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Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

Environmental Statement

Volume 2

Chapter 9B: Aquatic Ecology

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United Utilities

Water for the North West

Creating a world fit for the future

Haweswater Aqueduct Resilience Programme - Proposed Bowland Section

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9. Ecology – 9B Aquatic Ecology

9.1 Introduction

1) This chapter presents the approach and findings of the ecological impact assessment (EcIA) of potential impacts on nature conservation features arising from the Proposed Bowland Section on Aquatic Ecology (terrestrial ecology is covered in Chapter 9A (LCC_RVBC-BO-ES-009-01).

2) The chapter begins by reviewing the legislation and planning policies relevant to Aquatic Ecology. The study area and methodology for the assessment are then outlined. The nature, value and sensitivity of the existing baseline environment are then identified before an assessment is made of the potential effects on the Aquatic Ecology for the Proposed Bowland Section. Mitigation measures have been proposed to avoid, reduce or offset any potential effects and these embedded mitigation measures have been taken into account in the assessment, which are mentioned in Chapter 3: Design Evolution & Development Description (LCC_RVBC-BO-ES-003). Additional mitigation measures are further outlined in Section 9B.7.

9.2 Scoping and Consultations

9.2.1 Scoping

3) An Ecology chapter was included within the EIA Scoping Report which was submitted to the relevant planning authorities for comment in November 2019. Scoping report responses were provided by each of the local authorities and these have been reviewed and incorporated into the assessment. An EIA Scoping Addendum was submitted to the relevant planning authorities in February 2021 to capture changes in the proposed development and EIA approach since November 2019. Scoping comments and responses are outlined in Section 4.3 in Chapter 4 EIA methodology (LCC_RVBC-BO-ES-004).

9.2.2 Consultation

4) During the course of this assessment, consultation has taken place with relevant statutory and non-statutory consultees, stakeholders and third parties, through both correspondence and face-to-face meetings. This has been summarised in Appendix 14 (document reference: LCC_RVBC-BO-APP-014).

9.3 Key Legislation and Guidance

5) **Table 9.1** introduces relevant Aquatic Ecology legislation.

Table 9.1: **Ecology Key Legislation and Guidance**

Table 9.2

Applicable Legislation	Description
International legislation	
Bonn Convention on the Conservation of Migratory Species of Wild Animals 1979	Pertains to migratory species and those that regularly cross the political boundaries of countries. Appendix I includes critically threatened species (those in danger of extinction). Appendix II lists migratory species whose conservation status is unfavourable and which would benefit from coordinated conservation measures. The obligations of the Convention are transposed in the UK into national law by means of the Wildlife and Countryside Act 1981 as amended, with the Countryside and Rights of Way Act 2000 strengthening the protection of certain species in England and Wales.

Applicable Legislation	Description
The Water Environment (England and Wales) Regulations 2017 (WFD Regulations)	The Water Framework Directive (WFD) Regulations require that Environmental Objectives are set for every groundwater and surface waterbody where the Regulations have jurisdiction (England and Wales), to enable them to reach "Good" status by 2015. Where achieving this is not possible (e.g. due to disproportionate costs), less stringent targets are placed, enabling waterbodies to reach "Good" status either by 2021 or 2027
National legislation	
The Conservation of Habitats and Species Regulations 2017 (as amended) Including by: The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019	*The Conservation of Natural Habitats and of the Wild Fauna and Flora (the Habitats Directive 1992, EC Directive 92/43/EEC) is implemented in England by the Conservation of Natural Habitats and Species (Amendment) (EU Exit) Regulations 2019.* Notably Regulation 9 requires every competent authority in the exercise of any of its functions to have regard to the requirements of the Habitats Directive. Provides for the designation and protection of a network of 'European Sites' (also termed Natura 2000), including Special Areas of Conservation (SAC) and Special Protection Areas (SPA). Regulation 43 creates the following offences relating to European Protected Species (EPS): deliberately capture, injure, or kill any wild animal of a European Protected Species; deliberately disturb animals of any such species in such a way as to be likely to: • impair their ability to survive, breed, rear or nurture their young, hibernate or migrate, or • significantly affect the local distribution or abundance of the species to which they belong; • deliberately take or destroy the eggs of such an animal; or • damage or destroy a breeding site or resting place of such an animal. The Regulations also make it an offence (subject to exceptions) to deliberately pick, collect, cut, uproot, destroy, or trade in the plants listed in Schedule 5. However, the actions listed above can be made lawful through the granting of licences (European Protected Species Licence) by the appropriate authorities (Natural England in England). Licences may be granted for a number of purposes, but only after the appropriate authority has determined that the regulations are satisfied.
Natural Environment and Rural Communities (NERC) Act 2006	Section 40 of Natural Environment and Rural Communities (NERC) Act 2006 places a duty to public

Applicable Legislation	Description
	bodies and statutory undertakers, including United Utilities, to ensure due regard to the conservation of biodiversity.
Wildlife and Countryside Act 1981 (as amended)	A number of species are fully protected under the Wildlife and Countryside Act 1981 (as amended), in particular those listed on Schedule 5 (animals).
Countryside and Rights of Way Act 2000 (CROW)	Part III deals specifically with wildlife protection and nature conservation, requiring Government Departments to have regard for the conservation of biodiversity, in accordance with the Convention on Biological Diversity, and that The Secretary of State publishes a list of living organisms and habitat types that are considered to be of principal importance in conserving biodiversity. It also amends and strengthens certain protections afforded by the WCA.
The Eel (England and Wales) Regulations 2009	The Eel (England and Wales) Regulations 2009 implement Council Regulation (EC) No 1100/2007 (OJ No L 248) establishing measures for the recovery of the stock of European eel, which has been classified as "Critically Endangered" on the International Union for Conservation of Nature (IUCN) Red List.
Key EcIA Guidance	
CIEEM Guidelines for Preliminary Ecological Appraisal[1]	Provides a common framework for preliminary ecological assessment (PEA) to promote better communication, understanding and cooperation between stakeholders.
CIEEM Guidelines for Ecological Impact Assessment[2]	Promotes good practice, a scientifically rigorous and transparent approach to ecological impact assessment (EcIA). Provides a common framework for EcIA to promote better communication and closer cooperation between ecologists undertaking EcIA and provides decision makers with relevant information about the likely ecological effects of a project.

6) National and Local Planning Policies are covered in Chapter 5 of the Proposed Bowland Section Environmental Statement (document reference: LCC_RVBC-BO-ES-005).

[1] CIEEM (2017) Guidelines for Preliminary Ecological Appraisal, Second Edition. Chartered Institute of Ecology and Environmental Management, Winchester

[2] CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal. Chartered Institute of Ecology and Environmental Management, Winchester

9.4 Assessment Methodology and Assessment Criteria

9.4.1 Assessment Methodology

7) The assessment of aquatic ecology features undertaken to inform this Environmental Statement comprises an EcIA undertaken in accordance with current best practice methods, the Guidelines for Ecological Impact Assessment in the United Kingdom[3] (CIEEM, 2018).

8) The method was agreed with relevant stakeholders as outlined above in Section 9B.2.2.

9.4.2 Establishing the Baseline

The desk study and field survey methodologies are presented in full in Appendices 9B.1 - 9B.3 for WFD communities and white clawed crayfish (*Austropotamobius pallipes*), otter (*Lutra lutra*), and water vole (*Arvicola amphibious*) respectively.

9) The detailed methodology and results of the ecological surveys undertaken to provide baseline data in support of the aquatic ecology EcIA are provided within Appendices 9B.1 to 9B.3:

   - Appendix 9B.1: HARP Proposed Bowland Section - Aquatic ecology (WFD communities and white clawed crayfish) baseline information (document reference: LCC_RVBC-BO-TA-009-02-01)
   - Appendix 9B.2: HARP Proposed Bowland Section - Otter baseline information (document reference: LCC_RVBC-BO-TA-009-02-03)
   - Appendix 9B.3: HARP Proposed Bowland Section - Water vole ecology baseline information (document reference: LCC_RVBC-BO-TA-009-02-03)

9.4.2.1 Study Area

10) A study area has been defined for the aquatic ecology EcIA assessment as a 500 m buffer around all project development envelopes. This allowed for an understanding of the potential direct and/or indirect impacts of the activities associated with the Proposed Bowland Section.

11) Measuring approximately 5 km in length, three WFD surface water bodies, River Hindburn and River Hodder - conf Easington Bk to conf Ribble. In addition, any WFD water bodies which lay immediately up and downstream of the study area were also considered for assessment, to ensure that potentially wider reaching impacts of the Proposed Bowland Section were considered.

The watercourses within the study area, the associated WFD waterbody, and the component of the proposed Bowland section with hydrological connectivity to the Lower Houses Compound and Newton-in-Bowland Compound are shown in
12) **Table 9.3**.

Table 9.3: Watercourse summary and associated scheme component.

Watercourse	Watercourse ID	WFD waterbody	Relevant scheme component
Cod Gill	W206	River Hindburn GB112072066050	Access track (construction) and Newton in-Bowland compound
Unnamed Watercourse 163	W207		Newton in-Bowland compound
Unnamed Watercourse 169	W215		Access track (construction)

[3] CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1. Chartered Institute of Ecology and Environmental Management, Winchester. Updated September 2019.

Watercourse	Watercourse ID	WFD waterbody	Relevant scheme component
River Hindburn	W478		Access track (construction) and Newton in-Bowland compound
River Hodder	W477	Hodder - conf Easington Bk to conf Ribble (GB112071065560)	Access track (construction) and overflow
Unnamed Watercourse 384	W461		Access track (construction) and Lower House compound
Unnamed Watercourse 385	W462		Access track (construction) and Lower House compound
Unnamed Watercourse 386	W463		Access track (construction)
Unnamed Watercourse 391	W470		Access track (construction)
Unnamed Watercourse 1312	W1382		Access track (construction)

9.4.3 Valuation of Aquatic Ecology Features

13) The level of importance of an ecological feature is determined within a defined geographical context (see **Table 9.3**); international and European, national, regional, metropolitan, county, vice-county or other local authority-wide area, River Basin District, estuarine system/coastal cell, or local (CIEEM, 2018). When determining the importance of a defined site, habitat, ecosystem or species population, contextual information about legal status, distribution and abundance has been provided where available, including trends based on historical records. For example, a population of white clawed crayfish potentially affected by the proposed development could be considered important at a national level as these species are afforded statutory legal protection, are rare and their population is in decline.

Table 9.4: **Geographic context of ecological features**

Geographic importance	Criteria/examples
International and European	Internationally designated sites Features of internationally designated sites (SAC, SPA, Ramsar) Habitats or species listed on Annex I of the Habitats Directive. Habitat types that are considered priorities for conservation where over 1% of the international population or habitat extent is located within the affected area.
National	Designated or proposed SSSI, NNR, Marine Conservation Zones ('MCZ') and their qualifying features, some of which may depend on land outside the designation boundaries. Supporting habitats or populations which contribute to internationally designated sites (e.g. salmonid spawning habitat outside of a hydrologically connected SAC designated for Atlantic salmon) Species populations of national importance due to relative size, rarity or quality (including, but not exclusively, species listed on Schedules 5 or 8 of the W&C Act 1981 or occurring on UK Red Data lists).
Regional	Designated or proposed sites or species populations which exceed the County level designations but fall short of SSSI selection criteria. Over 1% of the regional population or habitat extent is located within the affected area.
Metropolitan, County, vice-county or other local authority-wide area River Basin District	Designated or proposed County Wildlife Sites (CWS) or other Local Wildlife Site (LWS) and their qualifying features where they occur within the designation boundaries. A viable area of ASNW or local BAP habitat which meets County significant criteria or smaller areas that are essential to maintain the viability of the whole at a county level. Regularly occurring species populations (including, but not exclusively protected species, SPI or other species of conservation concern) or habitat areas of County (or District) importance due to relative size, rarity or quality.
	Habitats or species within a catchment that contribute to local population/extent within the catchment but do not form above 1% of the wider population or extent within the region.
Estuarine system/Coastal cell	Not applicable
Local.	Local Nature Reserves (LNR), other reserves owned/managed by e.g. Local Wildlife Trust, Local Authority, RSPB (unless also designated at a higher level) and other non-designated sites which may not meet any of the above criteria but which appreciably enrich the local ecological network. Regularly occurring species populations which may include protected species, SPI, or County notable species which are of local significance due to relative size, quality or critical life stage supported. Features that do not meet any of the above criteria but which appreciably enrich the local ecological network, although these may themselves be common and

	widespread, such as small stream or rivers which support common species.
Less than local	Populations of common and widespread species or habitats without protection or conservation designation but which contribute to the diversity, ecological function, or interest of the immediate local area. Isolated and small fragments of HPI or populations of SPI (only where better representative examples of such habitats or species are common nearby).
Immediate site	Habitats of little or no ecological value or function

9.4.4 Assessment of Impact Significance

14) Effects of the Proposed Bowland Section on an ecological feature are assessed as significant within a geographical context; international, national, regional, county, district, local or site level, or not significant if the impact is not appreciable. A significant effect is an effect that either supports or undermines the integrity or conservation status of an ecological feature. The significant effect has been evaluated by considering the residual effect with mitigation in place.

15) The level of significance of an effect may not be the same as the level of importance of the feature. For example, a white clawed crayfish population identified within the study area may be assessed as important at a national level, however the effect on the species as a result of a proposed development may be significant only at a local level as the actual impact is temporary, minor in extent and mitigated through a specific working methodology designed to reduce the effect on the species.

