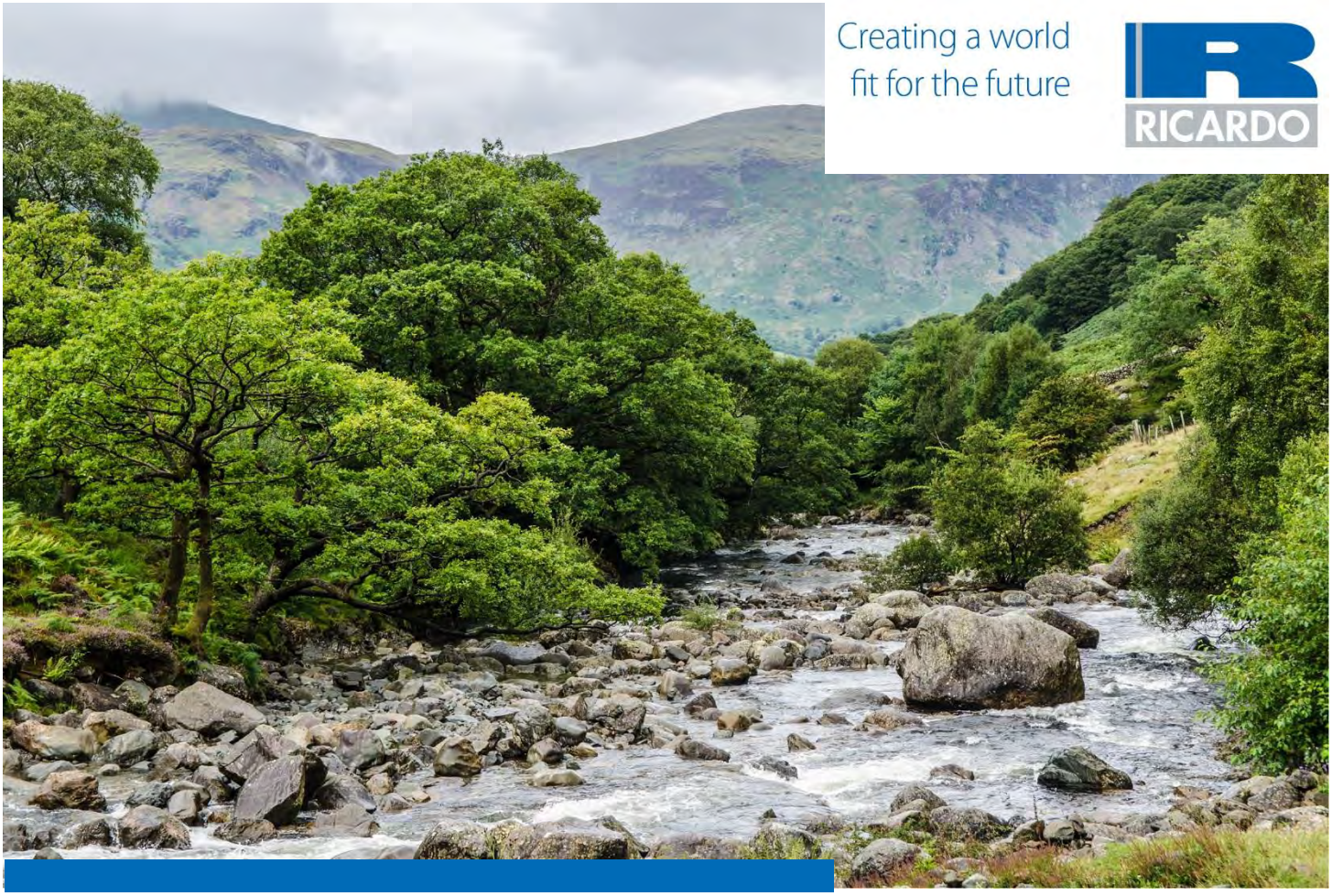

Haweswater Aqueduct Resilience Programme

Bowland Environmental Statement

Technical Appendix 9B.1:

Aquatic Ecology Baseline

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Ricardo is certified to ISO9001, ISO14001, ISO27001 and ISO45001

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1 Introduction

This report is a technical appendix to Chapter 9B Aquatic Ecology of the HARP Proposed Bowland Section Environmental Statement. The purpose of the report is to identify within the Proposed Bowland Section study area the presence of designated sites, the baseline condition of the aquatic ecology communities which inform the Water Framework Directive (WFD) status of the watercourses in the study area, and the presence of protected or notable species to inform the Ecological Impact Assessment (EcIA) and the associated mitigation strategy presented in Chapter 9B Aquatic Ecology.

This report presents baseline ecological data collated from a desk study of existing ecological data, walkover surveys, and white clawed crayfish surveys of watercourses within the Proposed Bowland Section study area.

2 Methodology

2.1 Desk study

The MAGIC website mapping tool was used to help identify any statutory or non-statutory designated sites for freshwater fish, macrophyte and aquatic macroinvertebrate species within the Proposed Docker Section study area.

In addition, ecological datasets for the period 2005 – 2018 were obtained via the Environment Agency Ecology and Fish Data Explorer website[1], this data included:

- National Fish Populations Database (NFPD): Freshwater Fish Counts for all Species for all Areas and all years. NFPD consists of information collected from fisheries monitoring work on rivers and lakes. This monitoring work is undertaken by the Environment Agency.
- Data for freshwater and marine biological surveys for macroinvertebrates, diatoms and macrophytes in England. The Environment Agency undertakes freshwater and marine biological monitoring in England. Freshwater and Marine Biological Surveys England is a large dataset containing taxonomic level species data for biological surveys carried out in freshwater and marine environments. This archive is more commonly known as BIOSYS.

These data were analysed in order to

- Identify important migratory pathways for diadromous fish species;
- Identify important spawning and nursery habitat for protected and notable species;
- Identify the location of protected and notable macrophyte and macroinvertebrate species in relation to the proposed development; and
- Identify important habitats that support key macrophyte and macroinvertebrate communities.

Several macrophyte species are known to be good indicators of water chemistry, habitat disturbance and seasonal changes in flow and have been used as a biological method to assess the trophic status of rivers and streams in the UK, including the impact of eutrophication and flow. They were selected for this method because:

- their species composition can change with increased nutrient concentrations;
- the changes in macrophyte community can be highly visible and may be deemed ‘undesirable’;
- most species recorded for the surveys are readily identifiable with the naked eye; and
- the rooted nature of many species means that any absence or presence of species is significant.

The UKTAG Fisheries Classification Scheme 2 (FCS2)[2] is used to assess the status of fish fauna (the WFD ‘Fish’ element) in rivers in England and Wales. Electric fishing data is inputted into a model which compares this observed data with the predicted fish assemblage for the river type given site location and four environmental variables (altitude, distance to tidal limit, mean wetted width and survey area). The site is then classified based on how the site performs against the predicted fish assemblage.

[1] Environment Agency Ecology and Fish Data Explorer website https://environment.data.gov.uk/ecology-fish/. Accessed 17 April 2020
[2] Available from: http://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/river%20fish.pdf

Records of white clawed crayfish (*Austropotamobius pallipes*) supplied by Lancashire Environmental Records Centre (LERC) were reviewed for within 2 km of the Proposed Bowland Section.

2.2 Watercourse walkover surveys

Walk-over habitat surveys were undertaken in April 2020 for watercourses within 500m of the Lower Houses Compound (tunnelling launch site) and Newton-in-Bowland Compound (tunnelling receptor site) which contain open cut sections, construction compounds, and an access track.

The walk-over habitat survey methodology was based on the Environment Agency's 'Restoration of Riverine Salmon Habitats' guidance manual[3]. The 'Hendry & Cragg-Hine' method was developed to be used to inform habitat restoration, fish survey site selection, and fish population studies.

The main objective walk-over survey was to obtain a detailed representation of the location, extent, and condition of habitat features along and surrounding a watercourse. This was done by walking the riverbank of the selected survey stretch and entering the river when necessary. The habitats and features were mapped using Esri ARC GIS and are presented in **Annex 1** to this appendix. The habitats and features recorded during the walk-over surveys included:

- Flow type
- Water depth
- Flow velocity (estimate of surface velocity)
- Substrate composition
- Species specific habitats
- Obstructions
- Macrophytes – estimated percentage cover for:
    - submerged macrophytes
    - emergent macrophytes
    - filamentous algae
    - Macrophyte choked channel
- Other features:
    - Coarse woody material
    - Debris dam
    - Bankside roots (target note)
    - Undercut bank (line along bank)
    - Overhanging terrestrial vegetation
    - Shading.

Incidental findings were also recorded during the walk-over surveys including Invasive Non-native Species (INNS), pollution sources, field boundaries, land use, and bank modifications.

2.3 White clawed-crayfish surveys

In order to establish if white clawed crayfish could be present in waterbodies within the zone of influence surveys were undertaken in 2019 and 2020.

An initial habitat assessment was undertaken as part of the Extended Phase 1 survey to determine the requirement for detailed white clawed crayfish surveys. The Extended Phase 1 survey of the Bowland scheme is presented in Phase 1 Technical Appendix 9A.2 (LCC_RVBC-BO-TA-009-01-002) to Chapter 9A of the Bowland Environmental Statement.

[3] Hendry & Cragg-Hine (1997) http://www.apemltd.co.uk/wp-content/uploads/2016/08/Restoration-of-Riverine-Salmon-Habitats-A-Guidance-Manual.pdf

Water courses with suitable habitat to support white clawed crayfish were subject to surveys to determine presence/likely absence in 2019 by Bowland Ecology the full results of these surveys are presented in **Annex 2** of this appendix and are summarised in Section 3.3.1. Following changes to the Proposed Bowland Section scheme design additional watercourses were surveyed for white clawed crayfish by Ricardo Energy & Environment in 2020, and the results of these surveys are presented in Section 3.3.1.

Water courses surveyed for white clawed crayfish in 2019 presented in this report:

- Cod Gill
- Unnamed Watercourse 169
- Unnamed Watercourse 178
- Unnamed Watercourse 186
- Unnamed Watercourse 384

Water courses surveyed for white clawed crayfish in 2020:

- River Hodder

The surveys followed the methodology within Survey and Monitoring Protocol for white clawed crayfish[4]. This comprised manual searching by carefully lifting suitable stones and debris on the channel bed which crayfish may use as refuge sites. Initially 100 refugia were searched within a 50 m stretch of riverbed. If five or more crayfish were observed (and captured) searching ceased. If fewer than five crayfish were observed, searching continued to 250 refugia. Refuge searching took place in an upstream direction to avoid poor visibility caused by disturbing silt/sediment. All crayfish captured were identified to species level, sexed, checked for signs of disease or injury and their carapace length (mm) recorded. A record of the approximate size/age class of crayfish observed but not captured was also made.

