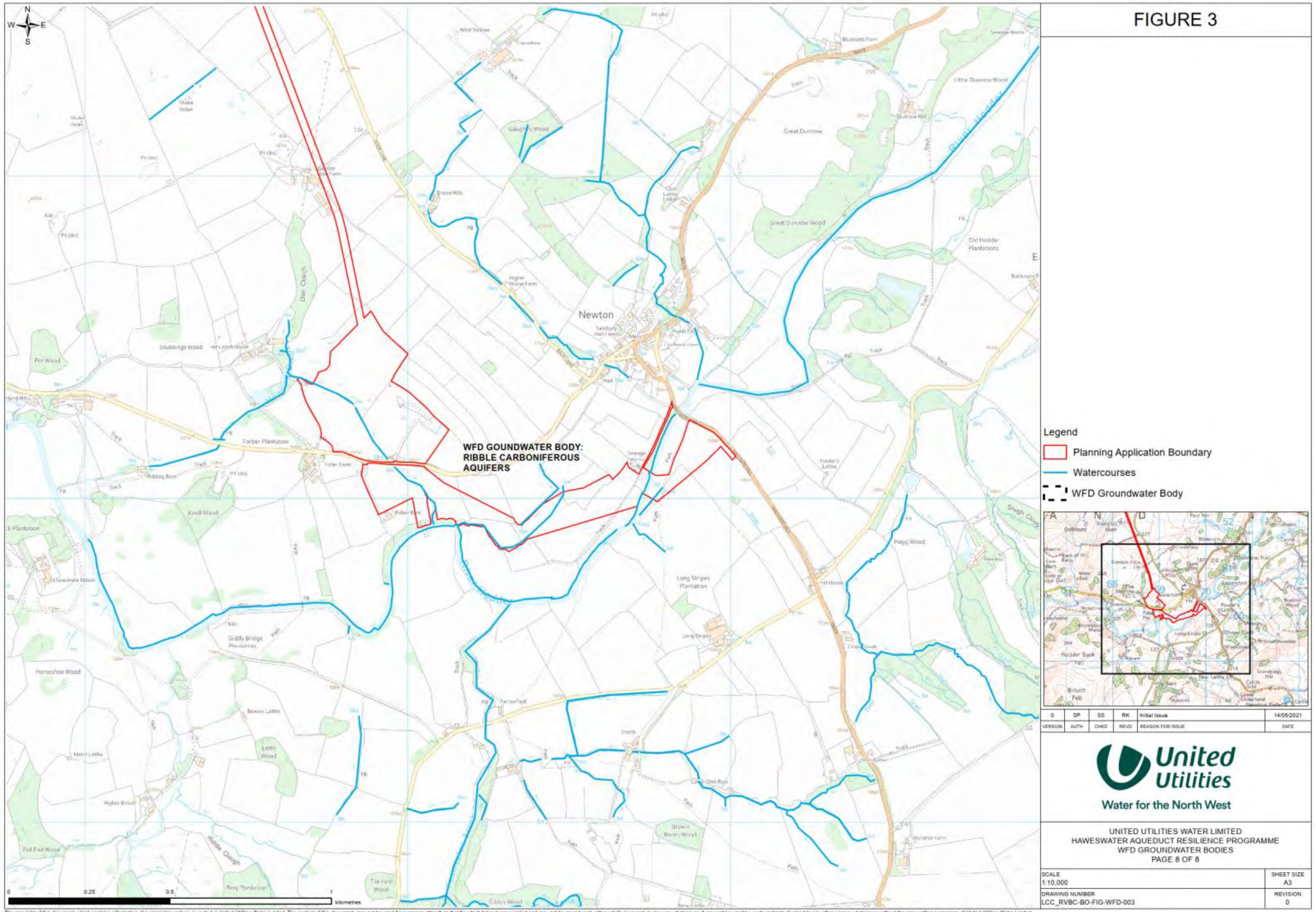


Figure 3h: Scoped in WFD groundwater bodies within the Proposed Bowland Section



4.2 Scoping of WFD Quality Elements

29) Table 4 and Table 5 outline the potential generic impacts of each of the Proposed Bowland Section activities outlined in Section 3 on the scoped in WFD surface water bodies and groundwater bodies respectively. Where an impact would not be anticipated, the quality element has been scoped out.

30) Chemical quality elements (priority substances, other pollutants, and priority hazardous substances) have been scoped out of further assessment as it is unlikely that any of the proposed activities would involve the use, creation, or discharge of these substances.

31) Section 5 provides a more comprehensive assessment of those quality elements scoped in.

Table 4: Scoping of Proposed Bowland Section activities and WFD quality elements for scoped in WFD surface water bodies

Quality Elements		Potential Impacts Per Activity			
		Access Tracks	Site Compound	Commissioning	Overflow
Hindburn					
Biological	Macro-invertebrates	**Scoped Out** ▪ Impacts unlikely to lead to change in quality element status.	**Scoped In** ▪ Drainage from site compound could introduce fine sediment and contaminants into downstream watercourses, disrupting/removing invertebrate habitats.	**Scoped Out** ▪ Temporary discharge unlikely to lead to changes in invertebrate habitat or assemblages.	**Scoped Out** ▪ Overflow not located within the WFD water body.
	Macrophytes and phytobenthos (combined)		**Scoped In** ▪ Drainage from site compound could introduce fine sediment and contaminants into downstream watercourses, disrupting/removing macrophytes and phytoplankton habitats.	**Scoped Out** ▪ No change anticipated due to temporary nature of discharge.	
	Fish		**Scoped In** ▪ Drainage from site compound could introduce fine sediment and contaminants into downstream watercourses, disrupting/removing fish habitats.	**Scoped Out** ▪ No change anticipated due to temporary nature of discharge.	
Physico-chemical	pH	**Scoped Out** ▪ Impacts unlikely to lead to change in quality element status.	**Scoped Out** ▪ Runoff from the site compound would be attenuated and treated prior to discharge, with limited impact on pH.	**Scoped Out** ▪ Treated flow temporarily discharged into watercourse, unlikely to lead to	**Scoped Out** ▪ Overflow not located within the WFD water body.

Quality Elements		Potential Impacts Per Activity			
		Access Tracks	Site Compound	Commissioning	Overflow
	Ammonia (total as N)		**Scoped Out** ▪ Runoff from the site compound would be attenuated and treated prior to discharge, with limited potential impact on water quality.	change in quality element status.	
	Phosphate				
	Dissolved oxygen		**Scoped Out** ▪ Changes to oxygenation resulting from new outfalls changing flow patterns likely to be localised not cause a change in quality element status.		
	Temperature		**Scoped Out** ▪ No likely source of impact from compound activities.		
Hydro-morphological	Quantity and dynamics of water flow	**Scoped In** ▪ Changes to flow and sediment regimes during construction and operation of culverts.	**Scoped In** ▪ Changes to flow from drainage outfall discharge.	**Scoped Out** ▪ Changes in flow processes likely, but for a short (six week) period of time before returning to baseline conditions.	**Scoped Out** ▪ Overflow not located within the WFD water body.
	Connection to groundwater	**Scoped Out** ▪ Localised changes to infiltration from temporary loss of permeable floodplain, however, unlikely to change quality element status.	**Scoped Out** ▪ Localised changes to infiltration from temporary loss of permeable in floodplain, however, no change to watercourses anticipated.	**Scoped Out** ▪ No change anticipated.	
	River continuity	**Scoped In**	**Scoped In**	**Scoped Out**	

Quality Elements		Potential Impacts Per Activity			
		Access Tracks	Site Compound	Commissioning	Overflow
		▪ Land use changes could result in the creation/disruption of overland flow paths and sediment pathways.	▪ Outfalls located on banks could locally disrupt lateral connectivity between the watercourse and the surrounding floodplain.	▪ No change anticipated.	
	River depth and width variation	**Scoped In** ▪ Changes to localised channel width and depth at watercourse crossing (i.e. culverts) locations. ▪ Change in localised morphological processes (scour/deposition) due to culverting of channel for access road.	**Scoped In** ▪ Drainage from site compounds could alter local flow processes, potentially causing disturbance to the bed and banks of the channel.	**Scoped In** ▪ Changes in stream energies for a period of time during discharge potentially leading to erosion and channel adjustment.	
	Structure and substrate of the river bed	**Scoped In** ▪ Exposure of bare earth surfaces arising from vegetation clearance, topsoil stripping, and earthworks creating a source of fine sediment.	**Scoped In** ▪ Exposure of bare earth surfaces arising from vegetation clearance and topsoil stripping, creating a source of fine sediment.	**Scoped In** ▪ Potential for change in bed substrate composition and presence of hydromorphological features.	
	Structure of the riparian zone	**Scoped In** ▪ Localised loss of riparian vegetation.	**Scoped In** ▪ Land use changes could result in the creation/disruption of sediment source pathways. ▪ Localised removal/disruption of riparian vegetation resulting from site clearance.	**Scoped Out** ▪ No change anticipated.	