To determine likely significance of impact, the following parameters are used as appropriate:

- impact type - direct or indirect, positive or negative.
- magnitude of impact – the 'amount' or intensity of an impact. This may sometimes be synonymous with 'extent' (see below) for certain receptors, such as habitats loss. For mortality it may be the number of individuals killed.
- extent of impact – the area over which the impact will be felt. It is noted that indirect effects such as habit fragmentation and pollution can affect a wider area of habitat, for example by limiting movement of fish to spawning, feeding and nursey areas present upstream of the crossing or by causing pollution downstream of the crossing.
- duration of impact – how long it will occur. CIEEM 2018 Guidelines suggest that ecological impact durations should be described in terms of ecological characteristics (e.g. species lifecycles/longevity) rather than human timeframes. Therefore, as an indicative guide for this assessment, for species receptors:
  - short-term is up to one season (e.g. migration, spawning, flowering and univoltine life cycles associated with fly life, etc.) – as a rough guide, 6 months to a year for fauna;
  - medium-term is up to one typical reproductive life-span (in the wild). This varies greatly depending on species, but generally anything from one year to 5 years as a rough guide for fauna; and
  - long-term is over several (species) generations.
  - permanent is where no reasonable chance of recovery/restoration is evident within the foreseeable future.

16) The ecological construction impacts refer to the actions resulting in changes to an ecological feature during construction. The main construction activities, programme, establishment of the proposed development construction working area and reinstatement are described in Chapter 3: Design Evolution & Development Description (LCC_RVBC-BO-ES-003).

17) With regard to the duration of construction effects; a temporary effect is taken to mean within the scheme construction period with an additional five-year establishment period for new planting.

9.4.5 Assumptions and Limitations

18) Constraints and or limitation to survey methodology and establishment of the baseline of specific ecological receptors (including desk study data) are identified in Appendices 9B.1 (LCC_RVBC-BO-TA-009-02-01), 9B.2(LCC_RVBC-BO-TA-009-02-01), and 9B.3 (LCC_RVBC-BO-TA-009-02-01).

19) Surveys were completed within appropriate seasons over appropriate periods in accordance with industry standards for the specific survey. Nevertheless, the surveys will only identify habitats and plants present at the time of survey. Additionally, most species investigated are mobile and will move into and out of areas over time. For these reasons a precautionary approach has been taken in the prediction of impacts. Where there is any doubt, except where specifically noted, species are assumed present and the impact is given the higher level of significance.

20) White clawed crayfish surveys were undertaken between the showers during the days when there was precipitation. The number of available refuges was a constraint in some surveys in 2019 where opportunities to search for crayfish were limited by the number of suitable refuges.

21) The water vole surveys were undertaken within the recommended period for water vole surveys, there were no seasonal constraints to the surveys. The weather conditions during the 2019 surveys were considered suitable for undertaking the survey, however the river conditions were considered sub-optimal

9.5 Baseline Conditions

9.5.1 Information Sources

22) Information from the following sources have been used to inform this EcIA for the Proposed Bowland Section:

- Haweswater Aqueduct Resilience Programme – Proposed Bowland Section – EIA Scoping Report (Jacobs, October 2019)
- Lancashire Environmental Records Network (LERN), including pre-existing records of aquatic species within 2 km of the Proposed Bowland Section
- Ecological datasets for the period 2009 – 2019 were obtained via the Environment Agency Ecology and Fish Data Explorer website
- Environment Agency Catchment Data Explorer to determine the extent and condition of WFD waterbodies and catchments.
- North West River Basin Management Plan (Environment Agency, 2018)
- Natural England habitat and species inventories including:
  - land-based statutory designated wildlife sites in England, including Ramsar sites, proposed Ramsar sites, Special Areas of Conservation (SAC), Possible SACs, Special Protection Areas (SPA), Potential SPAs, Sites of Special Scientific Interest (SSSI), SSSI units, SSSI Impact Risk Zones (IRZ), National Nature Reserves (NNR) and Local Nature Reserves (LNR)
  - European Protected Species Licences (EPSL)
- Ecology Survey Data Reports produced by Ricardo Energy and Environment for the Proposed Bowland Section:
  - Appendix 9B.1: HARP Proposed Bowland Section - Aquatic ecology (WFD communities and white clawed crayfish) baseline information
  - Appendix 9B.2: HARP Proposed Bowland Section - Otter baseline information
  - Appendix 9B.3: HARP Proposed Bowland Section - Water vole ecology baseline information.

23) The desk study and field survey methodologies are presented in full in Appendices 9B.1 - 9B.3 for WFD communities and white clawed crayfish (*Austropotamobius pallipes*), otter (*Lutra lutra*), and water vole (*Arvicola amphibio*us) respectively.

9.5.1.1 Desk study methodology

24) The MAGIC website mapping tool[4] was used to help identify any statutory or non-statutory designated sites for freshwater fish, macrophyte and aquatic macroinvertebrate species within the Proposed Bowland Section study area.

25) Historic records of otter and water vole from within 2km of the proposed scheme were requested from the local environmental records centre Lancashire Environmental Records Network (LERN) in 2019.

26) Ecological datasets for the period 2009 – 2019 were obtained via the Environment Agency Ecology and Fish Data Explorer website[5], 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.

27) Additional data sources utilised during the desk study:

- Aerial photography (MAGIC, 2020);
- Environment Agency Catchment Data Explorer (CDE) (Environment Agency, 2019)[6];
- Designated areas (Natural England, 2020)[7]; and,
- North West River Basin Management Plan (Environment Agency, 2018);

9.5.1.2 Field survey methodologies

28) The desk study data, consultations, and habitat suitability assessment undertaken as part of the Phase 1 Habitat survey were used to inform the scope of further ecological surveys including the distribution of the white clawed crayfish, otter, and water vole populations within the zone of influence. Details of species-specific methodologies and the results of the surveys are summarised in **Error! Reference source not found.** and detailed in Appendices 9B.1-9B.3 to Chapter 9B of the Environmental Statement.

29) Watercourse Walk-over habitat surveys were undertaken in April 2020 for watercourses within and adjacent to the Lower House and Newton-in-Bowland Compounds which contain the launch and receptor sites for the tunnelling works, open cut sections, compounds, and access tracks. The walk-over habitat survey methodology was based on the Environment Agency's 'Restoration of Riverine Salmon Habitats' guidance manual (Hendry & Cragg-Hine, 1997). The Hendry & Cragg-Hine' method was developed to be used to inform habitat restoration, fish survey site selection, and fish population studies. Details of the watercourse walkover methodology and the results of the surveys are summarised in **Error! Reference source not found.** and d etailed in Appendix 9B.1.

[4] Multi-Agency Geographical Information for the Countryside (MAGIC) [Accessed May 2020] https://magic.defra.gov.uk/MagicMap.aspx. Accessed May-July 2020.
[5] Environment Agency Ecology and Fish Data Explorer website https://environment.data.gov.uk/ecology-fish/. Accessed May-July 2020.
[6] Environment Agency Catchment Data Explorer website https://environment.data.gov.uk/catchment-planning/. Accessed May-July 2020.
[7] Natural England Designated Sites View website https://designatedsites.naturalengland.org.uk/SiteSearch.aspx. Accessed May-July 2020.

Table 9.5: Surveys undertaken to inform the aquatic ecology impact assessment.

Protected Species Survey	Survey Extent	Date of Surveys
Otter	Presence/absence survey were undertaken on watercourses with suitable habitat to support otter within the zone of influence	September 2019 and April 2020
Water Vole	Presence/absence survey were undertaken at three watercourses	September 2019 and April 2020
White Clawed Crayfish	White Clawed Crayfish manual search surveys were undertaken at eight watercourses surrounding the Bowland compounds and access tracks.	September 2019 and April 2020
Watercourse walkover surveys	The watercourse walkover surveys were undertaken to obtain a detailed representation of the location, extent, and condition of habitat features within watercourses and the riparian zone. This was done by walking the riverbank of the selected survey stretch and entering the river when necessary. The habitats and features were present mapped. 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.	April and May 2020

9.5.2 Designated Sites

30) The presence of sites designated for terrestrial ecology features and any associated impacts are discussed in Chapter 9A (document reference: LCC_RVBC-BO-ES-009-01). No statutory designated sites that are designated for aquatic habitats or species were identified within the zone of influence of the Proposed Bowland Section.

31) 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 are. These relevant non-statutory designated sites are summarised in Table 9B.5. Further information relating to these sites is provided in Technical Appendix 9A.1 (document reference: LCC_RVBC-BO-TA-009-01-01) for the Terrestrial Ecology Chapter 9A.

32) Unnamed Watercourse 384 is within the Gamble Hole Farm BHS upstream of the Newton-in-Bowland Compound. The BHS is of interest for the presence of vegetation associated with wet flushes and unimproved grasslands.

33) The River Hodder adjacent to the Newton-in-Bowland compound is fully within the River Hodder Biological Heritage Site (hereafter referred to as the River Hodder BHS) From Confluence with River Ribble Upstream to Cross of Greet Bridge/ Bowland Fells SSSI Boundary.

Table 9B.9.6: 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, green figwort and melancholy thistle. Many of the river 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)

9.5.3 Macrophytes and Phytobenthos

34) 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 EA in the assessment of WFD status of the Cycle 2 assessments.

35) 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.

36) The available baseline TDI scores for the sites associated with both the River Hodder and River Hindburn waterbodies are indicative of moderate nutrient conditions, while the very low percentage motile taxa are indicative of clear, undisturbed waters.

37) No Environment Agency macrophyte monitoring data was available for the relevant sections of the River Hodder or River Hindburn waterbodies.

38) Further details are provided in Appendix 9B.1 (LCC_RVBC-BO-TA-009-02-01).

9.5.4 Fish

39) The Environment Agency monitoring data was available for sites in the River Hodder and River Hindburn WFD waterbodies. The available baseline fish data indicates the communities present within the watercourses are typical of upland fast flowing watercourses dominated by salmonid species.

40) The River Hodder waterbody supports community dominated by salmonid species and included several internationally and/or nationally designated species including Atlantic salmon (*Salmo salar*), bullhead (*Cottus gobio*), and European eel (*Anguilla anguilla*).

41) The River Hindburn waterbody supports a community supports a community dominated by brown trout and bullhead with variable abundances of Atlantic salmon, low abundances of European eel, and high abundances of minor species such as minnow (*Phoxinus phoxinus*), stone loach (*Barbatula barbatula*), and bullhead.

42) Atlantic salmon, brown trout, and bullhead have low tolerance for environmental disturbance relating to reductions in flow velocity, water quality, or increases in fine sediments.

43) Further details are provided in Appendix 9B.1 (LCC_RVBC-BO-TA-009-02-01).

9.5.5 Aquatic Macroinvertebrates

44) The average LIFE score from Environment Agency monitoring sites on the River Hindburn and River Hodder WFD waterbodies indicates communities with a preference for moderate to high flow velocities and a high sensitivity to reduction in flow velocity.

45) The WHPT and $WHPT_{ASPT}$ scores from Environment Agency monitoring sites within the River Hindburn and River Hodder WFD waterbodies indicate that, in general, the macroinvertebrate communities associated with the water bodies are representative of good water quality with a high proportion of pollution sensitive families present.

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

47) Further details are provided in Appendix 9B.1 (LCC_RVBC-BO-TA-009-02-01).

9.5.6 White Clawed Crayfish

48) 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. No white clawed crayfish or non-native species were identified in the River Hodder. Unnamed Watercourse 384 was assessed as being unsuitable for white clawed crayfish and was not subject to surveys.

49) 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.

50) Further details are provided in Appendix 9B.1 (LCC_RVBC-BO-TA-009-02-01).

9.5.7 Otter

51) Three watercourses were surveyed in the River Hindburn WFD waterbody adjacent to the Newton-in-Bowland Compound (tunnelling receptor site): Unnamed Watercourse 169, Cod Gill, and Unnamed Watercourse 178. All surveyed watercourses in the Hindburn Catchment were assessed as having low suitability for otters, no evidence of otters was identified during surveys in 2019.

52) Two watercourses were surveyed in the River Hodder (confluence to Easington Brook) waterbody at adjacent to the Lower Houses Compound, both watercourses are part of the River Hodder (confluence to Easington Brook) catchment. No otter holts or lie-up areas were identified in the surveyed reach of Unnamed Watercourse 384. Extensive evidence of recent otter activity was found on the River Hodder including 22 spraints, three potential couches, and one possible holt. Unnamed Watercourse 384 was considered to have low suitability for otter but is likely to be used by otters intermittently due to the presence of otters on the River Hodder in the wider catchment.

53) Further details are provided in Appendix 9B.2 (LCC_RVBC-BO-TA-009-02-02).

9.5.8 Water vole

54) Four watercourses were surveyed for water vole field signs in the Hindburn catchment: Cod Gill, Unnamed Watercourse 169, Unnamed Watercourse 178, and Unnamed Watercourse 186. All four watercourses were assessed as having low suitability for water vole. No definitive evidence of water vole was identified in during the surveys.

55) Two watercourses were surveyed for water vole field signs in the River Hodder catchment: River Hodder and Unnamed Watercourse 384. Both watercourses were assessed as having low suitability for water vole. No evidence of water vole was identified in during the surveys.

56) No evidence of water vole was identified at any watercourses surveyed in 2019 and 2020 in either the River Hodder or Hindburn catchments. Due to the absence of definitive field signs and absence of historic desk study records it is concluded that water voles were absent from the watercourses adjacent to the Proposed Bowland Section

57) Further details are provided in Appendix 9B.3 (LCC_RVBC-BO-TA-009-02-03).

9.5.9 Summary and Valuation of Ecological Receptors

58) A summary of the value of aquatic ecology receptors within each watercourse is shown in **Table 9.7**.