2.3.1 Weather conditions and survey dates

The weather conditions and survey dates for the white clawed crayfish surveys are shown below in **Table 2.1** for surveys in 2019 and in **Table 2.2** for surveys in 2020.

Table 2.1: Dates and weather conditions for white clawed crayfish surveys in 2019

Survey Date	Cloud cover	Wind speed (Beaufort scale) and direction	Temperature (°C)	Precipitation
25/09/2019	8/8	F1	14°C	No precipitation

Table 2.2: Dates and weather conditions for white clawed crayfish surveys in 2020

Survey Date	Description
29/04/2020	Weather conditions during the survey were 11°C, dry with sunny spells and a light breeze. The survey was undertaken following a prolonged dry spell meaning water levels were low and water visibility excellent.

2.4 Study Limitations

The absence of desk study records cannot be relied upon to infer absence of a species/habitat. Often, the absence of records is a result of under-recording within the given search area.

The white clawed crayfish surveys in 2019 were undertaken following a period of heavy rain. As a result, whilst the weather conditions were suitable for undertaking the surveys, the watercourse conditions were sub-optimal with evidence of recent flooding/high water events.

In some cases, watercourses surveyed were considered to be sub-optimal for white-clawed crayfish due to fast flow of water or limited number of refuges available. This could be considered a constraint to the survey. In this case the fast flow is noted in the results section and all suitable refuges were searched.

[4] Peay S (2003). Monitoring the White-clawed Crayfish *Austropotamobius pallipes*. Conserving Natura 2000 Rivers Monitoring Series No.1, English Nature, Peterborough.

3 Baseline Conditions

3.1 Designated sites

No statutory designated sites that are designated for aquatic habitats or species were identified within the zone of influence of the Proposed Bowland Section. A total of three Biological Heritage Sites (BHS) which contain aquatic ecology receptors were identified within 2 km from the Proposed Bowland Section. No other non-statutory wildlife sites of conservation interest for aquatic ecology receptors were identified within the study area.

Table 3B.1: Designated sites – aquatic ecology

Wildlife Site	Proximity to Proposed Marl Hill Section and Site Area	Summary Features	Relevant watercourse
Non-Statutorily Designated Wildlife Sites Within 2 km of the Proposed Marl Hill Section			
Gamble Hole Farm Pasture BHS	Within Newton-in-Bowland Compound 2.5 ha	The site comprises an area of wet, semi-natural, neutral grassland with springs and flushes situated approximately 1 km west of the village of Newton. It lies on the lower slopes of a pasture adjoining Heaning Brook and supports a rich variety of plants characteristic of unimproved ancient grassland and flush systems. Lowland hay meadow (which includes species-rich neutral grassland) and swamp and fen are priority habitats.	Unnamed Watercourse 384 (W461)
River Hodder From Confluence with River Ribble Upstream to Cross of Greet Bridge/ Bowland Fells SSSI Boundary BHS	Crossed by Newton-in-Bowland Compound (construction access) 94.9 ha	The site comprises almost the entire length of the River Hodder. The river is important for otter and supports salmon, brown trout, sea trout, bullhead, dace and stone loach. Sandpipers and oystercatchers are associated with areas of shingle. Three species included in the Provisional Lancashire Red Data List of Vascular Plants are present along the riverside, namely yellow star-of-Bethlehem (*Gagea lutea*), green figwort (*Scrophularia umbrosa*) and melancholy thistle (*Cirsium heterophyllum*). Many of the river's banks are lined by woodland or individual trees and shrubs.	River Hodder (W477)
River Hindburn BHS	0.56 km east from the Lower Houses Compound 13.6 ha	The site covers 13.59 ha of the River Hindburn.	River Hindburn (W478)

3.2 Water Framework Directive (WFD) communities and status

3.2.1 Macrophytes

Available Environment Agency macrophyte monitoring data (2000-2020) have been reviewed for the relevant reaches of the River Hindburn (Northern extent of Proposed Bowland Section) and the River Hodder (Southern extent of Proposed Bowland Section). The WFD waterbody GB112072066050 (Hindburn) classifies as 'Good' for combined macrophytes and diatoms in 2016, Cycle 2. The WFD waterbody GB112071065560 (Hodder – conf Easington Bk to conf Ribble) classifies as 'Good' for combined macrophytes and diatoms in 2016, Cycle 2. Data to inform the baseline conditions for the macrophyte and diatom communities was absent from available Environment Agency data.

Table 3.2 shows the available WFD diatom (phytobenthos) monitoring sites.

Table 3.2 Details of diatom monitoring sites and WFD classification: River Hindburn & Hodder – conf Easington Bk to conf Ribble

Monitoring site	NGR	WFD Waterbody
Hindburn		
Hindburn (63499)	SD6130967534	GB112072066050
Hodder – conf Easington Bk to conf Ribble		
Hodder (160989)	SD7088551311	GB112071065560

The assessment of diatoms (phytobenthos) in rivers according to the requirements of the WFD is completed using a tool called DARLEQ2 (Diatoms for Assessing River and Lake Ecological Quality), based on a metric called the Trophic Diatom Index (TDI). 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). The TDI4 scores were used by the Environment Agency in the assessment of WFD status of the Cycle 2 assessments.

Percentage Motile Taxa data are also provided which gives the relative 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 available baseline TDI scores for the sites associated with the River Hindburn and River Hodder (**Table 3.3**) are indicative of moderate nutrient conditions, while the low percentage motile taxa are indicative of clear, undisturbed waters.

Table 3.3 Details of diatom monitoring sites and WFD classification: River Hindburn & Hodder – conf Easington Bk to conf Ribble

	TDI Score	Motile %
Hindburn (No of sites: 1, No of samples 6)		
Mean	41.45	15.45
Min	28.65	1.33
Max	66.87	57.28
Hodder - conf Easington Bk to conf Ribble (No of sites: 1, No of samples 2)		
Mean	31.28	9.33
Min	27.72	1.9
Max	34.84	16.77

3.2.2 Macroinvertebrates

Available Environment Agency macroinvertebrate data (2000-2020) were collated for the relevant WFD water bodies (**Table 3.4**). GB112072066050 (Hindburn) classifies as classifies as 'High' for macroinvertebrates in 2016, Cycle 2. The WFD waterbody GB112071065560 (Hodder - conf Easington Bk to conf Ribble) classifies as 'Good' for macroinvertebrates in 2016, Cycle 2. It should be noted that 2016 was the most recent WFD classification for the macroinvertebrate provided by the Environment Agency at the time of preparing this report.

Table 3.4 Details of macroinvertebrate monitoring sites and WFD classification: River Hindburn & Hodder - conf Easington Bk to conf Ribble

Monitoring site	NGR	WFD Waterbody
Hindburn		
Hindburn (63499)	SD6130967534	GB112072066050
Hindburn (66751)	SD5992268117	

Hodder - conf Easington Bk to conf Ribble		
Hodder (160989)	SD7088551311	GB112071065560

Over 100 invertebrate taxa have been recorded from the two sample sites on the River Hindburn. The main groups represented are Ephemeroptera (mayflies) and Diptera (true flies). Over 35 invertebrate taxa (species and groups of species) have been recorded from two sample sites on the River Hodder. The main groups represented are Coleoptera (riffle beetles), Diptera (true flies), Ephemeroptera (mayflies) and Trichoptera (caddisflies).

The Whalley Hawkes Paisley Trigg (WHPT) metric is primarily used to monitor the impact of organic enrichment, but also responds to toxic pollution, siltation, habitat reduction and reduced flows. High WHPT scores are associated with good water quality and high habitat quality. The WHPT scores observed for both the River Hindburn and River Hodder ranged from 76.5 to 202.3 and 167.3 to 234.6, respectively (see **Table 3.4**). The $WHPT_{ASPT}$ provides an indication of the tolerance of macroinvertebrates to pollution or adverse water quality. The $WHPT_{ASPT}$ values for the River Hindburn and River Hodder ranged from 6.38 to 7.65 and 6.97 to 7.11, respectively. The WHPT and $WHPT_{ASPT}$ data indicate that, in general, the macroinvertebrate community associated with these water bodies are representative of good to very good water quality with a number of pollution sensitive families present. Any impacts on water quality as a result of the implementation of the scheme could therefore result in changes in the macroinvertebrate community structure.

$WHPT_{NTAXA}$ is a simple species richness index. It is simply the number of scoring taxa (families) that contributed to the WHPT score. Habitat-rich rivers, such as lowland chalk streams will often have $WHPT_{NTAXA}$ scores exceeding 30. Upland systems with restricted habitats tend to have lower values. River reaches with impoverished habitat quality; siltation issues or reduced water quality will typically have reduced $WHPT_{NTAXA}$ scores compared with less impacted reaches in similar river types. The $WHPT_{NTAXA}$ ranged from 12 to 27 and 23 to 33 for the sites associated with the River Hindburn and River Hodder, respectively. The LIFE score was developed as a means of assessing flow as a stressor of the macroinvertebrate community of flowing watercourses. Individual species and family groups are assigned to a flow group depending on their documented flow preferences (current velocity) ranging from I (Rapid) to VI (Drought Resistant).

Species LIFE (S) provides a more precise measure than Family LIFE (F) as a number of aquatic invertebrate families contain species with wide-ranging flow requirements. The community LIFE score can be broadly interpreted according to published thresholds, ranging from 6.5 and below (Low sensitivity to reduced flows) to 7.26 and above (high sensitivity to reduced flows). LIFE scores ranged from 7.59 to 8.38 and 7.69 to 8.08 for the sites associated with the River Hindburn and River Hodder, respectively. The average LIFE score for both water bodies indicates a community with a preference for moderate flow velocities and a high sensitivity to low flows.

Table 3.5 Macroinvertebrate Indices for monitoring sites along the affected reach of the River Hindburn & Hodder - conf Easington Bk to conf Ribble

	WHPT ASPT	WHPT	NTAXA	LIFE (Family)
Hindburn (No of sites:2, No of samples:21)				
MEAN	7.07	135.75	19.14	7.95
MIN	6.38	76.5	12	7.59
MAX	7.65	202.3	27	8.38
Hodder (No of sites:1, No of samples 4)				
MEAN	7.04	207.7	29.5	7.92
MIN	6.97	167.3	24	7.69
MAX	7.11	234.6	33	8.08

No notable or protected macroinvertebrate species were identified in the available Environment Agency monitoring data for the River Hindburn and River Hodder WFD waterbodies.

3.2.3 Freshwater fish

Available fish data from Environment Agency monitoring sites (2000-2020) were collated for the River Hindburn and River Hodder (**Table 3.66**) along with the WFD status classification for the waterbodies. These waterbodies comprise a mix of salmonid and coarse fish species, including several internationally and/or nationally designated species including Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), bullhead (*Cottus gobio*) and eel (*Anguilla anguilla*). .