Quality Elements		Potential Impacts Per Activity			
		Access Tracks	Site Compound	Commissioning	Overflow
Hodder – confluence Easington Brook to confluence Ribble					
Biological	Macro-invertebrates	**Scoped In** ▪ Fine sediment inputs could disrupt or remove habitats for invertebrates. ▪ Removal and disruption of habitats from culverting.	**Scoped In** ▪ Drainage from site compound could introduce fine sediment and contaminants into downstream watercourses, disrupting/removing habitats.	**Scoped Out** ▪ Temporary discharge unlikely to lead to changes in invertebrate habitat or assemblages.	**Scoped In** ▪ Potential water quality implications affecting habitat and assemblages of fauna.
	Macrophytes and phytobenthos (combined)			**Scoped Out** ▪ No change anticipated due to temporary nature of discharge.	
	Fish				
Physico-chemical	pH	**Scoped Out** ▪ Impacts unlikely to lead to changes in quality element.	**Scoped Out** ▪ Runoff from the site compound would be attenuated and treated prior to discharge, with limited potential impact on pH.	**Scoped Out** ▪ Treated flow temporarily discharged into watercourse, unlikely to lead to changes in quality element.	**Scoped In** ▪ Potential for groundwater being discharged to lead to changes in water quality depending on its chemical composition.
	Ammonia (total as N)		**Scoped Out** ▪ Runoff from the site compound would be attenuated and treated prior to discharge, with limited potential impact on water quality.		
	Phosphate				
	Dissolved oxygen		**Scoped Out** ▪ Changes to oxygenation resulting from new outfalls changing flow patterns likely to be localised.		

Quality Elements		Potential Impacts Per Activity			
		Access Tracks	Site Compound	Commissioning	Overflow
	Temperature		**Scoped Out** ▪ No likely source of impact from compound activities.		
Hydro-morphological	Quantity and dynamics of water flow	**Scoped In** ▪ Changes to flow and sediment regimes during construction and operation of culverts.	**Scoped In** ▪ Changes to flow from drainage outfall discharge.	**Scoped Out** ▪ Changes in flow processes likely, but for a short (six week) period of time before returning to baseline conditions.	**Scoped In** ▪ Changes in localised flow processes from new continuous discharge.
	Connection to groundwater	**Scoped Out** ▪ Negligible changes to infiltration from floodplain loss.	**Scoped Out** ▪ Localised changes to infiltration from construction in floodplain, however, no change to watercourses anticipated.	**Scoped Out** ▪ No change anticipated.	**Scoped Out** ▪ No change anticipated.
	River continuity	**Scoped In** ▪ Land use changes could result in the creation/disruption of overland flow paths and sediment pathways.	**Scoped In** ▪ Potential localised disruption to lateral connectivity between the watercourse and the surrounding floodplain.	**Scoped Out** ▪ No change anticipated.	**Scoped Out** ▪ No change anticipated.
	River depth and width variation	**Scoped In** ▪ Localised changes to channel width and depth at watercourse crossing (i.e. culverts) locations. ▪ Localised change in morphological processes (scour/deposition) due to	**Scoped In** ▪ Potential disturbance to bed and banks from drainage discharge.	**Scoped In** ▪ Potential change to channel dimensions due to change in stream energy from discharge.	**Scoped In** ▪ Increased flow from groundwater ingress could lead to localised bed and bank scour.

Quality Elements		Potential Impacts Per Activity			
		Access Tracks	Site Compound	Commissioning	Overflow
		channel culverting for access road.			
	Structure and substrate of the river bed	**Scoped In** ▪ Stripping of surface layer would expose bare earth, creating a source of fine sediment.	**Scoped In** ▪ Stripping of surface layer exposes subsurface sediments, creating a source of fine sediment.	**Scoped In** ▪ Potential for change in bed substrate composition and presence of hydromorphological features.	**Scoped In** ▪ Increased flow from groundwater ingress could lead to localised bed scour and alteration of sediment transportation regime.
	Structure of the riparian zone	**Scoped In** ▪ Localised loss of riparian vegetation.	**Scoped In** ▪ Localised loss of riparian vegetation.	**Scoped Out** ▪ No change anticipated.	**Scoped Out** ▪ No change anticipated.

Table 5: Scoping of Proposed Bowland Section activities for the WFD groundwater bodies

Quality Elements		Potential Impacts Per Activity				
		Access tracks	Site compound	Tunnel (Including Shaft and Portal)	Open-cut Trenches	Overflow
Lune and Wyre Carboniferous Aquifers						
Quantitative	Saline intrusion	**Scoped Out** ▪ No local coastal sources or other saline waters.				
	Water balance	**Scoped Out** ▪ Limited or no dewatering required for access tracks, therefore limited potential for change to water balance.	**Scoped Out** ▪ Dewatering required for attenuation ponds, unlikely to lead to a change to water balance.	**Scoped In** ▪ Potential temporary reduction of or disturbance to groundwater levels and flows due to dewatering required for shaft/portal construction. ▪ Once constructed, the tunnel would not significantly affect flows at the groundwater body scale.	**Scoped In** ▪ Potential temporary reduction of or disturbance to groundwater levels and flows from dewatering required for open-cut.	**Scoped In** ▪ Dewatering around the decommissioned aqueduct potentially causing changes to water balance within surrounding aquifer.
	GWDTEs (non-designated)	**Scoped Out** ▪ No GWDTEs is present in vicinity of access tracks.	**Scoped In** ▪ Removal or change of GWDTEs by soil stripping, hard standing and compound area as well as excavations to construct drainage ponds could alter habitat quality and quantity.	**Scoped Out** ▪ No GWDTEs is present in vicinity of proposed shaft. ▪ Tunnel would be at depth and not impacting on surface receptors	**Scoped In** ▪ Potential dewatering effect during construction. ▪ Potential long-term flow disruption following backfilling.	**Scoped Out** ▪ Dewatering effects occurring at depth would not be expected to impact on surface receptors such as watercourses and GWDTEs.

Quality Elements		Potential Impacts Per Activity				
		Access tracks	Site compound	Tunnel (Including Shaft and Portal)	Open-cut Trenches	Overflow
	Dependent surface water body	**Scoped Out** ▪ No significant excavation required, therefore dewatering would not affect surface waters.	**Scoped Out** ▪ No significant excavation required, therefore dewatering would not significantly affect surface waters.	**Scoped Out** ▪ Dewatering rates for shaft/portal construction are unlikely to lead to significant impacts on surface water baseflows given the distance to the surface waters.	**Scoped Out** ▪ Dewatering rates for the open cut crossing are unlikely to lead to significant impacts on surface water baseflows given the distance to the surface waters.	**Scoped Out** ▪ No discharge to ground or groundwater for the overflow from the decommissioned aqueduct.
Chemical	Saline intrusion	**Scoped Out** ▪ No local coastal sources or other saline waters.				
	Drinking Water Protected Area	**Scoped Out** ▪ Impacts on water quality from access track construction activities are unlikely to cause deterioration in water quality such that additional treatment is required.	**Scoped Out** ▪ Impacts on water quality from site compound activities are unlikely to cause deterioration in water quality such that additional treatment is required.	**Scoped Out** ▪ Impacts on water quality from tunnelling are unlikely to cause deterioration in water quality such that additional treatment is required.	**Scoped Out** ▪ Impacts on water quality from the open cut crossing are unlikely to cause deterioration in water quality such that additional treatment is required.	**Scoped Out** ▪ No discharge to ground or groundwater for the overflow from the decommissioned aqueduct.
	GWDTEs (non-designated)	**Scoped Out** ▪ No GWDTEs is present in vicinity of access tracks.	**Scoped In** ▪ Deterioration of GWDTEs by contaminants from	**Scoped Out** ▪ No GWDTEs is present in vicinity of proposed shaft.	**Scoped In** ▪ Deterioration of GWDTEs by contaminants from	**Scoped Out** ▪ No discharge to ground or groundwater for the

Quality Elements		Potential Impacts Per Activity				
		Access tracks	Site compound	Tunnel (Including Shaft and Portal)	Open-cut Trenches	Overflow
			vehicles using the site compound. ▪ Potential sediment mobilisation from soil stripping.	▪ Tunnel would be at depth and not impacting on surface receptors.	construction activities. ▪ Potential sediment mobilisation from trenching.	overflow from the decommissioned aqueduct.
	Dependent surface water body	**Scoped Out** ▪ No significant excavation required, therefore dewatering would not affect baseflow quality to surface waters.	**Scoped Out** ▪ No significant excavation required, therefore dewatering would not significantly affect baseflow quality to surface waters.	**Scoped Out** ▪ New pipeline located up to approximately 285 m below ground, and not considered to be linked to surface waters. ▪ Construction of shaft/portals is unlikely to lead to significant impacts on surface water baseflows given the distance to the surface waters.	**Scoped Out** ▪ Excavation and dewatering for the open cut trenches are unlikely to lead to significant impacts on baseflow quality given the distance to the surface waters.	**Scoped Out** ▪ Decommissioned pipeline located up to approximately 370 m below ground, and not considered to be linked to surface waters. ▪ No discharge to ground or groundwater for the overflow from the decommissioned aqueduct.
	Chemical test	**Scoped Out** ▪ Any impacts would not be widespread enough to compromise the use of the groundwater resource either currently or in the future for the	**Scoped Out** ▪ Any impacts would not be widespread enough to compromise the use of the groundwater resource either currently or in the future for the groundwater body as a whole.	**Scoped Out** ▪ Any impacts would not be widespread enough to compromise the use of the groundwater resource either currently or in the future for the groundwater body as a whole.	**Scoped Out** ▪ Any impacts would not be widespread enough to compromise the use of the groundwater resource either currently or in the future for the	**Scoped Out** ▪ No discharge to ground or groundwater for the overflow from the decommissioned aqueduct.