Table 9.7: Importance of aquatic ecology receptors in each potentially impacted watercourse

Watercourse	River Hindburn	Cod Gill	Unnamed Watercourse 163	Unnamed Watercourse 169	River Hodder (W477)	Unnamed Watercourse 384 (W461)	Unnamed Watercourse 385 (W462)	Unnamed Watercourse 386 (W463)	Unnamed Watercourse 391 (W470)	Unnamed Watercourse 1312 (W1382)
WCID	W478	W206	W207	W215	W477	W461	W462	W463	W470	W1382
WFD water-body	River Hindburn (GB112072066050)	River Hindburn (GB112072066050)	River Hindburn (GB112072066050)	River Hindburn (GB112072066050)	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)
Designated sites	River Hindburn BHS - local	Not applicable	Not applicable	Not applicable	River Hodder BHS - local	Gamble Hole Farm BHS - local	Not applicable	Not applicable	Not applicable	No applicable
Macro-phytes	Local	Local	Immediate site	Immediate site	Local	Immediate site	Immediate site	Immediate site	Immediate site	Immediate site
Fish	Local	Local	Local	Immediate site	Local	Immediate site	Immediate site	Immediate site	Likely absent – value not applicable	Likely absent – value not applicable
Macro-invertebrates	Local	Local	Immediate site	Immediate site	Local	Immediate site	Immediate site	Immediate site	Likely absent – value not applicable	Likely absent – value not applicable
White clawed crayfish	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable
Otter	Immediate site	Immediate site	Immediate site	Immediate site	County	Local	Immediate site	Immediate site	Likely absent – value not applicable	Likely absent – value not applicable

Watercourse	River Hindburn	Cod Gill	Unnamed Watercourse 163	Unnamed Watercourse 169	River Hodder (W477)	Unnamed Watercourse 384 (W461)	Unnamed Watercourse 385 (W462)	Unnamed Watercourse 386 (W463)	Unnamed Watercourse 391 (W470)	Unnamed Watercourse 1312 (W1382)
Water vole	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable	Likely absent – value not applicable

9.6 Assessment of Likely Significant Effects

59) The impact assessments undertaken for the Environmental Statement consider the mitigation measures that have been incorporated into the proposed development design as well as best practice construction management activities which will be incorporated into the Construction Code of Practice (CCoP). These embedded mitigation measures to reduce/ avoid development impacts include, for example, site drainage, sediment management, water quality monitoring etc.; the embedded mitigation is outlined in the relevant sections of the CCoP. The assessment methodology involved the identification of the nature conservation value of each potentially affected important aquatic ecology receptor using a geographical framework. Those that were found to have at least local value have been subject to systematic impact assessment.

60) The aquatic ecology features scoped out of the assessment of likely significant effects based on the available baseline information are summarised in **Table 9.8**.

Table 9.8: Features and Effects Scoped Out

Aquatic Ecology Feature	WFD waterbody	Value	Reason
Water vole (all watercourses)	River Hindburn (GB112072066050)	Not applicable	Not present on any watercourses during baseline surveys no potential for adverse effects from enabling works
	Hodder - conf Easington Bk to conf Ribble (GB112071065560)		
Invasive non-native species	River Hindburn (GB112072066050)	Not applicable	Terrestrial invasive species are assessed as part of the terrestrial ecology assessment in Chapter 9A (document reference: LCC_RVBC-BO-ES-009-01). No aquatic invasive species were identified within the red line boundary for the enabling works and the embedded mitigation in the CCoP are considered sufficient to prevent the introduction of aquatic or riparian invasive species.
	Hodder - conf Easington Bk to conf Ribble (GB112071065560)		
White clawed crayfish	River Hindburn (GB112072066050)	Not applicable	Not present on any watercourses during baseline surveys no potential for adverse effects from enabling works
	Hodder - conf Easington Bk to conf Ribble (GB112071065560)		

9.6.1 Enabling Works Phase

61) The following section describes the effects of the Proposed Bowland Section on Aquatic Ecology during the enabling works phase.

62) Th Enabling works are anticipated to last from the time planning permission is obtained until the commencement of the construction phase in Q2 2023 and would include the following activities that have potential to result in biophysical changes to important aquatic ecological features:

- Construction of site compounds (including vegetation removal, earthworks, provision for compound drainage and SuDS, and creating areas of hardstanding) to provide a working area for construction phase activities
- Construction of temporary access routes (including vegetation removal, earthworks, and associated drainage)
- Construction of culverts for temporary access routes
- Fencing (comprising stock-proof post and wire around open-cut working areas and taller 'heras' type around compounds and lay-down areas).

63) Effects during the Enabling works phase have been summarised in **Table 9.9**. Likely nature conservation impacts include:

- Habitat loss (both temporary and permanent)
- Habitat fragmentation (temporary)
- Management changes to habitats (leading to habitat degradation)
- Disturbance of individuals or groups of animals
- Direct injury or mortality of individual animals and plants
- Pollution (a cause of habitat degradation and injury/mortality to species)
- Impacts from water level changes (a cause of habitat loss, degradation and/or injury/mortality to species)
- Invasive species (a cause of mortality or habitat degradation impacts).

64) These general types and sources of impact are described in generic terms below and then applied specifically to each valued receptor in **Table 9.10**.

9.6.1.1 Habitat Loss

65) Loss of habitat can directly affect the integrity of individual designated sites and the conservation status of notable habitats and associated protected or notable species if the overall area is reduced, thereby increasing its rarity. Habitat loss can also create a greater edge effect, whereby interior portions of a site or habitat, even if not directly impacted, may become more vulnerable to disturbance, physical damage or colonisation by non-native species.

66) Culvert construction at Unnamed Watercourse 169 for the access track to the Lower Houses Compound could cause compaction of bed substrate and disturbance of channel features on Unnamed Watercourse 169. The riparian vegetation is of limited ecological value, and although the watercourse may be intermittently used by foraging otters no otter holts or resting places were identified at this location. Therefore, habitat loss from construction of the access track culvert and associated riparian vegetation clearance would not result in a significant impact for otter. The construction of the culvert will result in temporary loss of in river habitats within the footprint of culvert for fish, macroinvertebrates, otter, and macrophytes. The baseline ecology data for the watercourse indicates that it is of immediate site value for macroinvertebrates, macrophytes, fish, and otter and has limited supporting habitat for nationally or internationally designated species. The impact of the temporary habitat loss would be restricted to the culvert footprint, low magnitude, medium duration, and reversible. Therefore, construction of the access track culvert and associated geomorphological impacts would not result in a significant impact for macroinvertebrates, macrophytes, or fish

67) Construction of culverts at Unnamed Watercourse 384 and Unnamed Watercourse 386 for the access track to the Newton-in Bowland Compound could cause compaction of bed substrate and disturbance of in channel features on the watercourses. The riparian vegetation is of limited ecological value, and although the watercourse may be intermittently used by foraging otters due to their presence in the wider catchment.

Unnamed watercourse 384 did not support suitable habitat for otter holts or resting places. The location of the culvert on unnamed Watercourse 384 is outside of the Gamble Hole Farm BHS consequently there will be no loss of aquatic habitats within the site during the enabling works phase. Therefore, habitat loss from construction of the access track culvert and associated riparian vegetation clearance would not result in a significant impact for otter. The construction of the culverts will result in temporary loss of in river habitats within the footprint of culverts for fish, macroinvertebrates, otter, and macrophytes. The baseline ecology data for the watercourse indicates that both watercourses are of immediate site value for macroinvertebrates, macrophytes, and fish. The impacts of the temporary habitat loss would be restricted to the culvert footprint, and are of low magnitude, medium duration, and reversible. Therefore, construction of the access track culvert and associated geomorphological impacts would not result in a significant impact for macroinvertebrates, macrophytes, or fish.

68) Clearance of riparian vegetation would be required for the construction of the bridge over the River Hodder for the Newton-in Bowland Compound access track. This will result in a small scale loss of habitats with the River Hodder BHS. This has potential for loss of resting places for otter, as extensive otter activity including a potential holt was identified downstream of the bridge. However, with the embedded mitigation included as part of the CCoP habitat loss from construction of the access track culvert and associated riparian vegetation clearance would not result in a significant impact for otter. No in channel activities are required for construction of the bridge therefore, there will be no reduction of habitat availability for macroinvertebrates, macrophytes, and fish in the River Hodder (including the River Hodder BHS).

69) Clearance of riparian vegetation would be required for the construction of the outfall at Cod Gill. This has potential for loss of resting places for otter, although no resting places were identified during baseline surveys it is a highly mobile species and is present in the downstream catchment (River Ribble) so use of the watercourse could change prior to commencing enabling works. However, with the embedded mitigation included as part of the CCoP habitat loss from construction of the access track culvert and associated riparian vegetation clearance would not result in a significant impact for otter. Outfall construction could disturb bed and bank features and cause compaction of bed substrate. Cod Gill was identified as being of local value for macroinvertebrates, macrophytes, and fish. Therefore, construction of the temporary outfall and associated geomorphological impacts would result in a significant impact at the local scale due to loss or change in of habitat availability/suitability for macroinvertebrates, macrophytes, and fish.

70) The temporary culverts and outfalls, access roads, and compounds would be removed at the end of the construction phase. It is assumed that these areas would be returned to the baseline conditions with appropriate landscaping therefore impacts associated with habitat loss at these locations are considered to be temporary, medium term and reversible.

9.6.1.2 Habitat Fragmentation

71) Habitat fragmentation generally results in a reduction in habitat connectivity and the increasing isolation of remaining areas. Fragmentation can occur through removal of habitat that creates a gap between two retained areas of habitat on either side. Such fragmentation becomes ecologically significant when species associated with that habitat type are then unable or unwilling to cross this gap, thus creating a barrier effect. Physical barriers to species movement such culverts can also cause habitat fragmentation within aquatic environment. Fragmentation can also sever a habitat's connection with the physical processes necessary to sustain that habitat. If the habitat reliant on such processes suffers degradation or loss as a result, then the habitat's conservation status is affected.

72) The creation of culverts at Unnamed Watercourse 169, Unnamed Watercourse 384, and Unnamed Watercourse 386 could prevent fish and otter from reaching upstream habitats. However, the watercourses are considered to be if limited value for foraging and commuting otters due to the small size, lack of connectivity to notable upstream food sources, limited availability of suitable prey within the channel, and high availability of other foraging habitats within the catchment. The watercourses are likely to support limited population of migratory fish species due to their presence in downstream watercourses. Therefore, with embedded mitigation for sympathetic culvert design impacts to otter and fish from habitat fragmentation due to installation of the access track culverts at Unnamed Watercourse 169, Unnamed

Watercourse 384 (including Gamble Hole Farm BHS), and Unnamed Watercourse 386 would not result in a significant effect.

73) The creation of Newton in-Bowland Compound could prevent fish and otter from reaching upstream habitats through increased disturbance to the River Hodder from increased lighting and noise. The River Hodder is considered to be of suitable for foraging and commuting otters with extensive evidence of activity observed during baseline surveys. The watercourse also supports populations of-migratory fish species sensitive to increased disturbance and lighting Therefore, impacts to otter and fish from habitat fragmentation due to increased disturbance from creation of the Newton-in Bowland Compound would result in a significant effect.

74) The compounds, access roads and associated bridges and culverts will be removed at the end of the construction phase. It is assumed that these areas would be returned to the baseline conditions with appropriate landscaping therefore impacts associated with habitat fragmentation at these locations are considered to be temporary, medium term and reversible.

9.6.1.3 Disturbance

75) Enabling works activities can result in increased levels of visual, noise, olfactory and vibration disturbance which could impact on habitats or species. Disturbance could impact different habitats and species in different ways at different times of the year. For example, disturbance to fish would be most acute during the migratory or breeding period for migratory fish such as Atlantic salmon.

76) Increased levels of disturbance are likely to increase the effects of habitat loss, fragmentation, and isolation, with habitats beyond the red line boundary effectively 'lost' due to increases in human disturbance. Increased disturbance levels whilst creating the compounds and the access track could act as a barrier to dispersal for species sensitive to increased levels of disturbance. As described above for Habitat fragmentation this will most relevant to noise and lighting at the Newton-in Bowland Compound. Without the embedded mitigation relating to direction and shielding of site lighting could disturb otter, Atlantic salmon, and eels in the River Hodder catchment (including the River Hodder BHS). Impacts to otter and fish from a reduction in habitat suitability due to increased disturbance from creation of the Newton-in Bowland Compound would result in a significant effect.

77) Disturbance of valued species is a risk associated with the Proposed Bowland Section within certain areas during times of the year when species such as salmonid fish are breeding, or during the night when species like otters and salmonid fish are more active. Due to the proposed embedded mitigation in the CCoP related to lighting direction and shielding, and low habitat suitability for migratory species this is not considered to be significant for salmonid fish or the fish communities of the River Hindburn catchments.

78) Due to the nature of the impact pathways from noise and lighting during the enabling works the impacts associated with habitat loss at these locations are considered to be temporary, medium term and reversible.

9.6.1.4 Direct Mortality or Injury

79) Enabling works for compounds and access track could represent a significant impact to protected or notable species. Direct mortality or injury could occur during enabling works through habitat clearance, by traffic (either site traffic or road traffic), or indirect mortality or injury through stress. Of particular concern for the Proposed Bowland Section are enabling works activities which may force species to leave favoured cover/habitat and navigate around or away from the disturbance where they become more prone to death or injury from predation or anthropogenic influences. This could occur for otter at the proposed access track bridge over the River Hodder and installation of culverts at Unnamed Watercourse 169, Unnamed Watercourse 384, and Unnamed Watercourse 386. However as described above for habitat fragmentation the potential for this impact to occur at Unnamed Watercourse 169, Unnamed Watercourse 384, and Unnamed Watercourse 386 is low due to the low level of otter use on the watercourses and the limited habitat suitability upstream the scheme. There is a low risk of impacts to otters from this at the River Hodder Bridge due to the absence of in channel works and maintenance of connectivity wit with upstream habitats via the river. The proposed fencing along the access track and surrounding compounds further reduce the risk of collision from vehicles or plant during the enabling works.

80) Mortality or injury of valued species is a risk associated with the Proposed Bowland Section both directly within the red line boundary, and indirectly if otters are displaced by disturbance and fragmentation into more hazardous environments. However, due to the intermittent use of the adjacent watercourses by otters and the proposed embedded mitigation included as part of the CCoP relating to pre-clearance checks of riparian vegetation and installation of fencing around the access tracks and compounds is considered sufficient to mitigate the risk of Adverse impacts. Therefore, impacts to otter direct mortality during installation of the culverts or overflow outfalls at Cod gill, Unnamed Watercourse 169, Unnamed Watercourse 384, and Unnamed Watercourse 386 would not result in a significant effect.