Table 3.6 Details of freshwater fish monitoring sites and WFD classification: River Hindburn & Hodder - conf Easington Bk to conf Ribble

Monitoring site	NGR	WFD Waterbody
Hindburn		
D/S River Hindburn Bridge (10159)	SD6136267501	GB112072066050
U/S habitat fencing (11062)	SD6248267555	
D/S habitat fencing (11065)	SD6244167545	
Bridge House Farm Tea Rooms (27217)	SD6085167596	
Hodder - conf Easington Bk to conf Ribble		
Birkett Farm (4195)	SD6828749150	GB112071065560
Newton Sewage Works u/s Road Bridge (5678)	SD6987250313	
Above Footbridge Birkett Farm (5679)	SD6902349885	
D/S Boarsden Farm footbridge (5680)	SD6790750014	

Species presence and distribution data from the fish monitoring sites can be used to provide an indicative reach-based classification of community environmental preferences and therefore sensitivity to potential environmental pressures associated with the proposed development. This is determined using the WFD Fisheries Classification Scheme Version 2 (FCS2). FCS2 uses a range of complex statistical models and geographical data to predict the fish community at any given location under natural conditions. The system then compares this with the actual survey catch at individual sites and provides a score (Ecological Quality Ratio, EQR) that reflects whether or not the two are similar. Scores determine the formal WFD status classification.

The Environment Agency collects data on the fish species and numbers present in the water bodies through a number of mechanisms including electric fishing survey data, fish counter data, fishery catch records and various other observations. Reach sensitivity can broadly be defined by the most sensitive of the fish taxa present (i.e. those with the lowest tolerance of environmental disturbance).

Table 3.7 Environment Agency fish monitoring sites: summary of species distribution (species tolerance of environmental disturbance as defined by the Fisheries Classification Scheme (FCS2) used in WFD classifications for the fish biological quality element).

Site	Date	Low Tolerance						Medium Tolerance						High tolerance					
		Brown / sea trout	Grayling	Bullhead	Atlantic salmon	Lamprey sp. ammocoetes	Brook Lamprey	Minnow	Stone loach	Pike	Gudgeon	Chub	Dace	Tench	European eel	European eels > elvers	Roach	3-spined stickleback	Perch
Hinburn																			
D/S River Hindburn Bridge (10159)	10/07/2002	11			3										5				
U/S habitat fencing (11062)	14/10/2003	22																	
U/S habitat fencing (11062)	28/09/2010	81													6				
U/S habitat fencing (11062)	27/08/2013	34													1				
U/S habitat fencing (11062)	13/09/2016	21													1				
D/S habitat fencing (11065)	14/10/2003	6													1				
Bridge House Farm Tea Rooms (27217)	08/08/2007	18		100-999	61			10-99	10-99						11				
Bridge House Farm Tea Rooms (27217)	26/07/2013	98		100-999	28				1-9						4				
Bridge House Farm Tea Rooms (27217)	17/08/2016	27		10-99				10-99	1-9						2				
Hodder - conf Easington Bk to conf Ribble																			
Birkett Farm (4195)	18/08/2004	81		100-999	7			100-999	1-9						1				
Birkett Farm (4195)	14/07/2009	50		100-999	40				1-9						4				
Birkett Farm (4195)	16/07/2015	106		10-99	3				1-9						6				
Newton Sewage Works u/s Road Bridge (5678)	19/07/2004	3			5										5				
Above Footbridge Birkett Farm (5679)	10/09/2004	4		10-99	99			10-99	10-99						10				
D/S Boarsden Farm footbridge (5680)	19/07/2004	3			45										2				
D/S Boarsden Farm footbridge (5680)	22/09/2009	3		100-999	170			10-99	100-999						7				
D/S Boarsden Farm footbridge (5680)	06/08/2015	8		100-999	65			100-999	10-99						4				

3.3 Protected and notable species

3.3.1 White clawed crayfish

3.3.1.1 Desk study

No records of white clawed crayfish were present in environment Agency Macroinvertebrate monitoring data (see Section 3.2.2) from the River Hodder or River Hindburn Beck.

No records of white clawed crayfish were received from LERC for within 2 km of the proposed scheme in the period 2010 to 2020.

3.3.1.2 White clawed crayfish surveys

The watercourses scoped out for requiring surveys following the Extended Phase 1 survey or habitat suitability assessment are shown in **Table 3.8**. The results of the surveys of watercourses for crayfish and habitat suitability undertaken in 2019 and 2020 are summarised in **Table 3.9**.

Four watercourses were surveyed in the River Hindburn catchment; Cod Gill, Unnamed Watercourse 163, Unnamed Watercourse 178; and, Unnamed Watercourse 186. No white clawed crayfish or non-native crayfish were identified in the watercourses surveyed. Cod Gill and Unnamed Watercourse 163 were considered to be sub-optimal due to a paucity of suitable refuges. Unnamed Watercourse 178 and Unnamed Watercourse 186 were considered to be suitable for white clawed crayfish, particularly downstream of the survey area, however, the number of suitable refuges within the survey area is considered to be a limiting factor.

One water course, the River Hodder, was surveyed in the Hodder - conf Easington Bk to conf Ribble waterbody. The River Hodder is a large tributary of the River Ribble. The watercourse is 10 m wide and flows over a substrate of stones, cobbles and boulders providing a good range of refuge sizes for white clawed crayfish. The survey section was flanked by steep sloping semi-natural broadleaved woodland on the north bank (with tree roots providing additional habitat for white clawed crayfish) and pasture on the south bank. The survey reach includes a number of pools, riffles and glides with exposed cobble bars. No white clawed crayfish were recorded during the survey of the River Hodder.

Although the surveys cannot confirm absence of White-clawed crayfish and there remains the possibility that a few individuals could be present, the survey effort employed, using three different survey techniques, would have established if a substantial population was present.

Table 3.8 Watercourses scoped out of surveys for white clawed crayfish

Name	WFD waterbody	Results of scoping exercise
Unnamed Watercourse 169	Hindburn	Not suitable
Unnamed Watercourse 384	Hodder - conf Easington Bk to conf Ribble	Not suitable

Table 3.9 White clawed crayfish survey results summary

Watercourse name	WFD catchment	Upstream NGR	Downstream NGR	Number of refuges searched	Survey results
Cod Gill	Hindburn	SD63236554	SD63746579	201 (3 sections, all suitable refuges searched)	No evidence of white-clawed crayfish or non-native crayfish species was found. This watercourse is considered to be sub-optimal for crayfish, with only short sections of the watercourse with suitable refuges.
Unnamed watercourse 163	Hindburn	SD63236554	SD63746579	250	No evidence of white-clawed crayfish or non-native crayfish species. This watercourse is considered to be sub-optimal for crayfish due fast-flowing sections.
Unnamed watercourse 178 Unnamed watercourse 186	Hindburn	SD64056389	SD64226385	89 (2 sections, all suitable refuges searched)	No evidence of white-clawed crayfish or non-native crayfish species. This watercourse is considered to be suitable for crayfish, particularly downstream of the survey area but number of suitable refuges within the survey area is considered to be a limiting factor.
River Hodder	Hodder - conf Easington Bk to conf Ribble	SD69231 49703	SD68876 49580	250	No evidence of white-clawed crayfish or non-native crayfish species. This watercourse is considered to be suitable for crayfish

3.4 Invasive species

3.4.1.1 Desk study

Environment Agency records from within 2km of the scheme did not identify any invasive non-native species. However, data from the wider River Hodder and River Hindburn waterbodies identified six records of the non-native aquatic macroinvertebrate species; Jenkin's spire snail (*Potamopyrgus antipodarum*) This species was recorded on River Hindburn Beck (downstream) and in the River Hodder both upstream and downstream of the Proposed Bowland Section. INNS records for within 2km of the Proposed Docker Section are summarised in **Table 3.10**.

Table 3.10: Environment Agency invasive and non-native species records from within 2km of the Scheme

Scientific name	Common name	Start date	Locality	Waterbody	OSGR	Distance to Bowland section
Potamopyrgus antipodarum	Jenkins' Spire Snail	08/11/2016	Hindburn - 100m D/S Bridge Ptc Roeburn	Hindburn	SD613675	2.7 km northwest (downstream)
Potamopyrgus antipodarum	Jenkins' Spire Snail	17/04/2015	Hindburn - 100m D/S Bridge Ptc Roeburn	Hindburn	SD613675	2.7 km northwest (downstream)
Potamopyrgus antipodarum	Jenkins' Spire Snail	07/11/2012	Hodder - U/S Barn Gill	River Hodder	SD717535	3.8 km north east (upstream)
Potamopyrgus antipodarum	Jenkins' Spire Snail	14/10/2014	Hodder - U/S Barn Gill	River Hodder	SD717535	3.8 km north east (upstream)
Potamopyrgus antipodarum	Jenkins' Spire Snail	18/05/2012	Hodder - U/S Barn Gill	River Hodder	SD717535	3.8 km north east (upstream)
Potamopyrgus antipodarum	Jenkins' Spire Snail	12/10/2010	Dunsop - Ptc R.Hodder	River Hodder	SD660500	2.7km west (downstream)

3.4.1.2 Survey results

No evidence of INNS was identified during walkover surveys of five watercourses adjacent to the Proposed Bowland Section. No incidental sightings of invasive non-native species were recorded during surveys for other species. A summary of the watercourses subject to walkover surveys is shown in **Table 3.11**.

Table 3.11: Watercourses subject to walkover surveys in 2020

Name	WC_ID	U/S Grid Ref	D/S Grid Ref	Invasive non-native species
Cod Gill	W206	SD63623 65709	SD63233 65546	No evidence of INNS
Unnamed Watercourse 163	W207	SD63983 65712	SD63573 65279	No evidence of INNS
Unnamed Watercourse 169	W215	SD63446 65534	SD63400 65396	No evidence of INNS
Unnamed Watercourse 384	W461	SD68665 50376	SD69080 49924	No evidence of INNS
River Hodder	W477	SD69231 49703	SD68876 49580	No evidence of INNS

4 Summary

4.1 Baseline Summary

A summary of the baseline conditions as identified through the desk study and surveys undertaken for the watercourses is presented for the River Hindburn waterbody in **Table 4.1** and for the River Hodder waterbody in **Table 4.2**.