Quality Elements		Potential Impacts Per Activity: Access tracks	Site compound	Tunnel (Including Shaft and Portal)	Open-cut Trenches	Overflow
		groundwater body as a whole.			groundwater body as a whole.	
Ribble Carboniferous Aquifers						
Quantitative	Saline intrusion	**Scoped Out** ▪ No local coastal sources or other saline waters				
	Water balance	**Scoped Out** ▪ Limited or no dewatering required for access tracks, therefore limited potential for change to water balance.	**Scoped Out** ▪ Dewatering required for attenuation ponds, unlikely to lead to a change to water balance.	**Scoped In** ▪ Potential temporary reduction of or disturbance to groundwater levels and flows due to dewatering required for shaft construction.	**Scoped In** ▪ Potential temporary reduction of or disturbance to groundwater levels and flows from dewatering required for open-cut trenches.	**Scoped In** ▪ Dewatering around the decommissioned aqueduct potentially causing changes to water balance within surrounding aquifer.
	GWDTEs (non-designated)	**Scoped In** ▪ Crossing of GWDTEs by road access tracks could alter the quality and quantity of habitat available ▪ Mobilisation of suspended solids below the water table could lead to migration of sediment to a	**Scoped In** ▪ Removal or change to GWDTEs by hard standing and compound area could alter habitat quality and quantity.	**Scoped In** ▪ Dewatering required for construction of shafts could cause a temporary reduction in groundwater flows or levels to a GWDTE.	**Scoped In** ▪ Mobilisation of suspended solids below the water table could lead to migration of sediment to a GWDTE via fracture flow and spring discharges.	**Scoped Out** ▪ Decommissioned aqueduct located up to approximately 370 m below ground, and not considered to be linked to GWDTEs.

Quality Elements		Potential Impacts Per Activity				
		Access tracks	Site compound	Tunnel (Including Shaft and Portal)	Open-cut Trenches	Overflow
		GWDTE via fracture flow and spring discharges.				
	Dependent surface water body	**Scoped Out** ▪ No significant excavation required, therefore dewatering would not affect surface waters.	**Scoped Out** ▪ No significant excavation required, therefore dewatering would not affect surface waters.	**Scoped Out** ▪ Dewatering rates for shaft construction are unlikely to lead to significant impacts on surface water baseflows given the distance to the surface waters.	**Scoped Out** ▪ Dewatering rates for the open cut crossing are unlikely to lead to significant impacts on surface water baseflows given the distance to the surface waters.	**Scoped Out** ▪ No discharge to ground or groundwater for the overflow from the decommissioned aqueduct.
Chemical	Saline intrusion	**Scoped Out** ▪ Not located within the proximity of coast or other saline waters.				
	Drinking Water Protected Area	**Scoped Out** ▪ Impacts on water quality from access road construction activities are unlikely to cause deterioration in water quality such that additional treatment is required.	**Scoped Out** ▪ Impacts on water quality from site compound construction activities are unlikely to cause deterioration in water quality such that additional treatment is required.	**Scoped Out** ▪ Impacts on water quality from shaft / tunnel construction activities are unlikely to cause deterioration in water quality such that additional treatment is required.	**Scoped Out** ▪ Impacts on water quality from open-road trench construction activities are unlikely to cause deterioration in water quality such that additional treatment is required.	**Scoped Out** ▪ No discharge to ground or groundwater for the overflow from the decommissioned aqueduct.

Quality Elements		Potential Impacts Per Activity				
		Access tracks	Site compound	Tunnel (Including Shaft and Portal)	Open-cut Trenches	Overflow
	GWDTEs (non-designated)	**Scoped In** ▪ Deterioration of GWDTEs by contaminants from vehicles using the access tracks.	**Scoped In** ▪ Deterioration of GWDTEs by contaminants from vehicles using the site compound.	**Scoped In** ▪ New pipeline located up to approximately 285 m below ground, and not considered to be linked to GWDTEs. ▪ Potential sediment mobilisation from shaft construction.	**Scoped In** ▪ Deterioration of GWDTEs by contaminants from construction activities and fine sediment mobilisation.	**Scoped Out** ▪ Decommissioned aqueduct located up to approximately 370 m below ground, and not considered to be linked to GWDTEs. ▪ No discharge to ground or groundwater for the overflow from the decommissioned aqueduct.
	Dependent surface water body	**Scoped Out** ▪ No significant excavation required, therefore dewatering would not affect baseflow quality to surface waters.	**Scoped Out** ▪ No significant excavation required, therefore dewatering would not affect baseflow quality to surface waters.	**Scoped Out** ▪ New pipeline located up to approximately 285 m below ground, and not considered to be linked to surface waters. ▪ Construction of shafts is unlikely to lead to significant impacts on surface water baseflows given the distance to the surface waters.	**Scoped Out** ▪ Excavation and dewatering for the open cut trenches are unlikely to lead to significant impacts on baseflow quality given the distance to the surface waters.	**Scoped Out** ▪ Decommissioned aqueduct up to approximately 370 m below ground, and not considered to be linked to surface waters. ▪ No discharge to ground or groundwater for the overflow from the decommissioned aqueduct.

Quality Elements		Potential Impacts Per Activity				
		Access tracks	Site compound	Tunnel (Including Shaft and Portal)	Open-cut Trenches	Overflow
	Chemical test	**Scoped Out** ▪ Any impacts would not be widespread enough to compromise the use of the groundwater resource either currently or in the future for the groundwater body as a whole.	**Scoped Out** ▪ Any impacts would not be widespread enough to compromise the use of the groundwater resource either currently or in the future for the groundwater body as a whole.	**Scoped Out** ▪ Any impacts would not be widespread enough the use of the groundwater resource either currently or in the future for the groundwater body as a whole.	**Scoped Out** ▪ Any impacts would not be widespread enough to compromise the use of the groundwater resource either currently or in the future for the groundwater body as a whole.	**Scoped Out** ▪ Any impacts would not be widespread enough to compromise the use of the groundwater resource either currently or in the future for the groundwater body as a whole.

5. Assessment of the Proposed Bowland Section

5.1 Site Specific Assessment Against WFD Quality Elements

32) This section provides a comprehensive site-specific assessment of the scoped in Proposed Bowland Section activities on the WFD quality elements at WFD water body scale (Table 6).

33) Impacts are assessed in terms of risk of deterioration to WFD elements using the following:

- White – Negligible risk of deterioration of status with local impacts anticipated
- Green - Low risk of deterioration of status with localised impacts anticipated (impacts managed by good practice measures)
- Orange - Medium risk of deterioration of status (additional mitigation required)
- Red - High risk of deterioration of status (potential for non-compliant in-combination with other impacts).

Table 6: Assessment of the Hindburn and Hodder – confluence Easington Brook to confluence Ribble WFD surface water bodies, and Lune and Wyre Carboniferous Aquifers and Ribble Carboniferous Aquifers WFD groundwater bodies for the Proposed Bowland Section

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
Construction					
Access Track	Biological	Macrophytes and phytobenthos (combined)	The exposure of bare earth surfaces as a result of topsoil stripping, vegetation clearance, and earthworks could lead to mobilisation of fine sediment, resulting in smothering of bed substate and reduced light availability. Culvert crossings would also change flow dynamics and cause habitat loss (see assessment of Hydromorphology quality element for further detail on changes to bed substrate and flow conditions). This would directly affect Unnamed Watercourse 169, with potential indirect impacts on the downstream Cod Gill and River Hindburn. The macrophyte/diatom community of the Hindburn WFD surface water body is considered indicative of undisturbed waters based on the Trophic Diatom Index (TDI) from an Environment Agency monitoring location (Site ID: 63499 (Hindburn) across a 10-year period. The TDI describes the nutrient preferences of a diatom community. It ranges from 1 (preference for extremely low nutrient levels) to 100 (preference for extremely high nutrient levels), with the Hindburn scoring 27.72-34.84 (moderate nutrient conditions). Percentage Motile Taxa data indicates proportions of phytobenthos taxa within the community that are motile. A high proportion of motile taxa (>50%) can indicate that light availability is influencing the community, which can be brought about by pressures such as siltation and high covers of filamentous algae. The baseline scores for the site ranged from 1.9%-16.77%, indicative for clear, undisturbed water with low nutrient levels across the 10-year period. Consequently, the macrophyte community of this WFD surface water body is likely to be sensitive to changes in sediment and nutrient conditions arising from the construction and use of the access road. However, given the localised nature of the impacts, distance between the River Hindburn and the activity (approximately 1 km), and adherence to industry good practice such as appropriate sediment management techniques, it is unlikely this activity would lead to a change in quality element status.	**Hindburn**	None required
			The potential impacts identified in the assessment of this activity for the Hindburn WFD surface water body are also relevant for this WFD surface water body. These would directly affect Unnamed Watercourse 384, Unnamed Watercourse 385, Unnamed Watercourse 386, and Unnamed Watercourse 391. There would be potential indirect impacts on the downstream River Hodder, which would also be crossed by a clear span bridge. The macrophyte/diatom community of the Hodder – confluence Easington Brook to confluence Ribble WFD surface water body is considered indicative of disturbed waters. This is based on data from an Environment Agency monitoring location (Site ID: 160989 (Hodder) across a 10-year period. TDI scores ranged from 28.65 to 66.87 (moderate to high nutrient conditions), whilst Percentage Motile Taxa data ranged from 1.33% to 57.28% across the 10-year period. Consequently, the macrophyte community in this WFD surface water body are likely to be relatively resilient to any changes in sediment and nutrient conditions arising from construction and use of the access roads. Given the resilience of macrophyte communities to potential impacts, it is unlikely this activity would lead to a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	None required
		Macro-invertebrates	The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Macroinvertebrates quality element. This would directly affect Unnamed Watercourse 169, with potential indirect impacts on the downstream Cod Gill and River Hindburn. The macroinvertebrate communities of the Hindburn WFD surface water body are indicative of good water quality and slight/minimal sedimentation. This is based data from two Environment Agency monitoring locations across a 10-year period. Both $WHPT_{ASPT}$ and PSI (indicator of sedimentation impacts) scores were high across all sampling occasions ($WHPT_{ASPT}$ ranging from 6.38-7.65 and PSI averaging 80). Due to hydrological connectivity, the macroinvertebrate communities in the lower reaches of tributaries of the River Hindburn are likely to have similar community composition and sensitivity as those in the River Hindburn, but with reduced diversity due to the smaller watercourse size and lower habitat variation. Given the distance between the River Hindburn and the activity (1 km), it is unlikely that the macroinvertebrate communities of the River Hindburn would be impacted, with any impacts restricted to Unnamed Watercourse 169 and Cod Gill. Given the localised nature of the impacts and adherence to industry good practice during construction, such as appropriate sediment	**Hindburn**	None required