81) Due to the low likelihood of direct mortality of otter during the enabling works impacts are considered to be low magnitude but permanent if mortality was to occur. Due to the presence and likelihood of direct mortality of crayfish during in river working the enabling works impacts are considered to be medium magnitude but permanent if mortality was to occur.

9.6.1.5 Impacts from Water Level Changes

82) Changes in water levels and flow regimes caused by changes to site drainage during enabling works can affect the quality and quantity of water-dependant habitats and associated species. Therefore, the effects are normally manifested as some form of habitat degradation (such as changes geomorphological processes in rivers) or habitat loss (i.e. reduction in wetted width) and can affect the conservation status of habitats or dependent species. Hydrological changes can arise from causes located within or outside of the scheme boundary during the enabling works process. Hydrological change is a risk associated with the Proposed Bowland Section, as its zone of influence includes a number of aquatic ecological receptors sensitive to changes in hydrology and includes discharges from site drainage.

83) Drainage (construction and surface water run-off) from the Lower Houses Compound would discharge via the temporary outfall into Cod Gill which is a tributary of the River Hindburn. Drainage (construction and surface water run-off) from Newton-in-Bowland Compound would discharge into the River Hodder via the existing outfall. The operation of the outfalls at cod gill and the River Hodder (including the River Hodder BHS) and the associated potential changes to water level are assessed as part of the Construction Phase assessment in Section 9.6.2.

9.6.1.6 Impacts from Pollution and sedimentation

84) Pollution involves the introduction of a novel substance to the environment which causes harm to organisms (e.g. toxic chemicals such as fuel). It can also arise from an already-present substance that is increased to harmful levels or mobilised in air or water to become more of a risk to organisms (e.g. nutrients, sediments, etc.). The effects are generally seen through mortality, reduced reproduction, and habitat degradation. Pollution can arise from within or outside of notable habitats, or habitats supporting designated or notable species. Where pollution occurs in hydrologically-influenced habitats (such as rivers), there is a higher potential for pollution to impact a larger area.

85) In the absence of mitigation, pollution is a key risk associated with the Proposed Bowland Section, in particular to the water environment, which includes a number of ecological receptors located adjacent to, crossed by, or downstream of the Proposed Bowland Section compounds and access tracks.

86) Sediment laden runoff impacts would most likely be associated with activities of topsoil stripping, vegetation clearance, necessary earthworks related to construct access tracks and creation of site compounds / construction laydown areas at both compounds (Lower Houses and Newton-in-Bowland) associated with the Proposed Bowland Section.

87) Unnamed Watercourse 169 would be crossed by the access route to Lower Houses Compound. The watercourse is likely to support macroinvertebrates and macrophytes that are sensitive to increased fine sediment input and siltation. The watercourse has limited supporting habitat for salmonid fish and bullhead however the fish community is likely to be sensitive to increased sedimentation. The impact of changes in supply of fine sediment would result in a significant effect on fish, macrophytes, and macroinvertebrate communities.

88) The River Hindburn (including the River Hindburn BHS) is approximately 800m east of the Lower Houses Compound. It is hydrologically connected to the Lower houses compound via Cod Gill and Unnamed Watercourse 169 which is crossed by the access route to Lower Houses Compound. The River Hindburn (including the River Hindburn BHS) supports macrophyte, macroinvertebrate and fish communities that are sensitive to increased sedimentation. Therefore, enabling works and associated water quality impacts from increased sedimentation would result in a significant impact at the local scale due to smothering or a reduction in of habitat suitability for macroinvertebrates, macrophytes, and fish

89) The River Hodder (and River Hodder BHS) would be crossed by the access route to Newton-in-Bowland Compound. The watercourse and BHS support macrophyte, macroinvertebrate and fish communities that are sensitive to increased sedimentation and reductions in water quality. Therefore, enabling works and associated water quality impacts from increased sedimentation would result in a significant impact at the local scale due to smothering or a reduction in of habitat suitability for macroinvertebrates, macrophytes, and fish present in the watercourse and BHS.

90) Unnamed Watercourse 384 and Unnamed Watercourse 386 will both be crossed by the access route to Newton-in-Bowland Compound. The baseline data from the downstream waterbody (River Hodder) indicates they are likely to supports macrophyte, macroinvertebrate and fish communities that are sensitive to increased sedimentation or reductions in water quality. The impact of changes in supply of fine sediment would result in a significant effect on fish, macrophytes, and macroinvertebrate communities. The Gamble Hole Farm BHS which includes the upper section of Unnamed Watercourse 384 is located upstream of the proposed compound location so would not receive additional sediment inputs during the enabling works.

91) Impacts from increased sedimentation and a reduction in water quality during site clearance, installation of culverts, access track and compounds are considered to be temporary, medium term and reversible.

9.6.1.7 Invasive Species

92) Enabling works activity may cause or facilitate the spread of (normally non-native) invasive species. Invasive plant species can colonise new areas of land from seeds contained in the parent plant or the soil, or from fragments of living root or stem. Such reproductive materials can be inadvertently transferred from enabling works areas outside of the scheme boundary if they adhere to vehicles, machinery, tools or clothing. They can also be inadvertently transferred in waste. Seeds and plant fragments can also be transported by watercourses and surface water runoff to areas not directly impacted by the work but with a hydrological connection.

93) Once present, invasive species can spread rapidly and out-compete the native vegetation that characterises the notable non-designated habitat. Habitat loss and fragmentation can also encourage the colonisation of invasive species by providing a pathway of suitable environmental conditions for invasive species to move closer to areas currently free from these species, this could affect the conservation status of a site, habitat, or species.

94) Terrestrial invasive species are assessed as part of the terrestrial ecology assessment in Chapter 9A (document reference: LCC_RVBC-BO-ES-009-01). No aquatic invasive species were identified within the red line boundary for the enabling works and the embedded mitigation in the CCoP are considered sufficient to prevent the introduction of aquatic or riparian invasive species.

9.6.1.8 Summary of Enabling Works Effects

95) .The assessment methodology involved the identification of the nature conservation value of each potentially affected important aquatic ecology receptor using a geographical framework. Those that were found to have at least local value have been subject to systematic impact assessment. A summary of the impact assessment of the enabling works phase effects prior to specific mitigation is provided below in **Table 9.10**.

Table 9.9: Summary of Enabling Phase Effects

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
River Hodder BHS	River Hodder - conf Easington Bk to conf Ribble	Local	Pollution and increased sedimentation from creation of Newton-in-Bowland construction compound, access track, and site drainage.	Pollution and increased sedimentation from creation of Newton-in-Bowland construction compound, access track, and site drainage.	Significant Adverse Local
			Disturbance to aquatic communities and habitats supported by the River Hodder BHS	Disturbance during watercourse crossings of access track, lighting, and noise	Significant Adverse Local
Gamble hole Farm BHS	River Hodder - conf Easington Bk to conf Ribble	Local	Habitat fragmentation through culverting of Unnamed watercourse 384.	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Noise and light disturbance during enabling works activities	Indirect, negative, low magnitude, temporary (medium term), reversible	Not significant
River Hindburn BHS	River Hindburn	Local	Pollution and increased sedimentation from creation of Lower houses construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
Macrophytes (River Hodder)	River Hodder - conf Easington Bk to conf Ribble	Local	Pollution and increased sedimentation from creation of the Newton-in-Bowland construction compound, access track, and site drainage.	Indirect (from upstream works), negative, low magnitude, temporary (up to medium term), reversible	Significant Adverse Local
Fish (River Hodder)	River Hodder - conf Easington	Local	Pollution and increased sedimentation from creation of Newton-in-Bowland construction	Indirect (from upstream works), negative, medium magnitude (especially in case of silt	Significant Adverse

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
	Bk to conf Ribble		compound, access track, and site drainage.	pollution), temporary (up to medium term), reversible	Local
			Disturbance during watercourse crossings of access track, lighting, and noise	Indirect, negative, low magnitude, temporary (up to medium term), reversible	Significant Adverse Local
			Direct injury or mortality during installation of the temporary outfall	Direct, negative, minor magnitude, permanent	Not significant
Aquatic macroinvertebrates (River Hodder)	River Hodder - conf Easington Bk to conf Ribble	Local	Pollution and increased sedimentation from creation of Newton-in-Bowland construction compound, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
			Direct injury or mortality during installation of the temporary outfall	Direct, negative, low magnitude, permanent	Not significant
Otter (River Hodder)	River Hodder - conf Easington Bk to conf Ribble	County	Degradation of habitat through pollution	Indirect (from upstream works), negative, medium magnitude, temporary (up to medium term), reversible	Significant Adverse County
			Disturbance during watercourse crossings of access track, lighting, and noise	Indirect, negative, low magnitude, temporary (up to medium term), reversible	Not Significant
			Degradation of prey resource	Indirect (from upstream works), negative, low magnitude, temporary (up to medium term), reversible	Not significant

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
			Direct mortality or injury	Direct, negative, low magnitude, permanent	Not significant
Macrophytes (River Hodder tributaries – Unnamed Watercourse 384, Unnamed Watercourse 385, Unnamed Watercourse 386, Unnamed Watercourse 391)	River Hodder - conf Easington Bk to conf Ribble	Immediate Site	Direct loss through culverting of Unnamed watercourse 384 and Unnamed Watercourse 386 for access track	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Pollution and increased sedimentation from creation of Newton-in-Bowland construction compound, access track, and site drainage.	Direct, negative, medium magnitude, temporary (medium term), reversible	Significant Adverse Immediate site
Fish (River Hodder tributaries – Unnamed Watercourse 384, Unnamed Watercourse 385, Unnamed Watercourse 386, Unnamed Watercourse 391)	River Hodder - conf Easington Bk to conf Ribble	Immediate Site	Direct loss of habitat through culverting of Unnamed watercourse 384 and Unnamed Watercourse 386 for access track	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Pollution and increased sedimentation from creation of Newton-in-Bowland construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
			Habitat fragmentation through culverting of Unnamed watercourse 384 and Unnamed Watercourse 386.	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Noise and light disturbance during enabling works activities	Indirect, negative, low magnitude, temporary (medium term), reversible	Not significant

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
Aquatic macroinvertebrates (River Hodder tributaries – Unnamed Watercourse 384, Unnamed Watercourse 385, Unnamed Watercourse 386, Unnamed Watercourse 391)	River Hodder - conf Easington Bk to conf Ribble	Immediate Site	Direct loss of habitat through culverting of Unnamed watercourse 384 and Unnamed Watercourse 386 for access track	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Pollution and increased sedimentation from creation of Newton-in-Bowland construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
Otter (River Hodder tributaries – Unnamed Watercourse 384, Unnamed Watercourse 385, Unnamed Watercourse 386, Unnamed Watercourse 391)	River Hodder - conf Easington Bk to conf Ribble	Immediate Site	Temporary habitat loss from culverting of Unnamed Watercourse 384 and Unnamed Watercourse 386	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Temporary habitat fragmentation from culverting of Unnamed Watercourse 384 and Unnamed Watercourse 386	Direct, negative, low magnitude, temporary (up to medium term), reversible	Not significant
			Disturbance during watercourse crossings of access track, lighting, and noise	Indirect, negative, low magnitude, temporary (up to medium term), reversible	Not significant
			Degradation of prey resource due to sedimentation and reduction in water quality	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Not significant
			Noise and light disturbance during enabling works activities	Indirect, negative, low magnitude, temporary (medium term), reversible	Not significant

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
Macrophytes (River Hindburn)	River Hindburn	Local	Downstream pollution and increased sedimentation from creation of the Lower Houses construction compound, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
Fish (River Hindburn)	River Hindburn	Local	Pollution and increased sedimentation from creation of Lower houses construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
Aquatic macroinvertebrates (River Hindburn)	River Hindburn	Local	Pollution and increased sedimentation from creation of Lower houses construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
Otter (River Hindburn)	River Hindburn	Local	Degradation of habitat through pollution	Indirect (from upstream works), negative, medium magnitude, temporary (up to medium term), reversible	Not significant
			Degradation of prey resource	Indirect (from upstream works), negative, medium magnitude, temporary (up to medium term), reversible	Not significant
Macrophytes (River Hindburn tributaries – Cod Gill, Unnamed Watercourse 163, and	River Hindburn	Local	Direct loss through culverting of Unnamed watercourse and installation of temporary outfall in Cod Gill Unnamed Watercourse 386 for access track	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
Unnamed Watercourse 169)			Pollution and increased sedimentation from creation of Newton-in-Bowland construction compound, access track, and site drainage.	Direct, negative, medium magnitude, temporary (medium term), reversible	Significant Adverse Immediate site
Fish (River Hindburn tributaries – Cod Gill, Unnamed Watercourse 163, and Unnamed Watercourse 169)	River Hindburn	Local	Direct loss of habitat through culverting of Unnamed watercourse and installation of temporary outfall in Cod Gill Unnamed Watercourse 386 for access track	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Pollution and increased sedimentation from creation of Newton-in-Bowland construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
			Habitat fragmentation through culverting of Unnamed watercourse 384 and Unnamed Watercourse 386.	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Noise and light disturbance during enabling works activities	Indirect, negative, low magnitude, temporary (medium term), reversible	Not significant
Aquatic macroinvertebrates (River Hindburn tributaries – Cod Gill, Unnamed Watercourse 163, and	River Hindburn	Local	Direct loss of habitat through culverting of Unnamed watercourse and installation of temporary outfall in Cod Gill Unnamed Watercourse 386 for access track	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
Unnamed Watercourse 169)			Pollution and increased sedimentation from creation of Newton-in-Bowland construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
Otter (River Hindburn tributaries – Cod Gill, Unnamed Watercourse 163, and Unnamed Watercourse 169)	River Hindburn	Immediate site	Temporary habitat loss from culverting of Unnamed Watercourse 169 and installation of temporary outfall	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Temporary habitat fragmentation from culverting of Unnamed Watercourse 169	Direct, negative, low magnitude, temporary (up to medium term), reversible	Not significant
			Disturbance during watercourse crossings of access track, lighting, and noise	Indirect, negative, low magnitude, temporary (up to medium term), reversible	Not significant
			Degradation of prey resource due to sedimentation and reduction in water quality	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Not significant
			Noise and light disturbance during enabling works activities	Indirect, negative, low magnitude, temporary (medium term), reversible	Not significant

9.6.2 Construction Phase

96) The following section describes the effects of the Proposed Bowland Section on Aquatic Ecology during the construction phase.