Table 4.1: Summary of Baseline conditions of watercourses in the River Hindburn WFD waterbody

Watercourse	River Hindburn (W478)	Cod Gill (W206)	Unnamed Watercourse 163 (W207)	Unnamed Watercourse 169 (W215)
WFD waterbody	River Hindburn GB112072066050	River Hindburn GB112072066050	River Hindburn GB112072066050	River Hindburn GB112072066050
Macro-phytes and phyto-benthos	Baseline phytobenthos monitoring data identified that watercourses in the River Hindburn WFD waterbody support diatom communities that are indicative of moderate nutrient conditions, with clear, undisturbed waters free from fine sediment inputs			
Fish	The fish community was dominated by salmonid species and including several internationally and/or nationally designated species including Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), bullhead (*Cottus gobio*) and European eel (*Anguilla anguilla*).	The fish community is likely to be comparable in species composition to the River Hindburn due to hydrological connectivity with the downstream waterbody but with reduced abundances and age classes. The watercourse is likely to support low numbers of designated species including Atlantic salmon, brown trout, bullhead, and European eel.	The fish community is likely to be comparable in species composition to the River Hindburn due to hydrological connectivity with the downstream waterbody but with reduced abundances and age classes. The watercourse is likely to support low numbers of designated species including Atlantic salmon, brown trout, bullhead, and European eel.	Small tributary of Cod Gill with limited supporting habitat for notable fish species. The fish community is likely to be comparable in species composition of cod gill but dominated by minor species such as minnow with occasional low numbers of designated species such as brown trout, bullhead, or European eel.

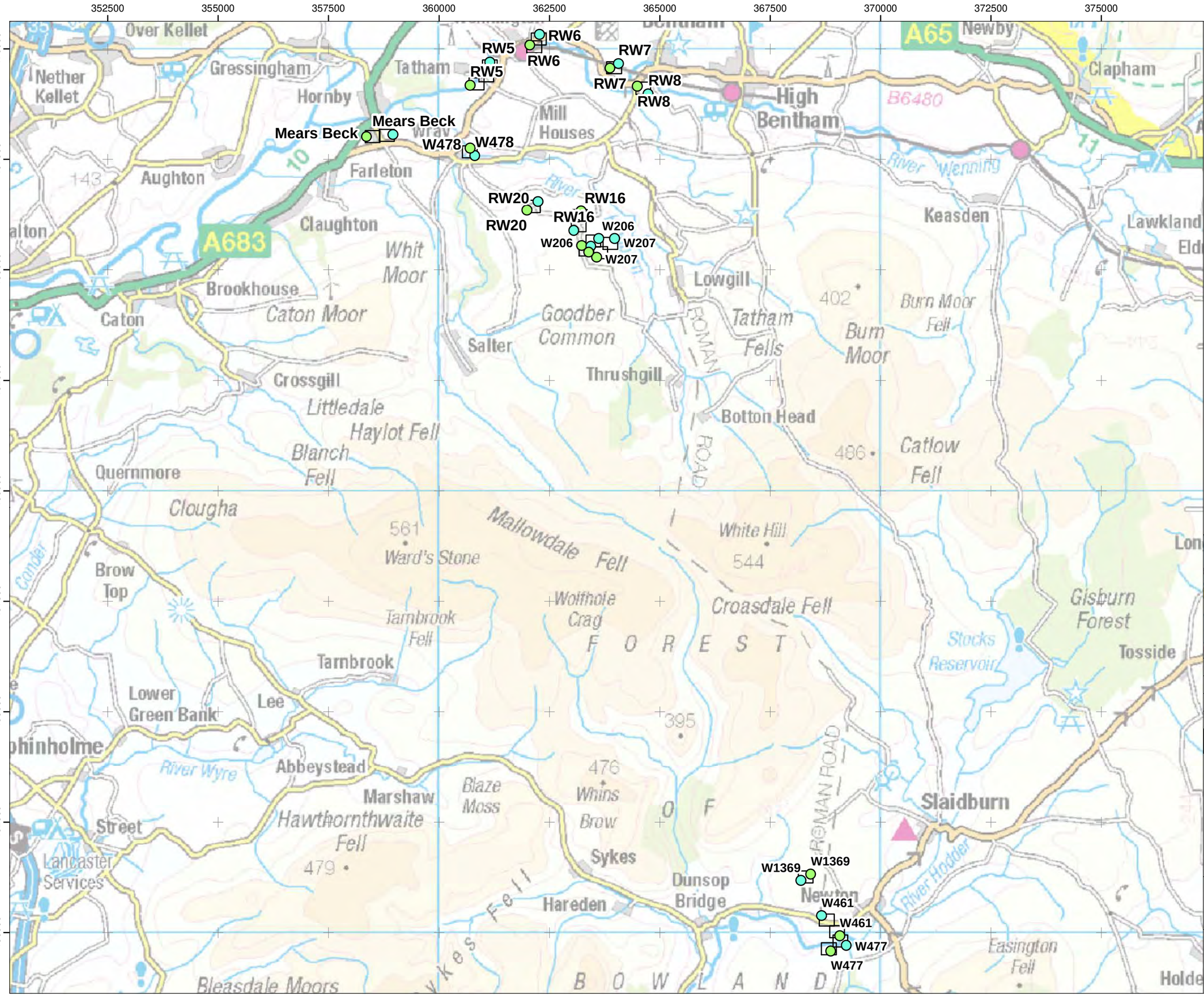
Watercourse	River Hindburn (W478)	Cod Gill (W206)	Unnamed Watercourse 163 (W207)	Unnamed Watercourse 169 (W215)
Macroinvertebrates	Baseline data identified macroinvertebrate communities in the River Hindburn WFD waterbody are associated with good water quality, moderate to high flows and coarse substrate. Considered to be sensitive to changes in flow, water quality and sedimentation.			
White clawed crayfish	No evidence of white-clawed crayfish or non-native crayfish species was found. This watercourse is considered to be sub-optimal for crayfish.	No evidence of white-clawed crayfish or non-native crayfish species. This watercourse is considered to be sub-optimal for crayfish	No evidence of white-clawed crayfish or non-native crayfish species. This watercourse is considered to be sub-optimal for crayfish	Not suitable for white clawed crayfish, not subject to surveys
Invasive species	No INNS identified in baseline data	No INNS identified in baseline data	No INNS identified in baseline data	No INNS identified in baseline data

Table 4.2: Summary of Baseline conditions of watercourses within the River Hodder (conf Easington Bk to conf Ribble) WFD waterbody

Watercourse	River Hodder (W477)	Unnamed Watercourse 384 (W461)	Unnamed Watercourse 385 (W462)	Unnamed Watercourse 386 (W463)	Unnamed Watercourse 391 (W470)	Unnamed Watercourse 1312 (W1382)
WFD waterbody	Hodder - conf Easington Bk to conf Ribble (GB112071065560)	Hodder - conf Easington Bk to conf Ribble (GB112071065560)	Hodder - conf Easington Bk to conf Ribble (GB112071065560)	Hodder - conf Easington Bk to conf Ribble (GB112071065560)	Hodder - conf Easington Bk to conf Ribble (GB112071065560)	Hodder - conf Easington Bk to conf Ribble (GB112071065560)
Macrophytes and phytobenthos	Baseline phytobenthos monitoring data identified that watercourses in the River Hodder WFD waterbody support diatom communities that are indicative of moderate nutrient conditions, with clear, undisturbed waters free from fine sediment inputs					
Fish	Baseline data indicates the fich community comprises a mix of salmonid and coarse fish species, including several internationally and/or nationally designated species including Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), bullhead (*Cottus gobio*) and European eel (*Anguilla anguilla*). The walkover data has indicated sub-optimal juvenile lamprey habitat in addition to suitable salmonid fry and parr habitat.	The fish community is likely to be comparable in species composition to the River Hodder due to hydrological connectivity but with reduced abundances and age classes. The watercourse could support a designated species including Atlantic salmon, brown trout, bullhead, and European eel. Four possible obstructions to fish passages noted during the walkover survey within the watercourse. No suitable habitat for juvenile lamprey or salmonid species were noted during the walkover survey	The fish community is likely to be comparable in species composition to the River Hodder due to hydrological connectivity but with reduced abundances and age classes. The watercourse could support a designated species including Atlantic salmon, brown trout, bullhead, and European eel. On possible obstruction to fish passages noted during the walkover survey within the watercourse. No suitable habitat for juvenile lamprey or salmonid species were identified in the waterbody.	The fish community is likely to be comparable in species composition to the River Hodder due to hydrological connectivity with the downstream watercourse but with reduced abundances and age classes. The watercourse could support a designated species including Atlantic salmon, brown trout, bullhead, and European eel.	Unnamed watercourse 391 is a tributary of unnamed watercourse 386. Small watercourse with limited suitable habitat. Likely to support small numbers of minor species.	The watercourse is a short drainage ditch with no downstream connectivity that dries regularly. It is unlikely to support aquatic communities
Macroinvertebrates	Baseline data identified macroinvertebrate communities in the River Hodder WFD waterbody are associated with good water quality, moderate to high flows and coarse substrate. Considered to be sensitive to changes in flow, water quality and sedimentation.					
White clawed crayfish	No evidence of white-clawed crayfish or non-native crayfish species. This watercourse is considered to be suitable for crayfish	Not suitable for white clawed crayfish, not subject to surveys	Not surveyed for white clawed crayfish	Not surveyed for white clawed crayfish	Not surveyed for white clawed crayfish	Not surveyed for white clawed crayfish
Invasive Non-native Species	No INNS identified in baseline data	No INNS identified in baseline data	No INNS identified in baseline data	No INNS identified in baseline data	No INNS identified in baseline data	No INNS identified in baseline data

Annexes

Annex 1: 2020 Watercourse walkover survey results

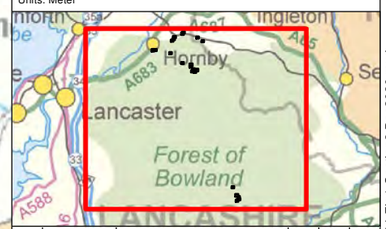


Legend:

Walkover extents

- Start Point
- End Point
- TR3 Map Views

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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TITLE: Figure 1:
Bowland TR3
Walkover Survey Overview

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363400

363500

363600

465700

465600

W206

W215

Legend:

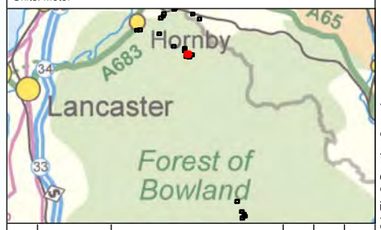
Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 1 of 22

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363200 363300 363400 363500

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465400

W206 W215 W215

16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

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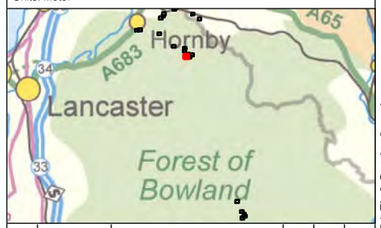

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TITLE: Figure 2:
Bowland TR3
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363900
364000
465700
465600
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W207
33
34
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40
41
42
43

Summer
House Gill

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
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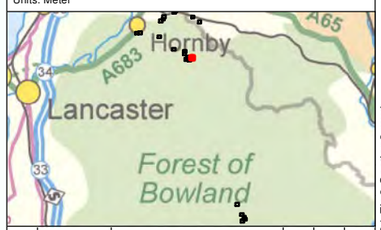