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
			management techniques, would also reduce the likelihood of fine sediment entering the watercourses. Consequently, it is unlikely this activity would lead to a change in quality element status.		
			The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Macroinvertebrates quality element. This would directly affect Unnamed Watercourse 384, Unnamed Watercourse 385, Unnamed Watercourse 386, and Unnamed Watercourse 391. There would be potential indirect impacts on the downstream River Hodder, which would also be crossed by a clear span bridge. The macroinvertebrate communities of the Hodder – confluence Easington Brook to confluence Ribble WFD surface water body are indicative of good water quality and slightly/minimal sedimentation. This is based data from one Environment Agency monitoring location across a 10-year period. Both $WHPT_{ASPT}$ and PSI (indicator of sedimentation impacts) scores were high across all sampling occasions ($WHPT_{ASPT}$ ranging from 6.97-7.11 and PSI averaging 83). Due to hydrological connectivity, the macroinvertebrate communities in the lower reaches of tributaries of the River Hodder are likely to have similar community composition and sensitivity as those in the River Hodder, but with reduced diversity due to the smaller watercourse size and lower habitat variation. Whilst the macroinvertebrate communities of the River Hodder and its tributaries are likely to be sensitive to changes in sediment levels and water quality, the scale of the impacts associated with this activity are likely to be localised. Adherence to industry good practice, such as appropriate sediment management techniques, would also reduce the likelihood of fine sediment entering the watercourses. Consequently, it is unlikely this activity would lead to a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	None required
		Fish	The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Fish quality element. This would directly affect Unnamed Watercourse 169, with potential indirect impacts on the downstream Cod Gill and River Hindburn. Historical data from Environmental Agency monitoring locations within the Hindburn WFD surface water body have shown the presence of diverse fish communities which would be sensitive to water quality and habitat changes (e.g. Brown trout, Atlantic salmon and European Eels). The impacts identified would be localised and occur on tributaries which do not have the same quality of physical habitat associated with the downstream River Hindburn. The distance between the River Hindburn and the activity (approximately 1 km), and adherence to industry good practice during construction such as appropriate sediment management techniques, would also reduce the impact on fish communities. Consequently, it is unlikely this activity would lead to a change in quality element status.	**Hindburn**	None required
			The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Fish quality element. This would directly affect Unnamed Watercourse 384, Unnamed Watercourse 385, Unnamed Watercourse 386, and Unnamed Watercourse 391. There would be potential indirect impacts on the downstream River Hodder, which would also be crossed by a clear span bridge. Historical data from Environmental Agency monitoring locations within the Hodder- confluence Easington Brook to confluence Ribble WFD surface waterbody have shown the presence of diverse fish communities which would be sensitive to water quality and habitat changes (e.g. Brown trout, Atlantic salmon, and European Eels). The impacts identified would be localised and occur on tributaries which do not have the same quality of physical habitat associated with the downstream River Hodder. Lack of direct physical interaction with the River Hodder channel and adherence to industry good practice during construction, such as appropriate sediment management techniques, would also reduce the likelihood of fine sediment entering the watercourses. Consequently, it is unlikely this activity would lead to a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	None required
			The culvert crossing of Unnamed Watercourse 169 could see localised change in flow dynamics up- and downstream of the culvert. However, as this is the only watercourse crossed in this manner in the WFD water body, coupled with the relatively short	**Hindburn**	None required

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
	Hydro-morphological	Quantity and dynamics of water flow	length of the crossing (8 m), it is unlikely that there would be a change in quality element status given the localised nature of the impacts.		
			Five watercourses are crossed by access roads within the WFD water body: ▪ Unnamed Watercourse 384 (crossed by two culverts) ▪ Unnamed Watercourse 385 (crossed by one culvert) ▪ Unnamed Watercourse 386 (crossed by one culvert) ▪ Unnamed Watercourse 391 (crossed by one culvert) ▪ River Hodder (crossed by a clear span bridge). The presence of multiple culverts in the water body could cause flow constriction, impacting on local depths and velocities. Constriction of flow, as well as change in hydraulic conditions (i.e. between open and closed channel conditions) could result in bed and/or bank scour. These impacts would be localised, with culvert lengths minimised to prevent extensive impacts. The crossing of the River Hodder by a clear span bridge would be unlikely to impact on flow dynamics, with abutments set back approximately 8-10 m from the bank tops. Flood flows would be routed through flood relief culverts built into the abutments. Whilst this would impact local overland flow processes, the overall quantity and general direction of flow would remain largely unaltered. The drainage of surface runoff from the access tracks would be discharged via four outfalls, two on Unnamed Watercourse 386 and two on the River Hodder. Surface runoff would be attenuated, and therefore is not anticipated to increase local flow rates. Overall, the presence of access roads and culverts would have small, localised impacts on flow regimes, however, these impacts would be unlikely to cause a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	None Required
		River continuity	The lateral connectivity between Unnamed Watercourse 169 and its floodplain would be impacted by the construction and use of the culvert crossing. Impacts would be localised to the length of the culvert (approximately 8 m), representing a marginal loss of connectivity in comparison to the overall length of the WFD water body (27.1 km).	**Hindburn**	None required
			The lateral connectivity of three watercourses would be impacted by the construction of five culverts. Impacts would be localised to the length of the culvert (approximately 8 m), representing a small loss of connectivity in comparison to the overall length of the WFD water body (34 km). Lateral connectivity of the River Hodder with its floodplain would not be impacted, with abutments of the bridge set back from the bank tops.	**Hodder – confluence Easington Brook to confluence Ribble**	None required
		River depth and width variation	In-channel working during the construction of the culvert crossings at Unnamed Watercourse 169 could lead to local bank destabilisation. The watercourse was assessed as laterally adjusting, with bank erosion observed along the reach which would be crossed. Presence of a culvert would lead to the natural river width and depth being artificially constrained. In addition to potential bank erosion, increased quantities of fine sediment created by construction activities could lead to aggradation of Unnamed Watercourse 169, and downstream watercourses, specifically Cod Gill. All the impacts identified would be managed by following industry good practice during construction, such as appropriate culvert design methodologies, sensitive channel reinstatement, and appropriate sediment management techniques, to prevent a change in quality element status.	**Hindburn**	None required
			In-channel working during the construction of the culvert crossings at Unnamed Watercourse 384, Unnamed Watercourse 385, and Unnamed Watercourse 386 could lead to local bank destabilisation. Culvert crossings could also see localised change in flow dynamics up- and downstream (see assessment of Quantity and dynamics of flow quality element for further explanation). Unnamed Watercourse 385 was actively adjusting, with evidence of erosion and deposition observed during site visits, so would be particularly susceptible to disruption of local fluvial processes or altering of the bed/bank structure, which could promote further bank destabilisation. Unnamed Watercourses 384 and 386 were observed as being stable (i.e. in dynamic equilibrium), and therefore would be less sensitive to disruption of fluvial processes. Construction of outfalls to allow for discharge of road runoff into Unnamed Watercourse 386 and the River Hodder could cause some localised bed and bank erosion. The location of the outfalls on the River Hodder appear to be stable, whilst Unnamed	**Hodder – confluence Easington Brook to confluence Ribble**	None required

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
			Watercourse 386 also appears stable. Discharge of surface water would be attenuated, and therefore unlikely to significantly impact on local depth/width. Whilst a number of impacts have been identified, following industry good practice during construction, such as appropriate culvert design methodologies, sensitive channel reinstatement, minimising requirement for in-channel working, and appropriate sediment management techniques, would prevent a change in quality element status.		
		Structure and substrate of the river bed	Mobilisation of fine sediment (from activities such as vegetation clearance, topsoil stripping, earthworks) could potentially smother the local bed substrate of Unnamed Watercourse 169. The culvert crossing would also replace approximately 8 m of the natural channel substrate. Increased quantities of fine sediment supplied to the channel via silt-laden runoff could lead to aggradation in both Unnamed Watercourse 169, and the downstream Cod Gill. All the impacts identified would be managed by following industry good practice during construction, such as appropriate culvert design, sensitive channel reinstatement and appropriate sediment management techniques, to prevent a change in quality element status.	**Hindburn**	None required
			The mobilisation of fine sediment (from activities such as vegetation clearance, topsoil stripping, earthworks) could potentially smother the local bed substrate of Unnamed Watercourses 384, 385, and 386. Each culvert crossing would also replace approximately 8 m of the natural channel substrate. Increased quantities of fine sediment supplied to the channel via silt-laden runoff could lead to aggradation and smothering of coarse bed substrate in Unnamed Watercourses 384, 385, and 386, as well as smothering of coarse bed substrate in the downstream River Hodder. All the impacts identified would be managed by following industry good practice during construction, such as appropriate culvert design, sensitive channel reinstatement and appropriate sediment management techniques, to prevent a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	None required
		Structure of the riparian zone	The relative stability of Unnamed Watercourse 169 would suggest that the loss of the riparian zone to accommodate a culvert crossing would have negligible impact on bank stability. Consequently, it is unlikely that there would be any change in quality element status.	**Hindburn**	None required
			Removal of vegetation and compaction of the banks to accommodate the construction and operation of the access track and associated culverts could increase the risk of bank destabilisation and quantities of fine sediment entering the watercourses crossed. This is particularly relevant to Unnamed Watercourse 385, where riparian vegetation likely helps to stabilise the banks. Adherence to industry good practice during construction, such as landscape reinstatement and appropriate sediment management techniques, and the localized nature of these impacts would make it unlikely that there would be a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	None required
	Quantitative (groundwater)	GWDTEs (non-designated)	Construction of access tracks across three GWDTEs (Gamble Hole Farm Pasture, Dunsop Bridge Road, and River Hodder North) would result in direct impact to GWDTEs, and disruption to shallow groundwater flow for adjacent areas. Given that the GWDTE sites do not have a statutory designation, impacts would not result in a change in quality element status. However, the area is identified as a GWDTE, and mitigation should still be explored, with any mitigation located as close to the site as possible and would be determined by species/habitat loss wherever feasible.	**Ribble Carboniferous Aquifers**	Minimise footprint of topsoil stripping and vegetation clearance wherever possible. This would reduce the extent of potentially significant effects caused by this activity, but there is no specific mitigation possible to avoid direct habitat loss. A feasibility assessment should be undertaken during the Detailed Design phase, for bridging the proposed access road (associated with the Newton-in-Bowland Compound) over Gamble Hole Farm Pasture. This