97) Following enabling works, the construction phase is anticipated to continue for just less than 6 years, from commencement of construction activities in Q2 2023 to completion in Q4 2028. Habitat reinstatement will follow on from the construction phase and into the commissioning phase, the timing of which is dependent on outage periods, which are limited to every two years and likely to occur in 2029. Blasting would be undertaken where hard rock is encountered and where alternative excavation methods are not practical. Appendix 17-3 (LCC_RVBC-BO-TA-017-03), discusses how blasting shall be considered during construction, including noise and vibration limits that would be adopted, subject to discussion and agreement with the local planning authority. Blasting to form the drive portal at the Newton-in-Bowland Compound is anticipated to occur during the first year of the construction phase in 2023.

98) Activities anticipated during the construction phase which have the potential to give rise to significant ecological effects are summarised as follows:

- Operation of the Newton-in-Bowland Compound, the launch facility, with activities including delivery and storage of tunnel sections, blasting and excavation to construct the drive portal, the operation and storage of plant, machinery and equipment, use and access to welfare facilities and offices. Above ground activities may require 24 hrs / 7 day week working once tunnelling is underway, although vehicle movements to and from site and blasting to construct the drive portal would be restricted outside normal construction site working hours
- Storage and treatment of tunnel arisings at the Newton-in-Bowland Compound before removal from site to Waddington Fell Quarry
- Vehicle movements and traffic management along temporary haulage routes between strategic road network and the Newton-in-Bowland and Lower Houses Compounds and lay-down areas, including but not limited to the delivery and removal of plant, machinery or equipment and removal of tunnel arisings
- Open cut sections comprising multi-line siphon (MLS) connections between new Valve House Buildings and existing aqueduct
- Construction of the drive portal at the Newton-in-Bowland Compound, including blasting works presumed to be undertaken during regular intervals during the first year of construction works
- De-watering operations (temporary attenuation and discharge of surface waters)
- Operation of power supply comprising generators, required 24 hr a day
- Operation of artificial lighting for safety reasons and where 24 hr working is required (lights would be located to minimise light spill towards sensitive locations)
- Construction of permanent new Valve House Buildings (single storey approximately 11 m wide and 12 m long) and associated maintenance tracks at both compounds
- Removal of temporary surfaces and
- Habitat reinstatement (following completion of construction phase), including soil handing, topsoil spreading and other ground preparation techniques, seeding, planting and aftercare requirements, installation of a slab cover over the tunnel shafts and backfilling for habitat reinstatement above (excepting for access covers). Methods and timing of habitat reinstatement would vary according to the target habitat and would be agreed with the LPA.

99) Likely nature conservation impacts in the absence of mitigation include:

- Management changes to habitats (leading to habitat degradation)
- Disturbance of individuals or groups of animals
- Direct injury or mortality of individual animals and plants

- Pollution (a cause of habitat degradation and injury/mortality to species)
- Impacts from water level changes (a cause of habitat loss, degradation and/or injury/mortality to species)
- Invasive species (a cause of mortality or habitat degradation impacts).

100) These general types and sources of impact are described in generic terms below and then applied specifically to each valued receptor in **Table 9.10**

9.6.2.1 Disturbance and habitat fragmentation

101) Construction activities can result in increased levels of visual, noise, olfactory and vibration disturbance which could impact on habitats or species. Disturbance would impact different sites, habitats, and species in different ways at different times of the year. For example, disturbance to fish would be most acute during the migratory or breeding period for migratory fish such as Atlantic salmon.

102) Increased levels of disturbance are likely to increase the effects of habitat loss, fragmentation, and isolation, with habitats beyond the red line boundary effectively 'lost' due to increases in human disturbance. Increased disturbance levels whilst creating the compounds and the access track could act as a barrier to dispersal for species sensitive to increased levels of disturbance. As described above for Habitat fragmentation in the enabling works phase (Section 9.6.1) this would be relevant to regular use of the River Hodder (including River Hodder BHS) by otter and occasional use by otter of Unnamed Watercourse 384, Unnamed Watercourse 385, and Unnamed Watercourse 386 within and adjacent Newton-in Bowland Compound. Increased noise and lighting during night-time working at the compound would reduce the suitability of the adjacent section of the River Hodder for otters. This impact is likely to be significant for otter on the River Hodder but not significant on the tributaries of the River Hodder due to limited use by otter. Lighting at the Newton-in-Bowland Compound without the embedded mitigation relating to direction and shielding of site lighting could disturb Atlantic salmon and eels in the River Hodder catchment and River Hodder BHS. This is unlikely to occur for fish communities the River Hindburn catchment (including River Hindburn BHS) due to the distance to the main river and limited suitability of the other habitats for salmonids adjacent to the Lower houses Compound. Therefore, impacts to fish communities within the River Hindburn (including the River Hindburn BHS) catchments from noise and lighting during the enabling works would be minimal. The use of blasting for tunnelling at the Newton-in-Bowland compound has potential to significantly affect fish distribution within the River Hodder catchment through disruption of migration routes through the affected section of the watercourse. Disruption of migration due fragmentation of migration routes would alter recruitment rates for fish communities with Atlantic salmon likely to be particularly adversely affected if high levels of vibration occur during the peak migration and breeding season (October to May). Migratory fish such as Atlantic salmon, sea trout, and European eel are known to predominantly travel during th night-time. Therefore, stopping blasting activity during night-time would allow fish to pass through and minimise the risk of affecting recruitment in the catchment or causing habitat fragmentation for migratory fish

103) Disturbance of valued from increased activity and lighting species is a risk associated with the Proposed Bowland Section within certain areas during times of the year when species such as salmonid fish are breeding, or during the night when species like otters and migrating salmonid fish are more active. Due to the proposed embedded mitigation in the CCoP related to lighting direction and shielding this is not considered to be significant for salmonid fish or the fish communities of the River Hindburn (including River Hindburn BHS) or River Hodder (including river Hodder BHS) catchments.

104) Due to the nature of the impact pathways from noise and lighting and cessation of the lighting and activity at the site following removal of the compounds and access track the impacts associated with habitat loss at these locations are considered to be temporary, medium term, and reversible.

9.6.2.2 Direct Mortality or Injury

105) Construction of the Proposed Bowland Section could represent a significant impact to protected or notable species. Direct mortality or injury could occur during construction through habitat clearance, by traffic (either site traffic or road traffic), or indirect mortality or injury through stress. Of particular concern for the Proposed Bowland Section is where particular construction activities may force species to leave favoured

cover/habitat and navigate around or away from the disturbance where they become more prone to death or injury from predation or anthropogenic influences.

106) Mortality or injury of valued species is a risk associated with the Proposed Bowland Section both directly within the red line boundary, and indirectly if otters are displaced by disturbance and fragmentation into more hazardous environments. However, due to the intermittent use of the adjacent watercourses by otters and the proposed embedded mitigation included as part of the CCoP relating to pre-clearance check for riparian vegetation and installation of fencing around the access tracks and compounds is considered sufficient to mitigate the risk of Adverse impacts. Therefore, impacts to otter though direct mortality during operation of the compounds and access tracks over the River Hodder (including River Hodder BHS), Unnamed Watercourse 384, Unnamed Watercourse 386, and Unnamed Watercourse 169 would not result in a significant effect.

107) Due to the distance (over 0.5 km) to the River Hindburn (including the Rive Hindburn BHS) and absence of evidence of regular use of the tributaries adjacent Lower houses Compound by otters, impacts relating to direct injury or mortality of otters are not anticipated as a result of the construction activities at the Lower Houses Compound.

108) Due to the low likelihood of direct mortality of otter during the construction works impacts are considered to be low magnitude but permanent if mortality was to occur.

9.6.2.3 Water quality impacts from pollution

109) Pollution involves the introduction of a novel substance to the environment which causes harm to organisms (e.g. toxic chemicals such as fuel). It can also arise from an already-present substance that is increased to harmful levels or mobilised in air or water to become more of a risk to organisms (e.g. nutrients, sediments, etc.). The effects are generally seen through mortality, reduced reproduction, and habitat degradation. Pollution can arise from within or adjacent to habitats supporting designated or notable species. Where pollution occurs in hydrologically-influenced habitats (such as rivers), there is a higher potential for pollution to impact a larger area. The majority of these potential pollutants would be located or stored within the construction compounds. In addition, there is the potential for chemical pollution caused by spillages along the access tracks and construction areas. The CCoP provides an overview of embedded mitigation measures related to chemical pollution which have been accounted for within this assessment (Sections 4.1.8-10 of the CCoP).

110) The construction of shafts and (minimal) open cut sections of tunnel at both TBM entry (Newton-in-Bowland Compound) and exit (Lower Houses Compound) points are activities which have the potential to create sediment which could enter watercourses. Chapter 7 Water Environment, Section **Error! Reference source not found.**.6.2 (document reference: LCC_RVBC-BO-ES-007). Construction Phase outlines the potential impact pathways for surface water quality from sediment sources during construction activities. Potential sources of increased sediments in watercourses include use of the Lower Houses and Newton-in-Bowland Construction Compounds, excavation of tunnel shafts, open cut pipe connection, storage of excavated materials, removal of access track and culvert, and habitat reinstatement.

111) Embedded mitigation outlined in relevant sections of CCoP (Sections 4.1.7 outlining the controls for the production of fine sediment and 7.4-7.8 outlining soil resources on site, including soil stripping, storage of soil, excavations from soil mounds, and soil reinstatement and reuse) would aim to minimise impacts of sediment laden runoff associated with soil storage, top soil stripping, and soil reinstatement and reuse. The Water Environment assessment (Chapter 7 Section 7.6.2 (document reference: LCC_RVBC-BO-ES-007)) identifies that the sediment run-off and chemical pollution from construction activities at the Lower Houses Compound have potential to affect the water quality of Cod gill, Unnamed Watercourse 169, Unnamed Watercourse 163, and the River Hindburn (including the River Hindburn BHS). For the Newton-in-Bowland Compound this has the potential to affect Unnamed Watercourse 384, Unnamed Watercourse 385, Unnamed Watercourse 386, and Unnamed Watercourse Unnamed Watercourse 1312, and River Hodder (including the River Hodder BHS). The Gamble Hole Farm BHS which includes the upper section of Unnamed Watercourse 384 is located upstream of the proposed compound location so would not receive additional sediment inputs during the enabling works. As outlined in the enabling works section, all site drainage, during the construction phase, would be appropriately treated before discharge either through passive treatment (e.g. settlement ponds to reduce suspended solid concentrations) and/or formalised treatment (e.g., use of flocculant dosing

for suspended sediment and/or oil and water separators). Site compound drainage outfalls are anticipated to discharge to the same watercourses during enabling works and construction phases.

112) Although the scale of the enabling and construction works and the multiple sources capable of producing sediment laden runoff has potential for high magnitude effects for the aquatic ecology features in the receiving waterbodies due the embedded mitigation for sediment control outlined in the CCoP. The construction phase works within the Lower Houses Compound would result in a significant impact at the local scale due to associated water quality impacts from increased sedimentation for macroinvertebrates, macrophytes, fish, and otter in Cod gill, Unnamed Watercourse 169, Unnamed Watercourse 163, and the River Hindburn (including the River Hindburn BHS).

113) The construction phase works within the Newton-in-Bowland Compound and associated access tracks would result in a significant effect at the local scale due to associated water quality impacts from increased sedimentation for macroinvertebrates, macrophytes, fish, and otter in Unnamed Watercourse 384, Unnamed Watercourse 385, Unnamed Watercourse 386, and Unnamed Watercourse Unnamed, and the River Hodder (including the River Hodder BHS).

114) The access roads and compounds would be removed at the end of the construction phase. It is assumed that these areas would be returned to the baseline conditions with appropriate landscaping therefore impacts associated with reduction in water quality and increased sedimentation at these locations are considered to be temporary, medium term and reversible.

9.6.2.4 Impacts from Water Level Changes

115) Changes in water levels and flow regimes caused by changes to site drainage during construction can affect the quality and quantity of water-dependant habitats and associated species. Therefore, the effects are normally manifested as some form of habitat degradation (such as changes geomorphological processes in rivers) or habitat loss and can affect the conservation status of habitats or dependent species. Hydrological changes can arise from causes located within or outside of the scheme boundary during the construction process.

116) Hydrological change is a risk associated with the Proposed Bowland Section, as its zone of influence includes a number of sensitive aquatic ecological receptors and includes discharges from site drainage.

117) Drainage (construction and surface water run-off) from the Lower Houses would discharge into Cod Gill through a temporary outfall. The Water Environment Chapter 7 Section 7.6.2 (document reference: LCC_RVBC-BO-ES-007) identifies that this discharge would be attenuated to 6 l/s and would not result in increased erosion or sediment mobilisation. Therefore, no impacts to the receiving watercourses (Cod Gill and the downstream River Hindburn) are anticipated due to the changes in flow from the discharge. No impacts associated with changes in water level from site drainage are anticipated for Unnamed Watercourse 163 or Unnamed watercourse 169. No significant effects from changes in flow would occur to macroinvertebrates, macrophytes, fish or otter at the River Hindburn (including River Hindburn BHS) or tributaries from construction activities at the Lower houses compound.