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363500 363600 363700 363800

465500 465400 465300

40 41 42 43 44 45 46 47 48 49 50 51

W207

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

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Projection: Transverse Mercator
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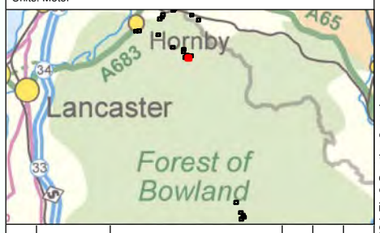
Units: Meter



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TITLE: Figure 2:
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368300
368400
451300
451200
W1369
W1369

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

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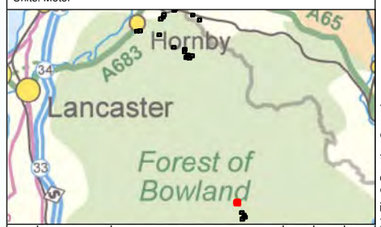
Datum: OSGB 1936
Units: Meter



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TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 5 of 22

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368700 368800 368900

450400 450300 450200

W461 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66

Fober Farm

Legend:

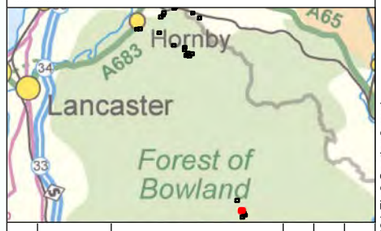
Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 6 of 22

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368900 369000 369100

450100 450000 449900

Fober Barn

63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 W461 94 97 93 99 96 95 98 92 101 91 100 102 103 104 105 106

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
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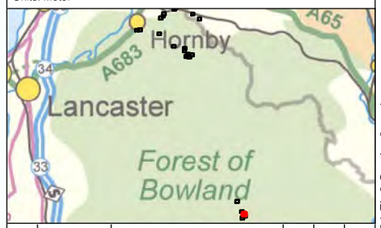

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TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 7 of 22

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369000
369100
369200
449900
449800
449700

W461
W477

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

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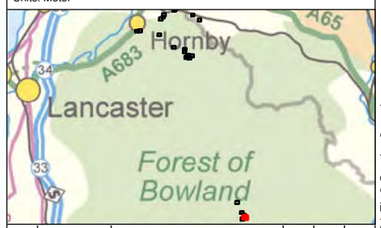

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TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 8 of 22

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368700 368800 368900

449700 449600 449500

111 112 113 114 115 116 117 118 W477 119

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
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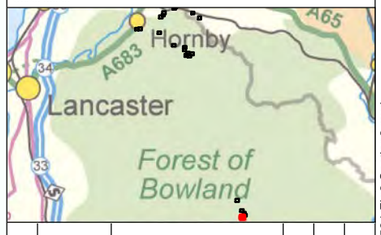

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TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 9 of 22

0 20 40
Meters
SCALE: 1:1,000 @ A3

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361000 361100 361200 361300

469700 469600 469500

RW5
120
121
122
123
124
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133
137

B648

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

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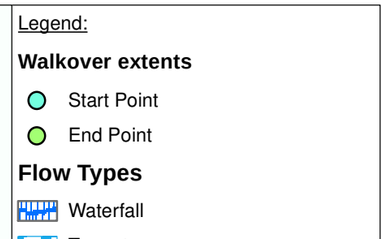

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RSK biocensus
EXPERTS IN ECOLOGY

TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 10 of 22

0 20 40
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SCALE: 1:1,000 @ A3

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361000 361100 361200

469500 469400 469300

129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter

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RSK biocensus EXPERTS IN ECOLOGY

TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 11 of 22

0 20 40
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SCALE: 1:1,000 @ A3

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360700 360800 360900 361000

469300 469200 469100

148 149 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 RW5

Legend:

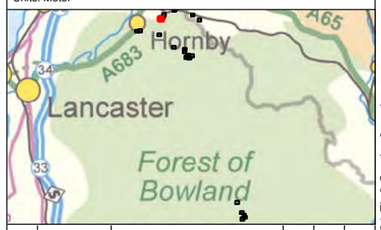
Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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RSK biocensus EXPERTS IN ECOLOGY

TITLE: Figure 2:
Bowland TR3
Walkover Survey
Map 12 of 22

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Meters
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362100 362200 362300 362400

470300 470200 470100

RW6
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ns Farm

Legend:

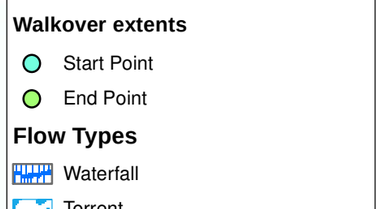
Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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TITLE: Figure 2:
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Cravens Farm

RW6

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

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Projection: Transverse Mercator
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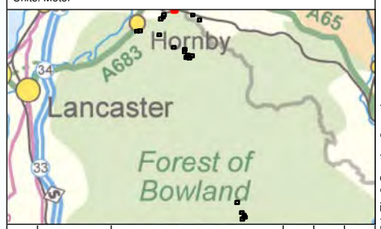

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RW7

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
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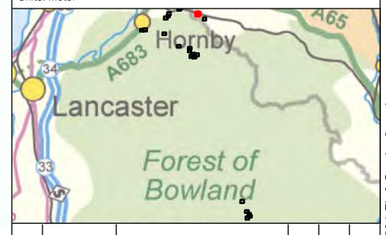
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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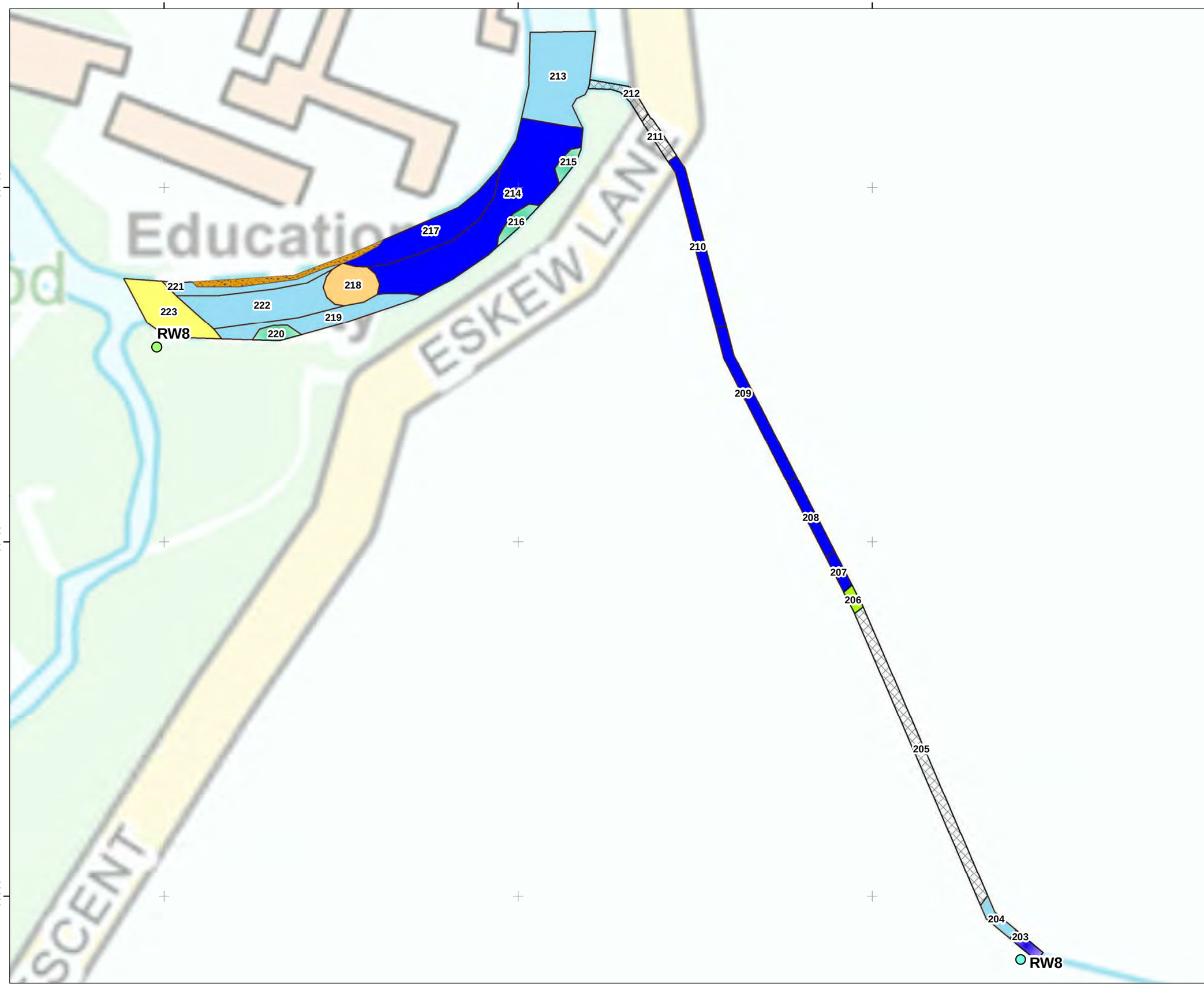

Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
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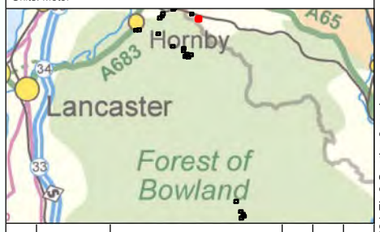
Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
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- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
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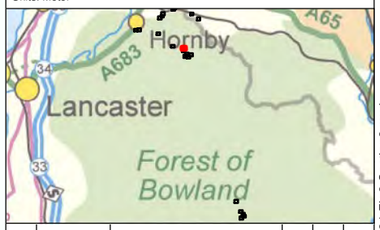

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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
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Coordinate System: British National Grid
Projection: Transverse Mercator
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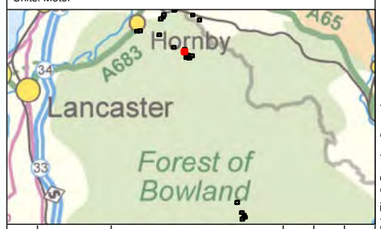
Units: Meter



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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
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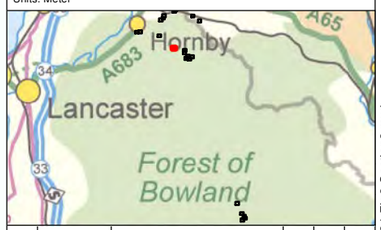
Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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STATION WAY

STATION CT

STATION ROAD

Mears Beck

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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
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- Juvenile Lamprey habitat
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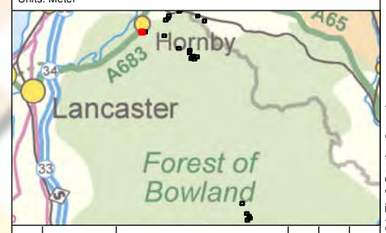