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
					would avoid the need for excavation and reduce potential direct impacts to highly sensitive habitats at the site. Spreading the load of heavy vehicles and plant along access areas should also be considered during the Detailed Design phase to reduce compaction effects. This would reduce potential impacts to habitats at Gamble Hole Farm Pasture and River Hodder North.
	Chemical (groundwater)	GWDTEs (non-designated)	Design iterations that have reduced the footprint of the Newton-in-Bowland Compound in the south, including the proposed access road, to minimise direct impacts as far as practicable. Construction of access tracks could lead to increase in sediment in the aquifers, and leaks of chemicals, fuels, and oils stored within the GWDTEs (Gamble Hole Farm Pasture, Dunsop Bridge Road, and River Hodder North). This could then lead to impacts on the GWDTEs' water quality. Adherence to industry good practice during construction would significantly reduce changes to groundwater quality, especially those relating to the treatment of surface water drainage (for example use of sediment traps, settlement ponds and buffer strips and adherence to the Pollution Incident Control Plan (or equivalent). Adherence to industry good practice and given the GWDTE sites are not designated, there would be no change in quality status	**Ribble Carboniferous Aquifers**	Stagger topsoil stripping activities, i.e. smaller sections at a time. Minimise footprint of topsoil stripping and vegetation clearance wherever possible. This would reduce the extent of potentially significant effects caused by this activity, but there is no specific mitigation possible to avoid direct habitat loss. Monitor suspended solids concentrations in the groundwater monitoring network pre, during and post-construction. Monitoring should start 12 months in advance of enabling or construction activity at the location, in order to gather baseline information. Monitoring could be achieved either using in-situ instruments or by sampling and laboratory analysis. Set trigger levels for suspended solids concentrations to identify work areas which may need additional mitigation if suspended solids concentrations exceed a pre-determined threshold value.

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
					Monitor weather forecasts, including rainfall / flood warnings and alerts to further reduce the likelihood of suspended solids entering the groundwater environment. A feasibility assessment should be undertaken during the Detailed Design phase, for bridging the proposed access road (associated with the Newton-in-Bowland Compound) over Gamble Hole Farm Pasture. This would avoid the need for excavation and reduce potential direct impacts to highly sensitive habitats at the site.
Site Compound	Biological	Macrophytes and phytobenthos (combined)	Mobilisation of fine sediment, as a result of exposure of bare earth surfaces from topsoil stripping, vegetation clearance, and earthworks could lead to a smothering of bed substate and changes in water quality (if fertilisers are present), whilst discharge of construction/surface water could also change flow dynamics (see assessment of Hydromorphology quality element for further detail on changes to bed substrate and flow conditions). Water quality could also be impacted by introduction of chemicals, fuels, and oils from construction activities being discharged to watercourses. This would directly affect Unnamed Watercourse 169 and Cod Gill, with potential indirect impacts on the downstream River Hindburn. As identified in the assessment of the Access Road activity, macrophyte and phytobenthos communities in the River Hindburn are sensitive to sedimentation. They are also likely to be sensitive to changes in water quality, which could result in mortality in some communities. Given the distance between the River Hindburn and the impacted watercourses (1 km), it is unlikely that impacts identified would spread to effect these communities, whilst adherence to industry good practice during construction, such as appropriate sediment management, chemical storage, and water treatment techniques, would also reduce the likelihood of fine sediment and chemicals entering the watercourses. Attenuation of water construction/surface water to (or near) greenfield runoff rates would also minimise any changes to flow conditions. Consequently, it is unlikely this activity would lead to a change in quality element status.	**Hindburn**	None required
			The potential impacts identified in the assessment of this activity for the Hindburn WFD surface water body are also relevant for this WFD surface water body. This would directly affect Unnamed Watercourse 384 and Unnamed Watercourse 385, with potential indirect impacts on the downstream River Hodder. As identified in the assessment of the Access Road activity, the macrophyte community in this WFD surface water body are likely to be relatively resilient to changes in sediment and nutrient conditions. Adherence to industry good practice during construction, such as appropriate sediment management, chemical storage, and water treatment techniques, would also reduce the likelihood of fine sediment and chemicals entering the watercourse. Attenuation of water construction/surface water to (or near) greenfield runoff rates would also minimise any changes to flow conditions. Consequently, it is unlikely this activity would lead to a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
		Macro-invertebrates	The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Macroinvertebrates quality element. This would directly affect Unnamed Watercourses 163, 169, and Cod Gill, with potential indirect impacts on the downstream River Hindburn. As identified in the assessment of the Access Road activity, macroinvertebrate communities in the River Hindburn are sensitive to impacts associated with sedimentation. Given the distance between the River Hindburn and the impacted watercourses (1 km), it is unlikely that impacts identified would spread to affect these communities. Attenuation of water construction/surface water to (or near) greenfield runoff rates would also minimise any changes to flow conditions. Further, adherence to industry good practice during construction, such as appropriate sediment management and water treatment techniques, would also reduce the likelihood of fine sediment and chemicals entering the watercourses. Consequently, it is unlikely this activity would lead to a change in quality element status.	**Hindburn**	None required
			The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Macroinvertebrates quality element. This would directly affect Unnamed Watercourses 384 and 385, with potential indirect impacts on the downstream River Hodder. As identified in the assessment of the Access Road activity, macroinvertebrate communities in the River Hodder are relatively resilient to impacts associated with sedimentation. Whilst impacts would occur on Unnamed Watercourse 384 and Unnamed Watercourse 385, it is possible that these impacts could propagate downstream, given the proximity of the River Hodder to the elements. Adherence to industry good practice during construction, such as appropriate sediment management, chemical storage, and water treatment techniques, would also reduce the likelihood of fine sediment and chemicals entering the watercourses. Attenuation of water construction/surface water to (or near) greenfield runoff rates would also minimise any changes to flow conditions. Consequently, it is unlikely this activity would lead to a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	
		Fish	The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Fish quality element. This would directly affect Unnamed Watercourses 163, and Cod Gill, with potential indirect impacts on the downstream River Hindburn. As identified in the assessment of the Access Road activity, fish communities in the River Hindburn are sensitive to sedimentation and habitat disturbance. They are also likely to be sensitive to changes in water quality, which could result in mortality and displacement of communities. The impacts identified would be localised and occur on tributaries which do not exhibit the same quality of physical habitat associated with the downstream River Hindburn, which is located approximately 1 km downstream of the impacted watercourses. Any sediment or pollutant likely to enter Unnamed Watercourses 163 and 169, or Cod Gill would be diluted enough to have negligible impact on fish communities within the River Hindburn. Consequently, it is unlikely this activity would lead to a change in quality element status.	**Hindburn**	**None required**
			The potential impacts identified in assessment of this activity for the Macrophytes and phytobenthos (combined) quality element are also relevant to the Fish quality element. This would directly affect Unnamed Watercourse 384 and Unnamed Watercourse 385, with potential indirect impacts on the downstream River Hodder. As identified in the assessment of the Access Road activity, fish communities in the River Hodder are sensitive to sedimentation and habitat disturbance. They are also likely to be sensitive to changes in water quality, which could result in mortality and displacement of communities. Whilst impacts would occur on Unnamed Watercourses 384 and Unnamed Watercourse 385 it is possible that these impacts could propagate downstream, given the proximity of the River Hodder to the activity. However, adherence to industry good practice during construction, such as appropriate sediment management, chemical storage, and water treatment techniques, would also reduce the likelihood of fine sediment and chemicals entering the watercourses. Attenuation of water construction/surface water to (or near) greenfield runoff rates would also minimise any changes to flow conditions. Consequently, it is unlikely this activity would lead to a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
	Hydro-morphological	Quantity and dynamics of water flow	Cod Gill would receive discharge from construction compounds at a maximum rate, following attenuation, of 6 l/s. Anticipated greenfield runoff rates for the Lower Houses Compound footprint is approximately 6.4 l/s, therefore the impact on this quality element would be negligible.	**Hindburn**	None required
			The River Hodder would receive discharge from construction compounds at a maximum rate, following attenuation, of 10 l/s. Anticipated greenfield runoff rates for the Newton-in-Bowland Compound footprint is approximately 9.7 l/s. This would not represent a significant deviation from baseline conditions and would therefore be unlikely to lead to a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	
		River continuity	The temporary outfall in Cod Gill would provide temporary and localised disruption to the lateral connectivity of the watercourse and its floodplain. However, disruption would not be sufficient to cause a change in quality element status.	**Hindburn**	None required
			Construction discharge to the River Hodder would use an existing asset (current overflow pipework), therefore there would not be a change from baseline conditions regarding this WFD quality element.	**Hodder – confluence Easington Brook to confluence Ribble**	
		River depth and width variation	The discharge of water from the Lower Houses Compound could cause localised bed and bank erosion of Cod Gill. However, as the channel was observed as being stable, and increase in flow is likely to be small (see assessment of Quantity and dynamics of water flow), any change to depth and width likely to be small and localised to the outfall. In addition to potential bed and bank scour, increased quantities of fine sediment (either from increased erosion or construction activities) supplied to the channel could lead to aggradation in Cod Gill. This would occur where flow dynamics already alter significantly e.g. around structures or at the confluence with other watercourses. The impacts identified would be managed by following industry good practice during construction, such as sensitive channel reinstatement and appropriate sediment management techniques, to prevent a change in quality element status.	**Hindburn**	None required
			The discharge of water from the Newton-in-Bowland Compound could lead to localised scour of the bed and banks of the River Hodder. The River Hodder at the point of discharge is wide enough that scour of the opposite bank would be unlikely, whilst entrainment of the coarse bed substrate would be unlikely to occur given the low volume of flow being discharged, relative to River Hodder flows (see assessment of the Commissioning activity for more information regarding River Hodder hydrology). Consequently, there would be no change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	
		Structure and substrate of the river bed	Topsoil stripping, vegetation clearance, and earthworks associated with the construction and use of the Lower Houses Compound could lead to silt laden runoff entering nearby watercourses (Unnamed Watercourse 163, Unnamed Watercourse 169, and Cod Gill, as well as the downstream River Hindburn). Scour caused by the discharge of water from temporary outfalls could alter the structure of the bed substrate in Cod Gill, removing any finer gravels present, whilst any increased incidence of scour (see River depth and width variation assessment) could create an additional fine sediment source. Any increase in fine sediment sources could smother coarser bed substrate, with the bedrock channels and coarse sediment features of Unnamed Watercourse 163 and the River Hindburn likely to be particularly sensitive to increased volumes of fine sediment. However, the distance between sensitive bedrock channels and the Lower Houses Compound (over 250 m downstream) would see the magnitude of this impact be reduced, as fine sediment volumes become diluted with increased flow, and opportunity for discrete deposition of fine sediment is increased. However, adherence to industry good practice during construction, such as treatment of attenuated water prior to discharge, use of silt fences, and positioning of stockpiles away from surface water flow paths, would mitigate any impacts likely to result in a change to quality element status.	**Hindburn**	None required
			Topsoil stripping, vegetation clearance, and earthworks associated with the construction and use of the Newton-in-Bowland Compound could lead to silt laden runoff entering nearby the watercourses (Unnamed Watercourse 384, Unnamed Watercourse 385, and the River Hodder). Significant bed scour (and therefore sediment entrainment and alteration of the bed substrate) from the discharge of construction water to the River Hodder would be unlikely (see River depth and width variation assessment). Increases in fine sediment supply could lead to the smothering of sensitive bed substrate and features (such as riffles and bars) in the River Hodder. However, the volumes fine sediment would be minimal where industry good practice during construction is followed, such as treatment of construction water prior to discharge, use of silt fences, and positioning of stockpiles away from surface water flow paths are implemented. Consequently, a change in quality element status would be unlikely.	**Hodder – confluence Easington Brook to confluence Ribble**	