118) Drainage (construction and surface water run-off) from the Newton-in-Bowland Compound would discharge into the River Hodder in the River Hodder BHS through an existing outfall and a temporary outfall on Unnamed watercourse 386. The Water Water Environment Chapter 7 Section 7.6.2 (document reference: LCC_RVBC-BO-ES-007) identifies that this is above the baseline greenfield runoff rate currently received by the watercourse and could increase erosion within the River Hodder and. The Water Environment Chapter also identifies potential for impacts from increased erosion caused by knickpoint formation during bank re-instatement at the River Hodder (moderate adverse), Unnamed Watercourse 384 (Negligible), Unnamed Watercourse 385 (moderate adverse), and Unnamed Watercourse 386 (negligible). Increased sediment mobilisation could have a detrimental effect on the habitat suitability for fish, macrophytes, and macroinvertebrates in the River Hodder (including the River Hodder BHS) and Unnamed Watercourse 385. The increased erosion within the result in a significant impact at the local scale due to smothering or a reduction in of habitat suitability of downstream habitats for macroinvertebrates, macrophytes, and fish communities in River Hodder (including the River Hodder BHS) and Unnamed Watercourse 385 and the downstream Unnamed watercourse 384. Due to the absence of potential geomorphological impacts from

flow change in Unnamed Watercourse 384 (including Gamble Hole Farm BHS) and Unnamed Watercourse 386 there would be no significant effects from flow changes on the aquatic receptors of these watercourses.

119) The temporary culvert and outfall, access road, and compounds would be removed at the end of the construction phase. It is assumed that these areas would be returned to the baseline conditions with appropriate landscaping therefore impacts associated with habitat loss at these locations are considered to be temporary, medium term and reversible.

9.6.2.5 Invasive Species

120) Construction activity may cause or facilitate the spread of (normally non-native) invasive species. Invasive plant species can colonise new areas of land from seeds contained in the parent plant or the soil, or from fragments of living root or stem. Such reproductive materials can be inadvertently transferred from construction areas outside of the scheme boundary if they adhere to vehicles, machinery, tools, or clothing. They can also be inadvertently transferred in waste. Seeds and plant fragments can also be transported by watercourses and surface water runoff to areas not directly impacted by the work but with a hydrological connection.

121) Once present, invasive species can spread rapidly and out-compete the native vegetation that characterises the notable non-designated habitat. Habitat loss and fragmentation can also encourage the colonisation of invasive species by providing a pathway of suitable environmental conditions for invasive species to move closer to areas currently free from these species, this could affect the conservation status of a site, habitat or species.

122) Terrestrial invasive species are assessed as part of the terrestrial ecology assessment in Chapter 9A (document reference: LCC_RVBC-BO-ES-009-01). No aquatic invasive species were identified within the red line boundary for the enabling works and the embedded mitigation in the CCoP are considered sufficient to prevent the introduction of aquatic or riparian invasive species. No impacts are anticipated for aquatic ecology receptors within the River Hodder (including the River Hodder BHS) and River Hindburn (including the River Hindburn BHS) catchments due introduction or spread of aquatic or riparian invasive non-native species during the construction phase.

9.6.2.6 Summary of Construction Effects

123) The assessment methodology involved the identification of the nature conservation value of each potentially affected important aquatic ecology receptor using a geographical framework. Those that were found to have at least local value have been subject to systematic impact assessment. The findings of the construction phase effects prior to mitigation is provided below in **Table 9.10**.

Table 9.10: Summary of Construction Phase Effects

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
Gamble Hole Farm BHS	River Hodder - conf Easington Bk to conf Ribble	Local	Flow changes from presence and removal of culvert at Unnamed watercourse 384	Not applicable – the BHS is located upstream of the proposed culvert location	Not significant
			Pollution and increased sedimentation from use of Newton-in-Bowland construction compound, access track, and site drainage.	Not applicable – the BHS is located upstream of the proposed compound location and will not receive increased sediment run off via Unnamed Watercourse 384	Not significant
River Hodder BHS	River Hodder - conf Easington Bk to conf Ribble	Local	Pollution and increased sedimentation from use of Newton-in-Bowland construction compound, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
			Disturbance and associated habitat fragmentation during watercourse crossings of access track from lighting and noise	Indirect, negative, low magnitude, temporary (up to medium term), reversible	Significant Adverse Local
			Hydrological impacts from discharge of site drainage and changes to flow during construction and reinstatement of banks.	Negative, medium magnitude, temporary (up to medium term), reversible	Significant Adverse Local
River Hindburn BHS	River Hindburn	Local	Pollution and increased sedimentation from use of Lower houses construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
			Hydrological impacts from discharge of site drainage into tributary of River Hindburn	Indirect, negative, low magnitude, temporary (up to medium term), reversible	Not significant
Macrophytes (River Hodder)	River Hodder - conf Easington Bk to conf Ribble	Local	Pollution and increased sedimentation from use of the Newton-in-Bowland construction compound, access track, and site drainage.	Indirect (from upstream works), negative, low magnitude, temporary (up to medium term), reversible	Significant Adverse Local
			Hydrological impacts from discharge of site drainage and changes to flow during construction and reinstatement of banks.	Negative, medium magnitude, temporary (up to medium term), reversible	Not significant
Fish (River Hodder)	River Hodder - conf Easington Bk to conf Ribble	Local	Pollution and increased sedimentation from use of Newton-in-Bowland construction compound, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
			Disturbance and associated habitat fragmentation due to blasting and lighting and noise from access track crossing the watercourse	Indirect, negative, low magnitude, temporary (up to medium term), reversible	Significant Adverse Local
			Hydrological impacts from discharge of site drainage and changes to flow during construction and reinstatement of banks.	Negative, medium magnitude, temporary (up to medium term), reversible	Significant Adverse Local

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
			Direct injury or mortality during installation of the temporary outfall	Direct, negative, minor magnitude, permanent	Not significant
Aquatic macroinvertebrates (River Hodder)	River Hodder - conf Easington Bk to conf Ribble	Local	Pollution and increased sedimentation from use of Newton-in-Bowland construction compound, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
			Hydrological impacts from discharge of site drainage and changes to flow during construction and reinstatement of banks.	Indirect, negative, low magnitude, temporary (up to medium term), reversible	Significant Adverse Local
			Direct injury or mortality during installation of the temporary outfall	Direct, negative, low magnitude, permanent	Not significant
Otter (River Hodder and tributaries)	River Hodder - conf Easington Bk to conf Ribble	County	Degradation of habitat through pollution	Indirect (from upstream works), negative, medium magnitude, temporary (up to medium term), reversible	Significant Adverse Local
			Disturbance and associated habitat fragmentation due to blasting and lighting and noise from access track crossing the watercourse	Indirect, negative, low magnitude, temporary (up to medium term), reversible	Significant Adverse County
			Degradation of prey resource	Indirect (from upstream works), negative, low magnitude, temporary (up to medium term), reversible	Not significant

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
			Direct mortality or injury	Direct, negative, low magnitude, permanent	Not significant
Macrophytes (River Hodder tributaries – Unnamed Watercourse 384, Unnamed Watercourse 385, Unnamed Watercourse 386, Unnamed Watercourse 391)	River Hodder - conf Easington Bk to conf Ribble	Immediate Site	Flow changes from presence and removal of culvert at Unnamed watercourse 384 and Unnamed Watercourse 386 for access track	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Pollution and increased sedimentation from use of Newton-in-Bowland construction compound, access track, and site drainage.	Direct, negative, medium magnitude, temporary (medium term), reversible	Significant Adverse Immediate site
Fish (River Hodder tributaries – Unnamed Watercourse 384, Unnamed Watercourse 385, Unnamed Watercourse 386, Unnamed Watercourse 391)	River Hodder - conf Easington Bk to conf Ribble	Immediate Site	Flow changes from presence and removal of culvert at Unnamed watercourse 384 and Unnamed Watercourse 386 for access track	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Pollution and increased sedimentation from use of Newton-in-Bowland construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
			Noise and light disturbance during construction works activities	Indirect, negative, low magnitude, temporary (medium term), reversible	Not significant
Aquatic macroinvertebrates (River Hodder tributaries – Unnamed Watercourse 384, Unnamed Watercourse 385, Unnamed Watercourse	River Hodder - conf Easington Bk to conf Ribble	Immediate Site	Flow changes from presence and removal of culvert at Unnamed watercourse 384 and Unnamed Watercourse 386 for access track	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Pollution and increased sedimentation from use of	Indirect (from upstream works), negative, medium magnitude	Significant

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
386, Unnamed Watercourse 391)			Newton-in-Bowland construction compounds, access track, and site drainage.	(especially in case of silt pollution), temporary (up to medium term), reversible	Adverse Local
Macrophytes (River Hindburn)	River Hindburn	Local	Downstream pollution and increased sedimentation from use of the Lower Houses construction compound, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
Fish (River Hindburn)	River Hindburn	Local	Pollution and increased sedimentation from use of Lower houses construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
			Hydrological impacts from discharge of site drainage into tributary of River Hindburn	Indirect, negative, low magnitude, temporary (up to medium term), reversible	Not significant
Aquatic macroinvertebrates (River Hindburn)	River Hindburn	Local	Pollution and increased sedimentation from use of Lower houses construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
			Hydrological impacts from discharge of site drainage into tributary of River Hindburn	Indirect, negative, low magnitude, temporary (up to medium term), reversible	Not significant
Otter (River Hindburn)	River Hindburn	Local	Degradation of habitat through pollution	Indirect (from upstream works), negative, medium magnitude, temporary (up to medium term), reversible	Not significant

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
			Degradation of prey resource	Indirect (from upstream works), negative, medium magnitude, temporary (up to medium term), reversible	Not significant
Macrophytes (River Hindburn tributaries – Cod Gill, Unnamed Watercourse 163, and Unnamed Watercourse 169)	River Hindburn	Immediate site	Flow changes from presence and removal of culvert at Unnamed Watercourse 169 and temporary outfall at Cod Gill.	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Pollution and increased sedimentation from use of Newton-in-Bowland construction compound, access track, and site drainage.	Direct, negative, medium magnitude, temporary (medium term), reversible	Significant Adverse Immediate site
Fish (River Hindburn tributaries – Cod Gill, Unnamed Watercourse 163, and Unnamed Watercourse 169)	River Hindburn	Immediate site	Flow changes from presence and removal of culvert at Unnamed Watercourse 169 and temporary outfall at Cod Gill.	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant
			Pollution and increased sedimentation from use of Newton-in-Bowland construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
			Noise and light disturbance during construction works activities	Indirect, negative, low magnitude, temporary (medium term), reversible	Not significant
Aquatic macroinvertebrates (River Hindburn tributaries – Cod Gill, Unnamed Watercourse 163, and	River Hindburn	Immediate site	Flow changes from presence and removal of culvert at Unnamed Watercourse 169 and temporary outfall at Cod Gill.	Direct, negative, low magnitude, temporary (medium term), reversible	Not significant

Environmental / Community Asset	WFD waterbody	Value	Potential Effect(s) Prior to Specific Mitigation	Nature of effects	Significance of Effect (Pre-Specific Mitigation)
Unnamed Watercourse 169)			Pollution and increased sedimentation from use of Newton-in-Bowland construction compounds, access track, and site drainage.	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Significant Adverse Local
Otter (River Hindburn tributaries – Cod Gill, Unnamed Watercourse 163, and Unnamed Watercourse 169)	River Hindburn	Immediate site	Temporary habitat fragmentation from culverting of Unnamed Watercourse 169	Direct, negative, low magnitude, temporary (up to medium term), reversible	Not significant
			Disturbance during watercourse crossings of access track, lighting, and noise	Indirect, negative, low magnitude, temporary (up to medium term), reversible	Not significant
			Degradation of prey resource due to sedimentation and reduction in water quality	Indirect (from upstream works), negative, medium magnitude (especially in case of silt pollution), temporary (up to medium term), reversible	Not significant
			Noise and light disturbance during construction works activities	Indirect, negative, low magnitude, temporary (medium term), reversible	Not significant

9.6.3 Commissioning Phase

124) The following provides an overview of the potential effects on aquatic ecology as a result of the commissioning phase. A summary of commissioning phase effects is shown in **Table 9.11**.

125) During the commissioning phase of the project it is assumed that the site compound and infrastructure created would still be utilised. Activities unique to the commissioning phase would largely take place in the subsoil environment and the assessment of specific impacts are more pertinent to groundwater receptors rather those related to surface water quality and the associated effects on aquatic ecology.

126) As it is assumed that the site compounds would be in use during the commissioning phase, it is anticipated that all the same potential impacts outlined in the previous section would be active during commissioning phase. As such, the assessment of magnitude of impacts and significance for all aquatic ecology features from use of the construction compounds and access tracks during commissioning are anticipated to be the same or less as those identified in for the enabling (Section 9.6.1) and construction (Section 9.6.2) phases.

127) The Changes in water levels and flow regimes caused by discharge of the commissioning flows could affect the quality and quantity of water-dependant habitats and associated species. Therefore, the effects are normally manifested as some form of habitat degradation (such as changes geomorphological processes in rivers) or habitat loss and can affect the conservation status of habitats or dependent species. Hydrological changes can arise from causes located within or outside of the scheme boundary during the commissioning process.

128) The commissioning flow at the north end of the proposed Bowland section would be discharged into Cod Gill from the temporary outfall at the Newton in-Bowland Compound at a rate of 25 l/s. The Water Environment Chapter 7 Section 7.6.3 (document reference: LCC_RVBC-BO-ES-007) assessment identifies that the discharge would be 3.9 times the volume of the baseline greenfield runoff (6.4 l/s) rate for the catchment and is therefore likely to result in increased erosion within the watercourse (Cod Gill). The increased flow volume and velocity within the watercourse has potential to increase cause erosion of the bed and opposite bank resulting in changes to existing habitats and increased turbidity and sediment mobilisation. The water environment assessment also identified the potential for erosion and sediment mobilisation downstream of the confluence with the River Hindburn due to increased flows. The baseline aquatic ecology data identifies that macrophyte, fish, and macroinvertebrate communities within Cod Gill and the downstream River Hindburn (including the River Hindburn BHS) are sensitive to increased sedimentation. The increased erosion, turbidity, and subsequent downstream sediment deposition would result in a significant adverse effect on the macrophyte, fish and macroinvertebrate communities of Cod Gill and the River Hindburn (including the River Hindburn BHS). Due to the large home range of otter and absence of direct impact pathways the adverse effects from temporary habitat degradation on otter would not be significant.