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Legend:

Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
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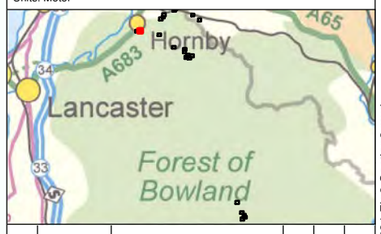

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Legend:

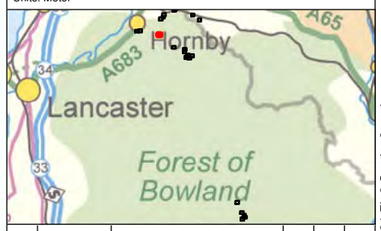
Walkover extents

- Start Point
- End Point

Flow Types

- Waterfall
- Torrent
- Cascade
- Run
- Glide
- Riffle
- No perceptible flow
- Pool
- Eddy
- Juvenile Lamprey habitat
- Salmonid habitat
- Dry
- Exposed Sediment
- Island
- Potential obstacle / obstruction to fish passage
- Overhanging Vegetation
- Coarse Woody Debris

Coordinate System: British National Grid
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Meter



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Bowland TR3
Walkover Survey
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Table 1: Habitat classifications and abbreviations

	Flow Type		Depth		Velocity		Substrate		Notable/species specific habitat		Macrophyte (% cover)		Other features
GL	Glide	A	0.05 - 0.1 m	0	0.01 - 0.05 m/s	BE	Bedrock	Pr	Salmonid parr habitat	SFL	Submerged fine-leaved	Obstruction	Potential obstacle/obstruction to fish passage
R	Run	B	0.1 - 0.2 m	1	0.05 - 0.15 m/s	BO	Boulder (> 256 mm)	Fr	Salmonid fry habitat	SLL	Submerged linear-leaved		
RI	Riffle	C	0.2 - 0.4 m	2	0.15 - 0.3 m/s	CO	Cobble (64 - 256 mm)	Pr/Fr	Mixed juvenile salmonid habitat	SBL	Submerged broad-leaved		
P	Pool	D	0.4 - 1.0 m	3	0.3 - 0.5 m/s	GR	Gravel (2 - 64 mm)	SPO	Optimal salmonid spawning habitat	ELL	Emergent linear-leaved		
CAS	Cascade	E	> 1.0 m	4	0.5 - 0.7 m/s	SA	Sand (< 2 mm)	SPSO	Sub optimal salmonid spawning habitat	EBL	Emergent broad-leaved		
ED	Eddy			5	> 0.7 m/s	SI	Silt	LO	Optimal juvenile lamprey habitat	FL	Filamentous algae		
TOR	Torrent					CL	Clay	LSO	Sub optimal juvenile lamprey habitat	FLO	Floating		
NP	No perceptible flow					AR	Artificial			FLR	Floating-leaved rooted		
DRY	Dry					NV	Not visible			CHOKED	Channel choked (veg)		

Table 2: HARP Bowland (TR3) walkover data

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
1	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
2	No perceptible flow	A	0	BO/CO/GR		
3	Glide	A	1	BE		
4	Run	A	1	CO/BO/BE		
5	No perceptible flow	A	0	BE		
6	Run	A	1	CO/BO/BE		
7	No perceptible flow	A	0	BE		
8	No perceptible flow	A	0	BO/BE/GR		
9	No perceptible flow	A	0	BO		
10	No perceptible flow	A	0	BO/BE/GR		
11	Pool	D	1	BO/CO/GR		
12	Waterfall	A	1	BO		
13	Cascade	A	1	BE		
14	No perceptible flow	B	0	BO/CO/GR		
15	Pool	B	1	BE/CO/GR		
16	No perceptible flow	A	0	BE		
17	Pool	B	1	BE/GR		
18	Pool	C	1	BE/BO/GR		
19	No perceptible flow	A	0	BO/GR/SI		
20	No perceptible flow	A	0	BO/GR/SI		
21	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
22	No perceptible flow	B	0	BO/GR/CL		
23	No perceptible flow	A	0	BO/CL		
24	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
25	No perceptible flow	B	0	BE		
26	No perceptible flow	B	0	BE/BO		
27	Pool	B	1	BE/CL		
28	No perceptible flow	B	0	BE/CL		
29	Pool	B	1	BO/CL		
30	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
31	Pool	B	0	BO/GR/CL		
32	No perceptible flow	A	0	BE/CL		
33	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
34	Run	A	2	GR/BO/SI		
35	Glide	A	1	GR/BO/SI		
36	Riffle	A	2	GR/BO/SI		
37	Pool	C	1	GR/BO/SI		
38	Glide	B	1	BE/SI/GR		
39	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
40	Run	A	2	BE/SI/GR		
41	Pool	C	1	BO/GR/SI		
42	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
43	Run	A	1	BO/GR/SI		
44	Run	A	1	BO/GR/SI		
45	No perceptible flow	A	0	BO/GR/SI		
46	Pool	C	1	SI/BE/GR		
47	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
48	No perceptible flow	A	0	BO/GR/SI	FL 5% EBL 50%	
49	No perceptible flow	A	0	BO/GR/SI		
50	No perceptible flow	A	0	BO/GR/SI	EFL 50%	
51	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
52	Run	A	2	SA/GR/CO	ELL 10%	
53	Run	B	2	GR/BO/SI	ELL 10%	
54	Run	A	2	GR/BO/SI	ELL 10%	
55	Glide	C	2	CO/BO/GR		
56	Run	A	2	SI/SA/CO	ELL 20%	
57	No perceptible flow	A	0	SI	ELL 50%	
58	Run	A	2	BO/CO/SA	EBL 10%	
59	Riffle	A	2	BO/CO/SA		
60	Run	A	2	SI/CO/GR	ELL 80% EBL 20%	
61	Riffle	A	2	BO/CO/GR		
62	Run	A	2	SI/CO	EBL 5% ELL 10%	
63	Run	A	2	SI/CO/BO		
64	Run	A	2	SI/CO/GR	EBL 40% ELL 40%	
65	Riffle	A	2	CO/GR/SI	EBL 5%	
66	No perceptible flow	A	0	SI	EBL 40% ELL 45%	
67	Glide	B	1	SI/GR/CO		
68	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
69	Pool	C	1	BO/CO		
70	Riffle	A	2	BO/CO/GR		
71	Pool	C	1	BO/CO/SI		
72	Riffle	A	2	SA/GR/SI		
73	Run	A	2	GR/SI/SA		
74	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
75	Riffle	A	2	BO/CO/SI		
76	Run	A	2	AR	FL 30%	
77	Run	A	2	CO/GR/SA		
78	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
79	Glide	B	1	AR		
80	Run	A	2	SI/CO/SA		

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
81	Glide	B	1	SA/GR/SI		
82	Riffle	A	2	CO/BO/SA		
83	Potential obstacle/Potential obstacle/obstruction to fish passage to fish passage					
84	Glide	C	2	BO/CO/GR		
85	Glide	B	2	BO/CO/GR		
86	Run	B	3	BO/CO/GR		
87	Run	B	2	BO/CO/GR		
88	Run	A	2	BO/CO/GR		
89	Salmonid habitat	C	3	BO/CO/GR		Fry
90	Salmonid habitat	C	3	BO/CO/GR		Parr/Fry
91	Glide	D	2	BO/CO/GR		
92	Glide	B	2	BO/CO/GR	FL 60%	
93	Pool	C	1	BO/CO/GR	FL 60%	
94	Glide	C	3	BO/CO/GR		
95	Run	B	3	BO/CO/GR	FL 40%	
96	Run	C	4	BO/CO/GR	FL20%	
97	Run	B	3	BO/CO/GR	FL 40%	
98	Glide	B	2	BO/CO/GR	FL 70%	
99	Pool	E	1	BO/CO/GR	FL 30%	
100	Run	B	2	BO/CO/GR	FL 50%	
101	Riffle	B	3	BO/CO/GR	FL 80%	
102	Run	C	3	BO/CO/GR	FL 50%	
103	Glide	C	2	BO/CO/GR		
104	Salmonid habitat	C	4	BO/CO/GR		Parr
105	Run	C	3	BO/CO/GR	FL 40%	
106	Run	C	3	BO/CO/GR	FL 70%	
107	Run	D	4	BO/CO/GR	FL 20%	
108	Run	A	2	BO/CO/GR	FL 80%	
109	Run	D	3	BO/CO/GR	FL 30%	
110	Glide	E	2	BO/CO/GR	FL80%	
111	Run	C	3	BO/CO/GR	FL 30%	
112	Salmonid habitat	C	3	BO/CO/GR	FL 10%	Parr
113	Juvenile lamprey habitat	B	1	SI/SA/GR		Sub optimal
114	Glide	C	3	BO/CO/PE	FL 90%	
115	Glide	B	1	BO/CO/GR	FL 80%	
116	Glide	C	3	BO/CO/GR	FL 90%	
117	Glide	E	2	BO/CO/GR	FL 10%	
118	Glide	B	2	SI		
119	Pool	D	1	BO/CO/GR		
120	Glide	B	2	BO/GR/SA		
121	Salmonid	B	4	CO/GR/SA		Fry

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
122	Salmonid	C	4	BO/CO/GR		Parr
123	Run	B	2	BO/CO/SA		
124	Run	C	3	BO/GR/SA		
125	Salmonid	C	3	BO/GR/SA		Sub optimal spawning
126	Lamprey	B	2	GR/SA/SI		Sub Optimal
127	Run	B	3	BO/GR/SA		
128	Salmonid	B	4	BO/GR/SA		Fry
129	Salmonid	C	4	BO/GR/SA		Fry
130	Lamprey	B	2	GR/SA/SI		Sub Optimal
131	Lamprey	B	1	GR/SA/SI		Sub Optimal
132	Glide	B	1	BO/SA/SI		
133	Run	C	3	BO/CO/SA		
134	Glide	B	2	BO/SA/SI		
135	Lamprey	B	2	GR/SA/SI		Sub Optimal
136	Run	C	2	BO/CO/SA		
137	Run	B	2	BO/CO/SA		
138	Riffle	B	2	BO/CO/SA		
139	Glide	B	1	BO/CO/SA		
140	Glide	C	2	BO/CO/SA		
141	Eddy	D	0	BO/CO/SI		
142	Glide	D	2	BO/CO/SA		
143	Glide	B	2	CO/SA		
144	Run	C	3	BO/CO/SA		
145	Glide	B	2	CO/SA		
146	Run	C	2	BO/CO/GR		
147	Salmonid	C	3	BO/CO/GR		Sub optimal spawning
148	Glide	B	2	BO/SA/GR		
149	Glide	C	2	BO/SA/GR		
150	Glide	B	2	BO/SA/GR		
151	Lamprey	B	2	GR/SA/SI		Sub optimal
152	Run	B	3	BO/GR/SA		
153	Run	B	3	BO/GR/CO		
154	Torrent	C	5	BO		
155	Potential obstacle/obstruction to fish passage					
156	Run	C	3	BO/SA/GR		
157	Run	B	3	BO/SA/GR		
158	Run	B	3	BO/SA/GR		
159	Salmonid	C	4	BO/CO/GR		Parr
160	Glide	B	2	BO/GR/SA		
161	Glide	B	1	BO/CO/GR		
162	Glide	D	2	BO/CO/SA		