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
		Structure of the riparian zone	The construction of the drainage outfall would require the removal of riparian vegetation and compaction of the right bank of Cod Gill. However, the scale of clearance required for outfall construction would be small when considered at a WFD water body scale, and therefore have negligible impact.	**Hindburn**	None required
			It is not anticipated that riparian vegetation removal would be required to accommodate the Newton-in-Bowland Compound on a scale which would be significant enough to cause a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	
	Quantitative (groundwater)	GWDTEs (non-designated)	Construction of the Lower Houses Compound would result in disruption to shallow groundwater flow for adjacent areas that would include GWDTEs Lower House Cottage and Park House Lane. Given that the GWDTE sites are not designated, impacts would not result in a change in quality element status. However, the areas are identified as GWDTEs, and mitigation would still be explored in order to avoid loss to a GWDTE.	**Lune and Wyre Carboniferous Aquifers**	Minimise footprint of topsoil stripping and vegetation clearance wherever possible. This would reduce the extent of potentially significant effects caused by this activity, but there is no specific mitigation possible to avoid direct habitat loss.
			Design iterations that have reduced the footprint of the Newton-in-Bowland Compound in the south, including the proposed access road, which has been re-designed to minimise direct impacts as much as feasibly possible. Construction of the Newton-in-Bowland compound across one GWDTE (Gamble Hole Farm Pasture) would result in direct loss to the GWDTE, and disruption to shallow groundwater flow for adjacent areas including the Coach House GWDTE northwest of the compound. Given that the GWDTE sites do not have a statutory designation, impacts would not result in a change in quality element status. However, the areas are identified as GWDTEs, and mitigation would still be explored in order to avoid loss to a GWDTE.	**Ribble Carboniferous Aquifers**	Minimise footprint of topsoil stripping and vegetation clearance wherever possible. This would reduce the extent of potentially significant effects caused by this activity, but there is no specific mitigation possible to avoid direct habitat loss. During the Detailed Design phase, opportunities for hydroecological compensation should be explored to offset short and long-term impacts expected to habitats at Gamble Hole Farm Pasture, including for e.g. outline habitat creation, enhancement and management proposals
	Chemical (groundwater)	GWDTEs (non-designated)	Construction of site compounds could lead to increase in sediment in the aquifers, and leaks of chemicals, fuels, and oils stored in the compounds affecting adjacent GWDTEs (Lower House Cottage and Park House Lane). This could lead to impacts on the GWDTEs' water quality, although measures outlined in the CCoP would significantly reduce changes to groundwater quality at a WFD water body scale. Adherence to industry good practice during construction would significantly reduce changes to groundwater quality, especially those relating to the treatment of surface water drainage (for example use of sediment traps, settlement ponds and buffer strips and adherence to the Pollution Incident Control Plan (or equivalent). Adherence to industry good practice and given the GWDTE sites are not designated, there would be no change in quality status	**Lune and Wyre Carboniferous Aquifers**	Stagger topsoil stripping activities, i.e. smaller sections at a time rather than the whole compound footprint as this would limit the concentration of suspended solids and associated solutes entering the aquifer(s) and would reduce peak contaminant concentrations. Minimise footprint of topsoil stripping and vegetation clearance wherever possible.

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
					This would reduce the extent of potentially significant effects caused by this activity, but there is no specific mitigation possible to avoid direct habitat loss. Monitor suspended solids concentrations in the groundwater monitoring network pre, during and post-construction. Monitoring should start 12 months in advance of enabling or construction activity at the location, in order to gather baseline information. Monitoring could be achieved either using in-situ instruments or by sampling and laboratory analysis. Set trigger levels for suspended solids concentrations to identify work areas which may need additional mitigation if suspended solids concentrations exceed a pre-determined threshold value. Monitor weather forecasts, including rainfall / flood warnings and alerts to further reduce the likelihood of suspended solids entering the groundwater environment.
			Construction of site compounds could lead to increase in sediment in the aquifers, and leaks of chemicals, fuels, and oils stored in the compounds within the GWDTEs (Gamble Hole Farm Pasture and Coach House). This could lead to impacts on the GWDTEs' water quality, although measures outlined in the CCoP would significantly reduce changes to groundwater quality at a WFD water body scale. Adherence to industry good practice during construction would significantly reduce changes to groundwater quality, especially those relating to the treatment of surface water drainage (for example use of sediment traps, settlement ponds and buffer strips and adherence to the Pollution Incident Control Plan (or equivalent). Adherence to industry good practice and given the GWDTE sites are not designated, there would be no change in quality status	**Ribble Carboniferous Aquifers**	Stagger topsoil stripping activities, i.e. smaller sections at a time rather than the whole compound footprint as this would limit the concentration of suspended solids and associated solutes entering the aquifer(s) and would reduce peak contaminant concentrations. Minimise footprint of topsoil stripping and vegetation clearance wherever possible.

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
					This would reduce the extent of potentially significant effects caused by this activity, but there is no specific mitigation possible to avoid direct habitat loss. Monitor suspended solids concentrations in the groundwater monitoring network pre, during and post-construction. Monitoring should start 12 months in advance of enabling or construction activity at the location, in order to gather baseline information. Monitoring could be achieved either using in-situ instruments or by sampling and laboratory analysis. Set trigger levels for suspended solids concentrations to identify work areas which may need additional mitigation if suspended solids concentrations exceed a pre-determined threshold value. Monitor weather forecasts, including rainfall / flood warnings and alerts to further reduce the likelihood of suspended solids entering the groundwater environment.
Tunnel (including the shaft and portal)	Quantitative (groundwater)	Water balance	Initial estimations suggest that construction of the tunnel by tunnel boring machine would result in little loss of groundwater from the bedrock aquifer. The modelled average inflow for the proposed Bowland section is 1.55 l/s, with the likelihood that there would be short duration spikes in inflow (approximately 5 l/s for up to a week, and approximately 30 l/s for up to 36 hours). Therefore, groundwater disturbance within the bedrock would be expected to be minor and localised, and short lived. As a result, any changes to the water balance would be expected to be negligible at the scale of the groundwater body. Dewatering would be required for the construction of the shaft and portal at each end of the tunnel. The maximum estimated inflows, with the shaft and portal at their design total depth, but before they are sealed, would be 530 l/day for the Lower Houses Shaft and 21,000 l/day for the Newton-in-Bowland Portal. Inflows for the Lower Houses Shaft are well below the Environment Agency's groundwater abstraction licencing threshold, and consequently it would be exempt from licensing.	**Lune and Wyre Carboniferous Aquifers**	None required