129) The commissioning flow at the southern end of the proposed Bowland Section would be discharged via the existing outfall to the River Hodder at a rate of up to 25 l/s. The Water Environment Chapter 7 Section 7.6.3 Water Environment Chapter 7 Section 7.6.2 (document reference: LCC_RVBC-BO-ES-007) assessment identified that the discharge would be within the variation in typically experienced in the watercourse with a negligible risk of impacts to water quality or sediment mobilisation. there is limited potential for adverse impacts to aquatic ecology receptors due to the small proportion of the watercourse flow that would be contributed by the commissioning discharge and absence of water quality or geomorphological impacts. Potential impacts to the macroinvertebrate, fish and macrophyte communities of the River Hodder and River Hodder BHS are not considered to be significant. Due to the large home range of otter and absence of direct impact pathways the adverse effects from temporary habitat degradation on otter would not be significant.

130) The commissioning discharges are temporary, and the temporary outfall and associated infrastructure would be removed following cessation of the commissioning phase (removal of temporary infrastructure was assessed as part of the construction phase in Section 9B.62). It is assumed that these areas would be returned to the baseline conditions with appropriate landscaping therefore impacts associated with hydrological changes at these locations are considered to be temporary, medium term and reversible.

9.6.3.1 Summary of commissioning effects

131) The assessment methodology involved the identification of the nature conservation value of each potentially affected important aquatic ecology receptor using a geographical framework. Those that were found to have at least local value have been subject to systematic impact assessment. The findings of the commissioning phase effects prior to mitigation is provided below in **Table 9.11**.

Table 9.11: Summary of Commissioning Phase Effects

Environmental / Community Asset	WFD waterbody	Value / Sensitivity	Potential Effect(s) Prior to Mitigation	Nature of effects	Significance of Effect (Pre-Mitigation)
River Hindburn BHS	River Hindburn	Local	Hydrological impacts and increased erosion and subsequent sedimentation due to increased flows from commissioning discharge.	Indirect (from upstream works), negative, medium magnitude, temporary (up to medium term), reversible	Not significant
River Hodder BHS	Hodder - conf Easington Bk to conf Ribble	Local	Hydrological impacts and increased erosion and subsequent sedimentation due to increased flows from commissioning discharge.	Indirect (from upstream works), negative, medium magnitude, temporary (up to long term), reversible	Not significant
Macrophytes (Cod Gill)	River Hindburn	Local	Hydrological impacts and increased erosion and subsequent sedimentation due to increased flows from commissioning discharge.	Indirect (from upstream works), negative, medium magnitude, temporary (up to medium term), reversible	Significant Adverse Local
Fish (Cod Gill and River Hindburn)	River Hindburn	Local	Hydrological impacts and increased erosion and subsequent sedimentation due to increased flows from commissioning discharge.	Indirect (from upstream works), negative, medium magnitude, temporary (up to medium term), reversible	Significant Adverse Local
Aquatic macroinvertebrates (Cod Gill and River Hindburn)	River Hindburn	Local	Hydrological impacts and increased erosion and subsequent sedimentation due to increased flows from commissioning discharge.	Indirect (from upstream works), negative, medium magnitude, temporary (up to medium term), reversible	Significant Adverse Local

Environmental / Community Asset	WFD waterbody	Value / Sensitivity	Potential Effect(s) Prior to Mitigation	Nature of effects	Significance of Effect (Pre-Mitigation)
Otter (Cod Gill and River Hindburn)	River Hindburn	County	Habitat degradation from hydrological impacts and increased erosion and subsequent sedimentation due to increased flows from commissioning discharge.	Indirect (from upstream works), negative, low magnitude, temporary (up to medium term), reversible	Not significant
Macrophytes (River Hodder)	Hodder - conf Easington Bk to conf Ribble	Local	Hydrological impacts and increased erosion and subsequent sedimentation due to increased flows from commissioning discharge.	Indirect (from upstream works), negative, medium magnitude, temporary (up to long term), reversible	Not significant
Fish (River Hodder)	Hodder - conf Easington Bk to conf Ribble	County	Hydrological impacts and increased erosion and subsequent sedimentation due to increased flows from commissioning discharge.	Indirect (from upstream works), negative, medium magnitude, temporary (up to long term), reversible	Not significant
Macroinvertebrates (River Hodder)	Hodder - conf Easington Bk to conf Ribble	County	Hydrological impacts and increased erosion and subsequent sedimentation due to increased flows from commissioning discharge.	Indirect (from upstream works), negative, medium magnitude, temporary (up to long term), reversible	Not significant
Otter (River Hodder)	Hodder - conf Easington Bk to conf Ribble	Local	Habitat degradation from hydrological impacts and increased erosion and subsequent sedimentation due to increased flows from commissioning discharge.	Indirect (from upstream works), negative, low magnitude, temporary (up to medium term), reversible	Not significant

9.6.4 Operational Phase

132) Activities during the operational phase (including the use of the new aqueduct and effects from the decommissioned asset) which may potentially give rise to effects on aquatic ecology features are anticipated to be limited to:

- De-watering of the decommissioned sections of aqueduct, requiring permanent discharge into surface waters
- Routine maintenance at air valves and valve houses with access by foot or light vehicle.

133) De-watering of the decommissioned, but retained sections of aqueduct, would require discharges into surface water features via existing outfall structures this is assessed as part of the decommissioning effects in Section 9.1.1.

134) The overflow from the Proposed Bowland Section aqueduct would discharge at the existing outfall location on the River Hodder. The discharge of water during the operation of the proposed aqueduct would be the same as the operational regime for the existing aqueduct (i.e. emergency discharges as required). Operational discharges from the existing aqueduct would stop and be replaced by discharges from the proposed aqueduct. There would be no change in flow conditions or water quality from the existing baseline conditions due to operation of the Proposed Bowland Section. Therefore, there is no potential for impacts on the aquatic ecology features of the River Hodder.

135) Routine maintenance activities at air valves and valve houses would require access by foot or light vehicle using existing access points and existing access routes. Maintenance events would be very short term. Temporary disturbance effects that might result upon aquatic habitats and species would be no greater than experienced during existing agricultural practices in the landscape or routine maintenance of existing above-ground infrastructure for the retained sections of the aqueduct. Potential effects on aquatic ecology receptors arising from routine maintenance of new above-ground structures associated with the Proposed Bowland Section are therefore unlikely to be of a scale, duration or nature that would give rise to significant ecological effects. These activities are scoped out from the EcIA for Aquatic Ecology

9.6.4.1 Summary of operational effects

136) The assessment methodology involved the identification of the nature conservation value of each potentially affected important aquatic ecology receptor using a geographical framework. Those that were found to have at least local value have been subject to systematic impact assessment. No potential operational effects above the current baseline conditions have been identified. Summary of commissioning effects

137) The assessment methodology involved the identification of the nature conservation value of each potentially affected important aquatic ecology receptor using a geographical framework. Those that were found to have at least local value have been subject to systematic impact assessment. The findings of the commissioning phase effects prior to mitigation is provided below in **Table 9.12**

Table 9.12: Summary of Operational Phase Effects

Environmental / Community Asset	WFD waterbody	Value / Sensitivity	Potential Effect(s) Prior to Mitigation	Nature of effects	Significance of Effect (Pre-Mitigation)
River Hindburn BHS	River Hindburn	Local	No change in flow or water quality or disturbance- no potential for impacts	Not applicable	Not significant
River Hodder BHS	Hodder - conf Easington Bk to conf Ribble	Local	No change in flow or water quality or disturbance- no potential for impacts	Not applicable	Not significant
Macrophytes (Cod Gill)	River Hindburn	Local	No change in flow or water quality or disturbance- no potential for impacts	Not applicable	Not significant
Fish (Cod Gill and River Hindburn)	River Hindburn	Local	No change in flow or water quality or disturbance- no potential for impacts	Not applicable	Not significant
Aquatic macroinvertebrates (Cod Gill and River Hindburn)	River Hindburn	Local	No change in flow or water quality or disturbance- no potential for impacts	Not applicable	Not significant
Otter (Cod Gill and River Hindburn)	River Hindburn	County	No change in flow or water quality or disturbance- no potential for impacts	Not applicable	Not significant
Macrophytes (River Hodder)	Hodder - conf Easington Bk to conf Ribble	Local	No change in flow or water quality or disturbance- no potential for impacts	Not applicable	Not significant
Fish (River Hodder)	Hodder - conf Easington Bk to conf Ribble	County	No change in flow or water quality or disturbance- no potential for impacts	Not applicable	Not significant

Environmental / Community Asset	WFD waterbody	Value / Sensitivity	Potential Effect(s) Prior to Mitigation	Nature of effects	Significance of Effect (Pre-Mitigation)
Macroinvertebrates (River Hodder)	Hodder - conf Easington Bk to conf Ribble	County	No change in flow or water quality or disturbance- no potential for impacts	Not applicable	Not significant
Otter (River Hodder)	Hodder - conf Easington Bk to conf Ribble	Local	No change in flow or water quality or disturbance- no potential for impacts	Not applicable	Not significant

9.6.5 Decommissioning Phase

138) The following section describes the effects of the Proposed Bowland Section on Aquatic Ecology during the enabling works phase. These impacts and significance of effects on aquatic ecology features are summarised in **Table 9.13**.

139) Following decommissioning of the existing aqueduct structure it is likely that groundwater would enter the decommissioned aqueduct over time as the structure is left in-situ. The existing aqueduct creates a flow pathway for groundwater ingress to reach the surface through the redundant tunnel structure. It is proposed this groundwater ingress would be discharged to the River Hodder through the existing outfall location.

140) The Water Environment assessment on decommissioning effects (Chapter 7 Section 7.6.5 document reference: LCC_RVBC-BO-ES-007) identifies that the discharged groundwater has the potential to be polluted with a range of potential contaminates related to natural bedrock geology and, current and historical land uses. Should groundwater be contaminated and discharged to the River Lune it has the potential to impact surface water quality downstream from the discharge location.

141) The impact from any chemical pollution from groundwater discharge on aquatic ecology features would be dependent on the, concentration of contaminants, volume, and rate of the discharge, as well as pH and buffering capacity of the receiving watercourse. The aquatic macroinvertebrate and fish communities present within the River Hodder are sensitive to reductions water quality particularly from changes in dissolved oxygen which could be reduced by the dissolved oxygen levels in the discharge or through and increase in chemical oxygen demand of the watercourse. A reduction water quality would reduce habitat suitability or direct mortality for sensitive species. This would result in changes to species composition and a reduction in abundance and distribution of sensitive species such as Atlantic salmon or sensitive macroinvertebrate or macrophyte species. The groundwater discharge has potential to adversely affect the fish and macroinvertebrate communities of the River Hodder this would be significant at the local Level in the absence of specific mitigation. Therefore, discharge of groundwater and the associated water quality impacts would result in a significant effect at the local scale due to a reduction in habitat suitability or direct mortality of macroinvertebrates, macrophytes, and fish within the River Hodder (including the River Hodder BHS). A reduction in water quality and degradation of the supporting habitat and prey resource would have a detrimental impact on the otter population of the River Hodder. Otter have a high metabolic rate due their high activity and energy requirements in cold water the high predation rate of fish a means they are susceptible to bioaccumulation of contaminants in waterbodies such as heavy metals. Consequently, in the absence of mitigation there is potential for a significant effect on otter populations of the River Hodder (including in the River Hodder BHS) due to water quality impacts from the operational discharge.

142) The discharge will occur permanently throughout the life of the scheme therefore impacts due to a reduction in water quality are considered to be permanent and irreversible.

143) There will be no discharges to watercourses within the River Hindburn Catchments and no potential impact pathways from decommissioning activities. The effect of decommissioning activities on aquatic ecology features of the River Hindburn catchments and River Hodder tributaries including the River Hindburn BHS and Gamble hole Farm BHS have been scoped out of the assessment due to absence of potential impact pathways during the decommissioning phase.

9.6.5.1 Summary of decommissioning effects

144) The assessment methodology involved the identification of the nature conservation value of each potentially affected important aquatic ecology receptor using a geographical framework. Those that were found to have at least local value have been subject to systematic impact assessment. The findings of the decommissioning phase effects prior to mitigation is provided below in **Table 9.13**.