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
163	Glide	D	3	BO/GR/SA		
164	Glide	B	2	BO/GR/SA		
165	Salmonid	B	3	BO/GR/SA		Sub optimal spawning
166	Salmonid	B	4	BO/CO/SA		Parr/Fry
167	Riffle	B	3	BO/GR/SA		
168	Lamprey	B	1	SA/SI		Optimal
169	Run	C	3	BO/CO/GR		
170	Run	E	3	BO/CO/GR		
171	Glide	B	3	BO/CO/GR		
172	Glide	D	3	BO/CO/GR		
173	Glide	B	3	BO/CO/GR		
174	Glide	A	1	BO/SA/GR		
175	Riffle	A	2	BO/CO/GR		
176	Glide	B	1	BO/SA/SI		
177	Pool	B	1	BO/SA/SI		
178	Run	A	2	CO/GR/SA		
179	Potential obstacle/obstruction to fish passage					
180	Pool	B	1	BO/CO/GR		
181	Run	A	2	CO/GR/SA		
182	Riffle	A	2	BO/CO/SA		
183	Run	A	2	CO/GR/SA		
184	Potential obstacle/obstruction to fish passage					
185	Pool	B	1	SA/SI/CO		
186	Run	A	2	CO/GR/SA		
187	Run	A	2	CO/GR/SA		
188	Potential obstacle/obstruction to fish passage					
189	Riffle	B	2	BO/SA/CO		
190	Run	A	2	SA		
191	Run	B	2	BO/CO/SA		
192	Run	C	3	BO/CO/GR		
193	Run	B	2	BO/CO/SA		
194	Lamprey	B	1	GR/SA/SI		Sub optimal
195	Salmonid	B	4	BO/CO/GR		Parr/Fry
196	Eddy	C	0	BO/SI		
197	Run	B	2	BE/BO/SA		
198	Run	C	3	BO/CO/GR		
199	Lamprey	B	1	SA/SI		Optimal
200	Glide	B	1	BO/CO/SA		
201	Run	C	2	BO/CO/SA		
202	Lamprey	B	1	SA/SI		Optimal
203	Pool	B	1	BO/SI/SA		

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
204	Run	B	2	BO/CO/SI		
205	Potential obstacle/obstruction to fish passage					
206	No perceptible flow	B	0	SA/SI	SFL-100	
207	Glide	B	2	SA/SI	SFL-60 EBL-40	
208	Glide	A	1	SA/SI	EBL-70	
209	Glide	A	1	SA/SI	SFL-40 EBL-40	
210	Glide	B	1	BO/CO/SA	EFL-20 EBL-10	
211	Potential obstacle/obstruction to fish passage					
212	Potential obstacle/obstruction to fish passage					
213	Run	C	3	BO/CO/SA	BO/CO/SA	
214	Glide	D	2	BO/SA/BE		
215	Eddy	D	0	BO/SA/BE		
216	Eddy	E	0	BO/SA/BE		
217	Glide	B	1	BO/GR/SA		
218	Salmonid	C	3	BO/GR/SA		Parr/Fry
219	Run	B	1	BE/SA		
220	Eddy	C	0	BO/SA/BE		
221	Run	B	2	BO/CO/SA		
222	Run	C	3	BO/CO/BE		
223	Riffle	C	4	BE		
224	Run	A	2	BO/CO/GR		
225	Riffle	A	3	BO/CO/GR		
226	Run	A	3	BO/CO/GR		
227	Potential obstacle/obstruction to fish passage					
228	Riffle	A	3	BO/CO/GR		
229	Run	A	3	BO/CO/GR		
230	Riffle	A	3	BO/CO/GR		
231	Run	A	3	BO/CO/GR		
232	Riffle	A	3	BO/CO/GR		
233	Glide	B	1	BO/CO/GR		
234	Potential obstacle/obstruction to fish passage					
235	Run	A	3	BO/CO/BE		
236	Riffle	A	2	BO/CO/SI		
237	Pool	B	1	SI/BO		
238	Riffle	A	2	BO/CO/SI		
239	Potential obstacle/obstruction to fish passage					
240	Run	A	3	GR/SI		
241	Pool	B	1	BO/SI		
242	Run	A	3	GR/SI		
243	Pool	C	1	SI		
244	Run	A	2	GR/SI	EFL-10 EBL-10	

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
245	Glide	B	1	SI	EFL-10 EBL-10	
246	Run	A	2	GR/SI	EFL-10 EBL-10	
247	Run	A	2	BO/CO/GR		
248	Riffle	A	3	BO/CO/GR		
249	Run	A	2	BO/CO/GR		
250	Riffle	A	3	BO/CO/GR		
251	Cascade	A	3	BO/CO		
252	Pool	C	1	BO/CO		
253	Potential obstacle/obstruction to fish passage					
254	Run	A	3	BO/CO/SI		
255	Glide	A	1	SI/SA		
256	Pool	B	1	BO/SI		
257	Potential obstacle/obstruction to fish passage					
258	Glide	A	1	SI/SA	EFL-5	
259	Run	A	2	SI/SA/GR	EBL-10	
260	Glide	A	2	SI/SA/GR	EBL-10	
261	Run	A	2	SI/SA/GR	EBL-10	
262	Potential obstacle/obstruction to fish passage					
263	Run	A	2	SI/GR	EBL-30	
264	Run	A	2	BO/CO/SA		
265	Potential obstacle/obstruction to fish passage					
266	Glide	B	1	SA/SI		
267	Glide	A	1	SA/SI/CL		
268	Run	A	2	SA/SI/CO		
269	Glide	A	1	SA/SI/CL		
270	Potential obstacle/obstruction to fish passage					
271	Glide	A	1	SA/SI/CL		
272	Glide	B	1	GR/SA/SI		
273	Run	A	2	SA/SI/CL		
274	Run	B	2	BO/SA/SI		
275	Potential obstacle/obstruction to fish passage					
276	Potential obstacle/obstruction to fish passage					
277	Run	B	2	BO/CO/SA		
278	Glide	B	1	BO/SA/SI		
279	Run	B	2	BO/SI/CL		
280	Riffle	A	2	BO		
281	Run	B	2	BO/SI/CL		
282	Potential obstacle/obstruction to fish passage					
283	Glide	B	1	BO/CO/SI		
284	Riffle	A	2	BO/CO/GR		
285	Potential obstacle/obstruction to fish passage					

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
286	Pool	C	1	BO/SI/CL		
287	Potential obstacle/obstruction to fish passage					
288	Potential obstacle/obstruction to fish passage					
289	Pool	D	1	BO/SA/SI		
290	Riffle	B	3	BO		
291	Pool	D	1	BO/SA/SI		
292	Potential obstacle/obstruction to fish passage					
293	Run	B	3	BE/SI		
294	Pool	D	1	BE/BO/SI		
295	Riffle	B	3	BE/BO/SI		
296	Lamprey	B	2	GR/SA/SI		Sub optimal
297	Glide	C	1	BE/BO/SI		
298	Riffle	A	3	BO/SA/CO		
299	Run	A	3	BO/GR/SI		
300	Riffle	A	3	BO/SI		
301	Potential obstacle/obstruction to fish passage					
302	Run	A	3	BO/GR/SI		
303	Riffle	A	3	BO/SI		
304	Glide	B	2	BO/SI		
305	Run	B	2	BO/SI		
306	Run	B	3	BO/SI		
307	Potential obstacle/obstruction to fish passage					
308	Run	B	3	BO/SI		
309	Run	C	3	BO/SA/SI		
310	Glide	C	2	BO/SI		
311	Run	B	4	BO/SA/SI		
312	Glide	C	2	BO/SA/SI		
313	Run	B	2	BO/SA/SI		
314	Glide	B	2	BO/SA/SI		
315	Run	B	3	BO/SA/SI		
316	Glide	C	1	BO/SI		
317	Glide	B	2	BO/SI		
318	Run	B	4	BO/SA/SI		
319	Run	B	3	BO/SA/SI		
320	Glide	B	2	SA/SI		
321	Riffle	A	3	BO/SI		
322	Run	B	3	BO/SI		
323	Potential obstacle/obstruction to fish passage					
324	Run	B	2	BO/SA/SI		
325	Potential obstacle/obstruction to fish passage					
326	Glide	C	1	BO/SI		

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
327	Run	B	2	BO/SI		
328	Glide	C	2	BO/SI		
329	Run	C	3	BO/SI		
330	Glide	C	1	SA/SI		
331	Glide	B	2	SI		
332	Run	C	3	BO/SI		
333	Glide	C	2	BO/SI		
334	Run	C	3	BO/SA/SI		
335	Glide	C	1	BO/SA/SI		
336	Run	B	3	SA/SI		
337	Glide	B	2	BO/SI		
338	Run	B	3	BO/SA/SI		
339	Glide	B	2	SI		
340	Run	B	2	SA/SI		
341	Run	A	2	BO/SA/SI		
342	Run	B	2	BO/SA/SI		
343	Run	B	3	SA/SI		
344	Pool	C	1	SA/SI		
345	Run	A	3	GR/SI		
346	Pool	C	1	GR/SI		
347	Glide	B	2	GR/SI		
348	Potential obstacle/obstruction to fish passage					
349	Glide	D	2	BO/BE/SA		
350	Lamprey	C	1	SA/SI		Optimal
351	Eddy	C	0	GR/SA/SI		
352	Run	C	3	BO/BE/CO		
353	Glide	D	2	BO/SA/CO		
354	Pool	E	1	BO/CO/SI		
355	Lamprey	C	1	SA/SI		Optimal
356	Glide	E	2	BO/SA/CO		
357	Salmonid	C	4	BO/CO		Parr
358	Salmonid	B	4	BO/CO		Parr/Fry
359	Run	B	2	BO/CO/SA		
360	Riffle	A	2	BO/CO/GR		
361	Lamprey	C	1	SA/SI		Optimal
362	Glide	D	1	BO/CO/SA		
363	Lamprey	B	1	SA/SI		Optimal
364	Run	C	2	BO/CO/SA		
365	Riffle	B	3	BO/CO/SA		
366	Glide	C	2	BO/CO/SA		
367	Lamprey	B	1	SA/SI		Optimal