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
			Estimated inflows for the Newton-in-Bowland Portal are marginally above the abstraction licensing threshold, therefore a licence would be required. Due to the scale of the aquifer, the magnitude of impact from this temporary dewatering at the Newton-in-Bowland Portal, on the bedrock aquifer is expected to be minor. Therefore, the scale of groundwater disturbance would be expected to be relatively small and short lived. As a result, any changes to the water balance would be expected to be minor at a WFD groundwater body scale for the portal, and negligible for the shaft, resulting in no change in quality element status. **Post-construction** Given the proposed shaft design diameter (15 m) and depth (10.5 mbgl) of the proposed Lower Houses shaft, permanent groundwater disturbances would be expected to be negligible. As a result, any impact would be expected to be negligible for both superficial and bedrock aquifers. Given the Proposed Bowland Tunnel design depth and dimensions (diameter of 3 m), and the fact the tunnel would be sealed, permanent groundwater disturbances would be expected to be negligible at the scale of the bedrock aquifer.	**Ribble Carboniferous Aquifers**	
		GWDTEs (non-designated)	Due to the depth of the proposed tunnel and the construction technique generating very limited groundwater dewatering, the construction of the tunnel itself would not impact on GWDTEs. The portal for the Newton-in-Bowland Compound is located within Gamble Hole Farm Pasture GWDTE. The estimated dewatering zone of influence is 73 m. Whilst groundwater disturbance within the superficial deposits and bedrock would be expected to be localised, there is potential for a significant effect on the GWDTE. Given that the GWDTE site does not have a statutory designation, impacts would not result in a change in quality element status. However, the area is identified as a GWDTE, and mitigation should still be explored, with any mitigation located as close to the site as possible, and be determined by species/habitat loss wherever feasible. **Post-construction** The portal excavation would need to be backfilled with arisings or a granular bedding material. Depending on the nature of the backfill material, a preferential groundwater flow path or barrier to groundwater flow could be created. Within the centre and east of the site, there could be minor but localised, permanent impacts on groundwater flows, propagating downgradient from the portal. No permanent impacts are expected in the west of the site. The scale of the impacts is likely to be such that there would be no change in quality element status.	**Ribble Carboniferous Aquifers**	Reduce dewatering durations to encourage greater chance of vegetation recovery.
	Chemical (groundwater)	GWDTEs (non-designated)	Construction of the Newton-in-Bowland Portal adjacent to the Gamble Hole Farm Pasture GWDTE has the potential to mobilise sediment which could discharge into the GWDTE. This would impact on the GWDTE's water quality, which would require additional measures to mitigate. Given that the GWDTE site does not have a statutory designation, impacts would not result in a deterioration of the groundwater body status. However, the area is identified as a GWDTE, and mitigation should still be explored, with any mitigation located as close to the site as possible and be determined by species/habitat loss wherever feasible.	**Ribble Carboniferous Aquifers**	Monitor suspended solids concentrations in the groundwater monitoring network pre, during and post-construction. Monitoring should start 12 months in advance of enabling or construction activity at the location, in order to gather baseline information. Monitoring could be achieved either using in-situ instruments or by sampling and laboratory analysis. Set trigger levels for suspended solids concentrations to identify work areas which may need additional mitigation if suspended solids concentrations exceed a pre-determined threshold value.

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
Open-cut trenches	Quantitative (groundwater)	Water balance	Dewatering would be required for the construction of the open cut trench for the construction of connections to the existing aqueduct and overflow structures. Excavations would not exceed 5 m depth, and dewatering is expected to a create zone of influence of 25 m. Abstraction rates would be relatively small, and as a result, any changes to the water balance would be expected to be negligible at a WFD groundwater body scale. The connections and overflow pipes are expected in the long term to have very limited and localised effects on groundwater flows. This would have a negligible effect at a WFD groundwater body scale and would not result in a change in quality element status.	**Lune and Wyre Carboniferous Aquifers and Ribble Carboniferous Aquifers**	None required
		GWDTEs (non-designated)	Dewatering would be required for the construction of open cut trenches for the construction of connections to the existing aqueduct. Excavations would not exceed 5 m depth, and dewatering is expected to create a zone of influence of 25 m. The open cut connection for the Lower Houses Compound is located in proximity to Lower House Cottage GWDTE. However, the site lies 20 m downgradient of the estimated zone of influence for this activity. Consequently, the impact on groundwater flows supporting GWDTEs at the site would be negligible, with any groundwater flow disturbances equilibrating upgradient of the site boundary. No change in quality element status is anticipated.	**Lune and Wyre Carboniferous Aquifers**	None required
			Dewatering would be required for the construction of the open cut trench for the construction of connections to the existing aqueduct and overflow structures. Excavations would not exceed 5 m depth, and dewatering is expected to create a zone of influence of 25 m. The open cut connection and overflow excavations for the Newton-in-Bowland Compound is located within Gamble Hole Farm Pasture GWDTE. Groundwater disturbance within the superficial deposits and bedrock during construction would be localised and short lived. There could be a potential longer-term impact to the GWDTE due to backfilling of the trench acting as a preferential pathway or barrier to flow, depending on the materials used as backfill. **Post-construction** Excavations for the multi-line and overflow connections, would need to be backfilled with arisings or a granular bedding material. Depending on the nature of the backfill material, a permanent preferential groundwater flow path or barrier to groundwater flow could be created. Since the southeast corner of the site falls directly within the footprint of the multi-line connection excavation, a moderate adverse impact on groundwater flows and levels in this part of the site is predicted. Elsewhere, within the centre and east of the site, there may be minor but localised impacts on groundwater flows, propagating downgradient from the connection areas. No permanent impacts are expected in the west of the site. Given that the GWDTE site does not have a statutory designation, impacts would not result in a change in quality element status. However, the area is identified as a GWDTE, and mitigation should still be explored, with any mitigation located as close to the site as possible and be determined by species/habitat loss wherever feasible.	**Ribble Carboniferous Aquifers**	Keep dewatering durations to minimum required to encourage greater chance of vegetation recovery. Use clay bunds when back-filling open cut trenches to reduce disruption to groundwater flow.
	Chemical (groundwater)	GWDTEs (non-designated)	Construction of the open cut trenches within close proximity to Lower House Cottage GWDTE has the potential to mobilise sediment which could discharge to the GWDTE. However, any potential impact on the GWDTE would be negligible which, in addition to the lack of statutory designation, would not result in a change in quality element status.	**Lune and Wyre Carboniferous Aquifers**	None required
			Construction of the open cut trenches within Gamble Hole Farm Pasture GWDTE have the potential to mobilise sediment which could discharge to the GWDTE. This would impact on the GWDTE's water quality, which would require additional measures to mitigate. Given that the GWDTE site does not have a statutory designation, impacts would not result in a change in quality element status. However, the area is identified as a GWDTE, and mitigation should still be explored, with any mitigation located as close to the site as possible and be determined by species/habitat loss wherever feasible.	**Ribble Carboniferous Aquifers**	Monitor suspended solids concentrations in the groundwater monitoring network pre, during and post-construction. Monitoring should start 12 months in advance of enabling or construction activity at the location, in order to gather baseline information. Monitoring could be achieved either using in-situ instruments or by sampling and laboratory analysis.

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
					Set trigger levels for suspended solids concentrations to identify work areas which may need additional mitigation if suspended solids concentrations exceed a pre-determined threshold value.
Commissioning	Hydro-morphological	River depth and width variation	Potential for channel adjustment through erosion of the bed and/or banks as a result of the 25 l/s commissioning discharge. Whilst Cod Gill was observed as being largely stable, commissioning flows could be large enough to trigger new erosive processes, especially where they interact with the culvert located immediately downstream of the outfall. This could lead to a long-term destabilisation of the channel, damage to the culvert, and change in channel dimensions. Similar impacts would also be expected to occur at the confluence with the River Hindburn (900 m downstream).	**Hindburn**	Monitoring plan during commissioning discharges of the receiving watercourses, including an adaptive management strategy should erosion or other channel change be noted
			There would be a negligible change in flow regime on the River Hodder during the discharge of commissioning flows, with stream power increasing by approximately 0.3 W/m^2. Consequently, any significant change in quality element status would be unlikely.	**Hodder – confluence Easington Brook to confluence Ribble**	None required
		Structure and substrate of the river bed	Increased flow during commissioning could mobilise existing fine sediment in Cod Gill, as well as adding new sources of fine sediment through bank erosion (see assessment of River depth and width variation). This could lead to a smothering of morphological features present on both Cod Gill and the downstream River Hindburn. Increased flow could also lead to gravels in Cod Gill becoming entrained, potentially homogenising the reach immediately downstream of the outfall.	**Hindburn**	Monitoring plan during commissioning discharges of the receiving watercourses, including an adaptive management strategy should erosion or other channel change be noted
			Sediment entrainment analysis suggests that the size (and therefore potentially volume) of sediment capable of being transported by the River Hodder would not increase during commissioning. Consequently, any significant change in quality element status would be unlikely.	**Hodder – confluence Easington Brook to confluence Ribble**	None required
Operational					
Overflow	Biological	Macrophytes and phytobenthos (combined) Macro-invertebrates Fish	No water quality data related to groundwater ingress are available, which could contain unknown levels of pollutants/contaminants from either natural or other sources (e.g. historical mines). Change in water quality (e.g. pH levels), could lead to mortality in the communities present, whilst discharge of considerable amounts of water (135 l/s) could cause loss of habitat and increase in turbidity levels. As identified in the assessment of the Access Road activity, macrophyte, macroinvertebrate and fish communities in the River Hodder are sensitive to changes in water quality, with biological indicators and physico-chemical quality element baseline information suggesting quality of water is currently of high quality. If groundwater ingress were to change pH, nitrous or dissolved oxygen levels in the River Hodder, community compositions could change, mortality rates could increase, and health (quality and quantity) of fish populations reduce. Bed and near-bank habitat could also be disrupted (see assessment of Hydromorphology quality element for further detail on changes to bed substrate and flow conditions). Given the sensitivity of the biological communities present and the uncertainty surrounding changes to water quality (see assessment of Physico-chemical quality elements for further detail) it is possible that this activity could lead to changes in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	The potential impacts arising from the discharge of groundwater ingress are largely associated with the unknown quality of the water. To mitigate for this a water quality monitoring programme would be required to understand the baseline quality of groundwater ingress and monitor change over time. The monitoring programme would be supported by an adaptive management strategy, to enable timely response in the event that contaminants/pollutants are detected in quantities that would impact on biological

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
					WFD quality elements of the Hodder -confluence Easington Brook to confluence Ribble WFD surface body
	Physico-chemical	pH	No water quality data related to groundwater ingress are available, with unknown levels of pollutants/contaminants possibly entering the aqueduct once decommissioned, either from natural or other sources (e.g. historical mines). This could alter current pH levels, and in turn disrupt established macroinvertebrate and macrophyte communities (see Biological quality element assessments for additional detail). Given the unknown physico-chemical quality of the groundwater ingress being discharged, it is not possible to discount a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	The potential impacts arising from the discharge of groundwater ingress are largely associated with the unknown quality of the water. To mitigate for this a water quality monitoring programme would be required to understand the baseline quality of groundwater ingress and monitor any change over time. The monitoring programme would be supported by an adaptive management strategy, to enable timely response in the event that contaminants/pollutants are detected in quantities that would impact on physico-chemical WFD quality elements of the Hodder - confluence Easington Brook to confluence Ribble WFD surface body.
		Ammonia (total as N) and phosphate	No water quality data related to groundwater ingress are available, with unknown levels of pollutants/contaminants possibly entering the aqueduct once decommissioned, either from natural or other sources (e.g. agricultural practices). If groundwater contains high levels of ammonia and phosphate this could alter the nutrient balance within the River Hodder. This could promote excessive growth of algae and aquatic flora, with further impacts on dissolved oxygen levels (levels fluctuating due to photosynthesis/respiration), and disruption of established communities of aquatic fauna and flora. Increased levels of nitrogen could also lead to fish mortality (see Fish quality element assessments for additional detail) Given the unknown physico-chemical quality of the groundwater ingress being discharged, it is not possible to discount a change in quality element status.		
		Dissolved oxygen	No water quality data related to groundwater ingress are available, with unknown levels of pollutants/contaminants possibly entering the aqueduct once decommissioned, either from natural or other sources (e.g. historical mines). Dissolved oxygen levels would be indirectly impacted if there are elevated levels of ammonia/phosphate in the groundwater being discharged (see Ammonia (total as N), and phosphate quality element assessment for additional detail) Given the unknown physico-chemical quality of the groundwater ingress being discharged, it is not possible to discount a change in quality element status.		
		Temperature	No water quality data related to groundwater ingress are available, with unknown levels of pollutants/contaminants possibly entering the aqueduct once decommissioned, either from natural or other sources (e.g. historical mines). If the groundwater being discharged varies significantly in temperature from water in the River Hodder, local changes in temperature would occur. This could result in disruption of seasonal water temperature variations, influence other water quality parameters (e.g. dissolved oxygen levels), or cause stress to local fish populations. Given the unknown physico-chemical quality of the groundwater ingress being discharged, it is not possible to discount a change in quality element status.		
	Hydro-morphological	Quantity and dynamics of water flow	It is anticipated that groundwater ingress would be continuously discharged from an existing outfall (located approximately 5 m above the toe on the right bank) to the River Hodder at a rate of approximately 135 l/s. This would equate to approximately: ▪ 25% increase in Q95 flow ▪ 8% increase in Q50 flow ▪ 0.1% increase in Qmed (bankfull) flow. Local and downstream flow dynamics would therefore be impacted, although this would only likely be noticeable during low magnitude flow events e.g. Q95. The frequency with which flow events are encountered would not change i.e. the present Q70 flow would not become the new Q95 flow. Specific stream power during Qmed flows has been calculated as 215 W/m^2, which would increase to 215.4 W/m^2 with the discharge of groundwater ingress. Therefore, whilst there would be an increase in flow volumes, there would be unlikely to be a change in quality element status at a WFD surface water body scale.	**Hodder – confluence Easington Brook to confluence Ribble**	None required

Activity	WFD Quality Element		Potential Impacts	Relevant WFD Water Body	Additional Mitigation Required
		River depth and width variation Structure and substrate of the river bed	Whilst the increase in flow and stream power are small when considered volumetrically/at a catchment scale (see Quantity and dynamics of water flow quality element assessment for additional detail), the manner with which groundwater ingress would be discharged i.e. from a single point several meters above the toe of the bank, would encourage scour of the river bed and banks. *Bed scour/change in substrate* The discharge of water from height would see the outfall acting in a manner analogous to a waterfall, which would cause a scour hole to form below. The channel is relatively shallow at this location, with a riffle located at the site of the outfall. Discharge at this location would cause entrainment of some/all the material that makes up the riffle, which are a relatively rare feature along this reach of the River Hodder. The channel would also end up deepening, which would represent a significant departure from current conditions. It is also possible that the scour hole may propagate upstream, causing further destabilisation of the channel, and disruption of fluvial features such as riffles and bars. The scour hole may also trigger bank destabilisation depending on where it forms, and how it shifts over time. *Bank scour* The reach of the River Hodder where the outfall is present was observed as having potential for lateral adjustment, with the banks upstream showing evidence of scour. Weakening of the bank structure through the discharge of groundwater ingress could trigger erosive processes in the vicinity of the outfall. These processes would be exacerbated by the outfall (and therefore scour) being located on the outside of a meander bend. This could lead to bank failure, which may in turn lead to the undermining of the outfall and adjacent pipe bridge abutments. Depending on how far water is projected into the channel from the outfall, it is possible that the left (opposite) bank could be impacted as well as/instead of the right bank Given the potential for destabilisation of the reach, and change in bed substrate, discharge of groundwater ingress would result in a change in quality element status.	**Hodder – confluence Easington Brook to confluence Ribble**	This should be undertaken on a monthly basis for the first 12 months following commencement of discharge, then on an 'as required' basis. Review of the need for monitoring should be carried out after five years in consultation with the Environment Agency."Formation of an adaptive management plan would also be required, which would be activated once predefined conditions are met.
	Quantitative (groundwater)	Water balance	Modelling of groundwater ingress to the decommissioned existing tunnel has predicted ingress rates of 75 to 139.5 l/s for the entire existing Bowland tunnel section, which is about 16.5 km long, equating to an ingress rate of 4.56E-03 to 8.457E-03 l/s/m. This represents a permanent, yet small, dewatering rate which when considered at a WFD groundwater body scale, therefore, there would be unlikely to be a change in quality element status.	**Lune and Wyre Carboniferous Aquifers and Ribble Carboniferous Aquifers**	None required

5.2 Review of WFD Specific Mitigation Measures

34) Within each RBMP, there is a list of mitigation measures or environmental improvements specifically for HMWBs, which have been identified for implementation by a specified date for the UK to meet the target date set by the WFD. Part of the a WFD compliance assessment is to consider these WFD specific mitigation measures and assess whether the Proposed Bowland Section can contribute to them, or prevent any of them from being delivered. None of the WFD water bodies covered by this assessment are A/HMWBs, therefore there are no mitigation measures to assess.

5.3 Cumulative Assessment with other Proposed Developments

35) Future planned developments (approved and pending planning decisions) have been screened to determine whether there would likely be any cumulative effects when considered in conjunction with the Proposed Bowland Section. The closest planned developments would occur at least 4.5 km from the Proposed Bowland Section red line boundary; therefore, it is unlikely that there would be any cumulative effects on WFD surface water quality elements.

36) The Proposed Bowland Section would interact with the Hodder – confluence Easington Brook to confluence Ribble WFD Surface Water Body, which also interacts with the Proposed Marl Hill Section of HARP. It is not anticipated that there would be any cumulative/intra-development impacts which would cause either development to be non-compliant.

5.4 Compliance with WFD Objectives

37) Table 5.3 provides a summary of the compliance of the Proposed Bowland Section against the WFD objectives outlined in Section 1.2. In summary, it is considered that at a WFD water body scale the Proposed Bowland Section would be compliant for all WFD water bodies assessed.

Table 5.1: Compliance with the environmental objectives of the Water Environment Regulations

Environmental Objective	Conclusions For The Proposed Bowland Section	Compliant With The Regulations
No changes affecting high status sites	Not applicable – no high-status water bodies present.	Yes
No changes that would cause failure to meet surface water Good Ecological Status or Potential or result in a deterioration of surface water Ecological Status or Potential	The Proposed Bowland Section as outlined would not cause deterioration in the status of any water body, but this needs to be confirmed.	Yes
No changes which would permanently prevent or compromise the Environmental Objectives being met in other water bodies	The Proposed Bowland Section would not cause a permanent exclusion or compromise achieving the objectives in other bodies of water within the same River Basin District.	Yes
No changes that would cause failure to meet good groundwater status or result in a deterioration of groundwater status.	The Proposed Bowland Section would not cause deterioration in the status of any groundwater body.	Yes, as whilst some GWDTEs would be significantly impacted, there are no statutory designations attached to them (SAC or SSSI). Consequently, there would be no grounds for deterioration in the quality element status at a WFD scale. However, local impacts would be considered by the Environmental Statement.