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
368	Salmonid	C	3	BO/CO/GR		Sub optimal spawning
369	Lamprey	B	2	GR/SA/SI		Sub optimal
370	Salmonid	B	4	BO/CO/GR		Parr/Fry
371	Run	B	3	BO/CO/SA		
372	Run	C	3	BO/CO/SA		
373	Lamprey	B	2	GR/SA/SI		Sub optimal
374	Glide	B	1	SA/SI		
375	Lamprey	B	2	GR/SA/SI		Sub optimal
376	Lamprey	B	1	GR/SA/SI		Sub optimal
377	Run	B	3	BO/CO/SA		
378	Run	B	3	BO/CO/SA		
379	Riffle	B	2	BO/CO/GR		
380	Run	B	2	BO/CO/GR		
381	Riffle	B	2	BO/CO/GR		
382	Run	C	2	BO/CO/GR		
383	Potential obstacle/obstruction to fish passage					
384	Salmonid habitat	B	4	BO/CO/GR		Parr/Fry
385	Run	B	2	BO/CO/GR		
386	Glide	C	2	BO/CO/GR		
387	Run	B	2	BO/CO/GR		
388	Glide	C	2	BO/CO/GR		
389	Salmonid habitat	B	3	BO/CO/GR		Fry
390	Run	B	3	BO/CO/GR		
391	Salmonid habitat	B	3	BO/CO/GR		Fry
392	Run	D	2	BO/CO/GR		
393	Potential obstacle/obstruction to fish passage					
394	Run	C	2	BO/CO/GR		
395	Run	B	2	BO/CO/GR		
396	Salmonid habitat	B	3	BO/CO/GR		Fry
397	Run	C	3	BO/CO/GR		
398	Run	B	2	BO/CO/GR		
399	Potential obstacle/obstruction to fish passage					
400	Glide	B	1	BO/CO/GR		
401	Run	C	2	BO/CO/GR		
402	Riffle	B	2	BO/CO/GR		
403	Run	B	2	BO/CO/GR		
404	Glide	C	2	AR/BO		
405	Potential obstacle/obstruction to fish passage					
406	Pool	C	2	BO/CO/GR		
407	Run	B	2	BO/CO/GR		
408	Salmonid habitat	B	3	BO/CO/GR		Fry

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
409	Run	B	3	BO/CO/GR		
410	Salmonid habitat	B	3	BO/CO/GR		Fry
411	Run	B	3	BO/CO/GR		
412	Salmonid habitat	B	4	BO/CO/GR		Parr/Fry
413	Run	C	2	BO/CO/GR		
414	Salmonid habitat	B	3	BO/CO/GR		Fry
415	Salmonid habitat	B	4	BO/CO/GR		Parr/Fry
416	Pool	C	2	BO/CO/GR		
417	Salmonid habitat	B	3	BO/CO/GR		Fry
418	Run	B	2	BO/CO/GR		
419	Potential obstacle/obstruction to fish passage					
420	Riffle	B	2	BO/CO/GR		
421	Pool	D	2	BO/CO/GR		
422	Run	C	2	BO/CO/GR		
423	Run	B	2	BO/CO/GR		
424	Run	C	2	BO/CO/SA		
425	Run	D	4	BO/CO/GR		
426	Run	C	3	BO/CO/GR		
427	Torrent	D	5	BO/CO/GR		
428	Salmonid habitat	C	4	BO/CO/GR		Parr
429	Pool	D	2	BO/CO/GR		
430	Run	D	4	BO/CO/GR		
431	Salmonid habitat	C	4	BO/CO/GR		Parr
432	Lamprey	C	1	SI/SA		Optimal
433	Run	B	2	BO/CO/GR		
434	Salmonid habitat	C	4	BO/CO/GR		
435	Run	B	3	BO/CO/GR		
436	Run	B	3	BO/CO/GR		
437	Salmonid habitat	B	4	BO/CO/GR		Parr/Fry
438	Torrent	D	5	BO/CO/GR		
439	Run	C	3	BO/CO/GR		
440	Run	E	4	BO/CO/BE		
441	Run	C	3	BO/CO/GR		
442	Eddy	D	0	BO/CO/GR		
443	Eddy	D	0	BO/CO/GR		
444	Run	B	2	BO/CO/GR		
445	Run	E	5	BO/CO/GR		
446	Run	D	4	BO/CO/GR		
447	Torrent	E	5	BO/CO/GR		
448	Run	C	4	BO/CO/GR		
449	Lamprey	C	0	SI/SA		Optimal

Target Note	Flow Type	Water depth	Water velocity	Dominant substrate	Vegetation type and % coverage	Habitat type
450	Salmonid habitat	C	4	BO/CO/GR		Parr
451	Torrent	C	5	BO/CO/GR		
452	Run	B	2	BO/CO/GR		
453	Run	C	3	BO/CO/GR		
454	Run	C	4	BO/CO/GR		
455	Salmonid habitat	B	3	BO/CO/GR		Parr/Fry
456	Salmonid habitat	C	4	BO/CO/GR		Parr
457	Run	B	3	BO/CO/GR		
458	Run	C	3	BO/CO/GR		
459	Run	C	4	BO/CO/GR		
460	Run	D	3	BO/CO/GR		
461	Run	D	3	BO/CO/GR		
462	Run	C	3	BO/CO/GR		

Annex 2: Bowland Ecology (2019) – TR3 Ecology Survey Data Report: White-clawed Crayfish

TR3 Ecology Survey Data Report: White-clawed Crayfish

1 Project Details			
Project Name:	Haweswater Aqueduct Resilience Programme	Project Number:	80061155
Written:	Ellen Milner, *Principal Ecologist*	Approved:	Alice Helyar, *Principal Ecologist*
Report reference:	TR3 White-clawed Crayfish Report 2019 V1 TR3 White-clawed Crayfish Report 2019 V2	Date:	11/11/2019 24/06/2020
2 Project Drawings			
TR3 Crayfish Survey Plans – October 2019 (Ref: BOW167_HARP_9.5_CRAYFISH_TR3)		Sheets 1-2	
3 Ecology Surveys			
Surveyors:	Ellen Milner MA, MRes, CEnv, CIEEM Eve Loxham MBiolSci (Hons), GradCIEEM		
Survey date(s):	25/09/2019		
Survey Method:	An initial habitat assessment was undertaken as part of the Extended Phase 1 survey to determine the requirement for detailed white-clawed crayfish (*Austropotamobius pallipes*) surveys. The surveys followed the methodology within Survey and Monitoring Protocol for White-clawed Crayfish (Peay, 2002). This comprised manual searching: carefully lifting suitable stones and debris on the channel bed which crayfish may use as refuge sites. Initially 100 refugia were searched within a 50 m stretch of riverbed. If five or more crayfish were observed (and captured) searching ceased. If fewer than five crayfish were observed, searching continued to 250 refugia. Refuge searching took place in an upstream direction to avoid poor visibility by disturbing silt/sediment. All crayfish captured were identified to species level, sexed, checked for signs of disease or injury and their carapace length (mm) recorded. A record of the approximate size/age class of crayfish observed but not captured was also made.		
Weather Conditions:	25/09/2019: Cloud cover 8/8, Wind Beaufort F1, 14°C, no precipitation.		
Limitations to the survey:	The surveys were undertaken following a period of heavy rain. As a result, whilst the weather conditions were suitable for undertaking the surveys, the watercourse conditions were sub-optimal with evidence of recent flooding/high water events. In some cases watercourses surveyed were considered to be sub-optimal for white-clawed crayfish due to fast flow of water or limited number of refugia available. This could be considered a constraint to the survey. In this case the fast flow is noted in the results section and all suitable refugia were searched.		
4 Survey Results			
TR3.WC6			

Upstream: SD63236554

Downstream: SD63746579

No evidence of white-clawed crayfish or non-native crayfish species was found. This watercourse is considered to be sub-optimal for crayfish, with only short sections of the watercourse with suitable refugia.

Number of refugia searched:201 (3 sections, all suitable refugia searched)

A watercourse with a max depth of approximately 0.25 m and low turbidity, but with some brown colouration to the water.

	The refuges present comprised mainly cobbles with boulders, woody debris, other debris and moss also present. Potential refuges in the bank were present in the form of cobbles/boulder and vertical/undercut banks. The main substrate beneath was gravel, with sections of bedrock and silt also present. Shading was in excess of 30% of the watercourse and comprised overhanging vegetation and shading from trees. The flow is moderate to fast and the watercourse has an approximate mean width of 1 m. The bankside vegetation comprises coarse grassed, soft rush (*Juncus effusus*) and common nettle (*Urtica dioica*). The banks are poached by livestock in places.
TR3.WC12	
	Upstream: SD63826557 Downstream: SD63966569 No evidence of white-clawed crayfish or non-native crayfish species. This watercourse is considered to be sub-optimal for crayfish due fast-flowing sections. Number of refugia searched: 250 (1 section) A watercourse with a max depth of approximately 0.3 m and low turbidity, but with some brown colouration to the water. The refuges present comprised mainly cobbles with boulders, woody debris and other debris (broken pipes). There were no potential refuges in the bank identified. The main substrate beneath was gravel, with sections of bedrock and silt also present. Shading was in excess of 30% of the watercourse from bankside oak (*Quercus* sp.) and hawthorn (*Crataegus monogyna*). The flow is moderate to fast with some slow flowing sections and the watercourse has an approximate mean width of 0.4 m. It flows through sheep grazed pasture. The bankside vegetation comprises coarse grassed, creeping buttercup (*Ranunculus repens*), creeping thistle (*Cirsium arvense*) and soft rush (*Juncus effusus*). The banks are poached by livestock in places as the watercourse is unfenced.
TR3.WC31	
	Upstream: SD64056389 Downstream: SD64186389 Number of refugia searched: 89 (2 sections, all suitable refugia searched) No evidence of white-clawed crayfish or non-native crayfish species. This watercourse is considered to be suitable for crayfish, particularly downstream of the survey area but number of suitable refugia within the survey area is considered to be a limiting factor. A watercourse with a max depth of approximately 0.4 m (with some deeper pools) and low turbidity, but with strong

	brown colouration to the water. The refuges present comprised mainly cobbles with boulders, fine tree roots, moss, woody debris. There were potential refuges in the bank in the form of cobbles/boulder, large tree roosts and vertical/undercut banks. The main substrate beneath was cobbles, with sections of gravel also present. Shading was in excess of 30% of the watercourse from bankside trees. The flow is slow with fast flowing riffles, rapids and small waterfalls. It flows through sheep grazed pasture. It has undercut rock and earth banks and is dark where it flows within woodland in the downstream section of the survey area.

References

Peay S (2003). Monitoring the White-clawed Crayfish *Austropotamobius pallipes*. Conserving Natura 2000 Rivers Monitoring Series No.1, Natural England, Peterborough.

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