Table 9.13: Summary of decommissioning effects

Environmental / Community Asset	WFD waterbody	Value / Sensitivity	Potential Effect(s) Prior to Mitigation	Nature of effects	Significance of Effect (Pre-Mitigation)
River Hodder BHS	River Hodder - conf Easington Bk to conf Ribble	Local	Reduction in water quality from discharge of groundwater from the decommissioned aqueduct	Direct, negative, medium magnitude, permanent	Significant Adverse Local
River Hindburn BHS	River Hindburn	Local	No potential effects from decommissioning activities	Not applicable	Not significant
Gamble Hole Farm BHS	River Hodder - conf Easington Bk to conf Ribble	Local	No potential effects from decommissioning activities	Not applicable	Not significant
Macrophytes (River Hodder)	River Hodder - conf Easington Bk to conf Ribble	Local	Reduction in water quality from discharge of groundwater from the decommissioned aqueduct	Direct, negative, medium magnitude, permanent	Significant Adverse Local
Fish (River Hodder)	River Hodder - conf Easington Bk to conf Ribble	Local	Reduction in water quality from discharge of groundwater from the decommissioned aqueduct	Direct, negative, medium magnitude, permanent	Significant Adverse Local
Macroinvertebrates (River Hodder)	River Hodder - conf Easington Bk to conf Ribble	Local	Reduction in water quality from discharge of groundwater from the decommissioned aqueduct	Direct, negative, medium magnitude, permanent	Significant Adverse Local

Environmental / Community Asset	WFD waterbody	Value / Sensitivity	Potential Effect(s) Prior to Mitigation	Nature of effects	Significance of Effect (Pre-Mitigation)
Otter (River Hodder)	River Hodder - conf Easington Bk to conf Ribble	County	Habitat degradation and reduction in prey availability due to reductions in water quality from the groundwater discharge	Indirect, negative, low magnitude, permanent	Significant Adverse Local
Macrophytes (River Hodder Tributaries)	River Hodder - conf Easington Bk to conf Ribble	Local	No potential effects from decommissioning activities	Not applicable	Not significant
Fish (River Hodder Tributaries)	River Hodder - conf Easington Bk to conf Ribble	Local	No potential effects from decommissioning activities	Not applicable	Not significant
Aquatic macroinvertebrates (River Hodder Tributaries)	River Hodder - conf Easington Bk to conf Ribble	Local	No potential effects from decommissioning activities	Not applicable	Not significant
Otter (River Hodder Tributaries)	River Hodder - conf Easington Bk to conf Ribble	Immediate site	No potential effects from decommissioning activities	Not applicable	Not significant
Macrophytes (River Hindburn and tributaries)	River Hindburn	Local	No potential effects from decommissioning activities	Not applicable	Not significant
Fish (River Hindburn and tributaries)	River Hindburn	Local	No potential effects from decommissioning activities	Not applicable	Not significant

Environmental / Community Asset	WFD waterbody	Value / Sensitivity	Potential Effect(s) Prior to Mitigation	Nature of effects	Significance of Effect (Pre-Mitigation)
Aquatic macroinvertebrates (River Hindburn and tributaries)	River Hindburn	Local	No potential effects from decommissioning activities	Not applicable	Not significant
Otter (River Hindburn and tributaries)	River Hindburn	Immediate site	No potential effects from decommissioning activities	Not applicable	Not significant

9.7 Mitigation and Residual Effects

145) Mitigation is most effective if considered as an integral part of the Proposed Bowland Section design in order to avoid, reduce or offset any adverse effects on the aquatic ecology or wider environment.

146) There is potential for adverse effects to the fish, aquatic macroinvertebrates, and otter in The River Hindburn and Tributaries and The River Hodder and tributaries from a reduction in water quality during the enabling works, construction, and operational phases. Therefore, additional mitigation would be required to further reduce the surface water quality impacts from the Proposed Bowland Section.

147) The proposed additional mitigation measures consider current best practice, legislation, and guidance during both construction and operational phases of the Proposed Bowland Section. Additional mitigation measures to reduce impacts to geomorphology, surface water quality, and sediment management are identified in Water Environment Chapter 7 Section 7.7 (document reference: LCC_RVBC-BO-ES-007) these include:

- Construction Method Statements (CMS) for each construction activity.
- A site Pollution Prevention Plan for enabling and construction activities.
- Modification of existing drainage systems to reduce potential for sediment run off
- A suitably qualified and experienced Environment Clerk of Work (EnvCow) (Mitigation reference: **WE17**) would be appointed by the Contractor to oversee the implementation of mitigation and monitoring of the water environment
- timing restrictions for in channel works (i.e. when flows are at or below the mean average) to reduce the potential for sediment release and scour.
- To mitigate against the uncertainty in the groundwater quality and potential impacts on River Hodder from decommissioning flows on surface water quality, it was recommended that further assessment is undertaken.
- A water quality monitoring programme would be implemented to help ensure groundwater ingress discharges from the decommissioned aqueduct pass the required discharge standards. To provide reassurance that the decommissioning flows entering the River Hodder are not having a significant adverse impact upon surface water quality
- A programme of surface water quality monitoring work is proposed to be undertaken for a period of 12 months once the decommissioning phase has begun and groundwater ingress flows begin discharging from the 'old' aqueduct.
- Reinstatement of watercourse substrate and banks following removal of the culverts, bridge, and temporary outfalls on Unnamed Watercourse 169, Unnamed Watercourse 384, Unnamed Watercourse 385 (Mitigation reference: **WE2-WE5**), Cod Gill (Mitigation reference: **WE12-WE16**), and River Hodder (Mitigation reference**: WE1-WE6**) to prevent erosion.

148) Reinstatement of terrestrial habitats described in Chapter 9A Section 9A.7 (document reference: LCC_RVBC-BO-ES-009-01) will also reduce the potential for sediment transfer during site restoration in the commissioning and operation phases.

149) The proposed River Hodder Restoration Options Assessment[8] for removal of the temporary access bridge identify the following measures for the reach between the B6478 and the inflow of Foulscale Brook (which includes the proposed access route crossing):

- Planting of riparian vegetation
- Fencing to reducing the risk of poaching

[8] Jacobs, 2018. NEP AMP6 Stocks Reservoir – River Hodder Restoration Options Assessment

- In-channel improvements including berms and flow deflectors to increase sediment transport and improve hydraulic processes in a homogenous and overwide reach
- Investigation weir removal or fish passage
- Sediment augmentation downstream of the B6478 bridge.

9.7.1 Fish

150) Additional mitigation above that described in the CCoP is required to reduce the potential for adverse effects from increased sedimentation from the installation and use of the culverts at Unnamed Watercourse 169, Unnamed Watercourse 384, and Unnamed Watercourse 386 and the temporary outfalls at Unnamed Watercourse 386 and Cod Gill.

151) In locations identified as important for salmonid fish, River Hindburn (Mitigation reference**: EA1**) and tributaries and River Hodder and tributaries(Mitigation reference**: EA2**), no in-river work or high vibration work adjacent to rivers will be undertaken during the main breeding season between October and May inclusive. In-river works between May and September inclusive also have the potential to result in effects on salmonid fry and parr but are less likely to result in significant effects on recruitment as whole and good practices in terms of construction methodologies and pollution prevention are likely to offer adequate protection.

152) Timing restrictions for in river works in combination with the additional mitigation outlined the Water Environment Chapter 7 Section 7.7 (document reference: LCC_RVBC-BO-ES-007) are considered to be sufficient to reduce the significance of potential impacts from sedimentation and water quality deterioration on the fish communities of River Hindburn and River Hodder.

9.7.2 Aquatic Macroinvertebrates

153) Additional mitigation above that described in the CCoP required to reduce the potential for adverse effects from increased sedimentation from the installation and use of the temporary outfalls in culverts at Unnamed Watercourse 169, Unnamed Watercourse 384, and Unnamed Watercourse 386 and the temporary outfalls at Unnamed Watercourse 386 and Cod Gill.

154) The additional mitigation measures to reduce impacts to geomorphology, water quality, and sediment management that are identified in Water Environment Chapter 7 Section 7.7 (document reference: LCC_RVBC-BO-ES-007). These mitigation measures are considered to be sufficient to reduce the significance of potential impacts from increased sediments in the watercourses on the macroinvertebrate communities of the River Hindburn and River Hodder.

155) No further essential mitigation measures are therefore required for aquatic macroinvertebrates.

9.7.3 Aquatic Macrophytes

156) The additional mitigation measures to reduce impacts to geomorphology, water quality, and sediment management are identified in Water Environment Chapter 7 Section 7.7 (document reference: LCC_RVBC-BO-ES-007). These mitigation measures are considered to be sufficient to reduce the significance of potential impacts from increased sediments in the watercourses on the macrophyte communities of River Hindburn and River Hodder.

157) No further essential mitigation measures are therefore required for aquatic macrophytes.

9.7.4 Otter

158) The additional mitigation measures to reduce impacts to geomorphology, water quality, and sediment management are identified in Water Environment Chapter 7 Section 7.7 (document reference: LCC_RVBC-BO-ES-007) and the additional mitigation identified in Chapter 9A Section 9.7 relating to lighting and noise disturbance. These measures are considered to be sufficient to reduce the significance of potential impacts from habitat and prey resource degradation on the otter populations of the River Hindburn and the River Hodder.

159) Pre enabling works checks for otter resting places are specified as part of the CCoP. If otter resting places are confirmed in any areas requiring vegetation removal/disturbance of riverbanks removal, mitigation under licence from Natural England would be implemented as appropriate to the location and status resting place.

9.7.5 Designated Sites

160) The additional mitigation measures to reduce impacts to geomorphology, water quality, and sediment management are identified in Water Environment Chapter 7 Section 7.7 (document reference: LCC_RVBC-BO-ES-007), the additional mitigation identified in Chapter 9A Section 9.7 relating to lighting and noise disturbance, and additional mitigation identified for fish. These measures are considered to be sufficient to reduce the significance of potential impacts on the habitats and species supported by the River Hodder BHS, river Hindburn BHS, and Gamble Hole Farm BHS.

161) No further essential mitigation measures are therefore required for non-statutory designated sites.

9.7.6 Residual Effects

162) Following the application of additional mitigation measures, the residual significant impacts likely to occur during any of the project phases: enabling, construction, commissioning, operation, or decommissioning, are identified in **Table 9.14**. In summary, no residual significant impacts of are expected related to aquatic ecology features of the River Hindburn and River Hodder catchments, for the phases assessed.

Table 9.14: Summary of Mitigation and Residual Effects

Environmental / Community Asset	Specific Mitigation	Magnitude (With Mitigation)	Residual Effect and Significance
Macrophytes (River Hodder and tributaries)	Surface water quality and fluvial geomorphology mitigation measures identified in the Water Environment Chapter 7 Section 7.7.	Low	Not significant
Fish (River Hodder and tributaries)	Surface water quality and fluvial geomorphology mitigation measures identified in the Water Environment Chapter 7 Section 7.7. Timing of in river works (May to September).	Low	Not significant
Aquatic macroinvertebrates (River Hodder and tributaries)	Surface water quality and fluvial geomorphology mitigation measures identified in the Water Environment Chapter 7 Section 7.7. Timing of in river works (July to September).	Low	Not significant
Otter (River Hodder and tributaries)	Surface water quality and fluvial geomorphology mitigation measures identified in the Water Environment Chapter 7 Section 7.7.	Low	Not significant
Macrophytes	Surface water quality and fluvial geomorphology mitigation	Low	Not significant

Environmental / Community Asset	Specific Mitigation	Magnitude (With Mitigation)	Residual Effect and Significance
(River Hindburn and tributaries)	measures identified in the Water Environment Chapter 7 Section 7.7.		
Fish (River Hindburn and tributaries)	Surface water quality and fluvial geomorphology mitigation measures identified in the Water Environment Chapter 7 Section 7.7. Timing of in river works (May to September).	Low	Not significant
Aquatic macroinvertebrates (River Hindburn and tributaries)	Surface water quality and fluvial geomorphology mitigation measures identified in the Water Environment Chapter 7 Section 7.7. Timing of in river works (July to September).	Low	Not significant
Otter (River Hindburn and tributaries)	Surface water quality and fluvial geomorphology mitigation measures identified in the Water Environment Chapter 7 Section 7.7.	Low	Not significant

9.8 Cumulative Effects

163) The following section provides an overview of the potential cumulative effects from different developments, in combination with the Proposed Bowland Section (inter-project). For cumulative effects related to the combined action of a number of different environmental topics (intra-project), see Chapter 19 (Cumulative Effects and Interaction of Effects) and supporting Figure 19.1.

164) Cumulative effects have been assessed in terms of the additional and combined effects. No committed developments with potential for cumulative effects on the aquatic ecology receptors of the River Hindburn (GB112072066050) and Hodder - conf Easington Bk to conf Ribble (GB112071065560) waterbodies were identified during the assessment. Therefore, there is no potential for cumulative effects in combination the Proposed Bowland Section.

9.9 Conclusion

165) This chapter of the ES considered the potential aquatic ecology impacts associated with enabling works, construction, commissioning, operation, and decommissioning impacts at nearby watercourses within 500 m with hydrological connectivity from the route of the Proposed Bowland Section.

166) After undertaking the assessment of the likely impact of the Proposed Scheme on the aquatic ecology receptors considered in this chapter potential impacts were identified for fish, macroinvertebrates, macrophytes, and otter during the enabling works, construction, and decommissioning phases. Therefore, it was necessary to identify mitigation measures to minimise the potential impacts.

167) Following incorporation of all mitigation measures the magnitude, probability, scale, and duration of the impacts to aquatic ecology receptors would be reduced to minor for the residual effects for aquatic ecology receptors during all phases of the proposed Bowland Section.

168) No committed developments with potential for cumulative effects on the aquatic ecology receptors of the River Hindburn (GB112072066050) and Hodder - conf Easington Bk to conf Ribble (GB112071065560) waterbodies were identified during the assessment. Therefore, there is no potential for cumulative effects in combination the Proposed Bowland Section.

9.10 Off-Site Highways Works and Proposed Ribble Crossing

169) As explained in Chapter 1, off-site highways works and the Proposed Ribble Crossing were developed at a late stage in the EIA programme, and are therefore assessed in Volume 5 and Volume 6 respectively.

170) This section summarises the likely significant effects associated with enabling works and construction activities required for off-site highways works and the enabling, construction, operation, and decommissioning phases of the Proposed Ribble Crossing. It is also worth noting that likely significant effects have been identified for the proposed off-site highways works. While the overall cumulative effects of each EIA topic are summarised in Chapter 19 it is worth noting here that cumulative effects are envisaged when taking account of the main construction compounds, construction access routes on the local public highway, and the off-site highways works.

171) It is envisaged that the off-site TR3 highways improvement works may account for significant effects to the macrophyte, fish, and macroinvertebrate communities, and otter populations in the Bonstone Brook (RW22 and RW23) and Unnamed Watercourse 2096 (RW22) due to road widening activities at four highways works areas. Potential impacts from increased sedimentation and a reduction in water quality, and disturbance during site clearance, creation of road widening and are considered to be temporary, medium term, and reversible. There is also potential for long term changes to fine sediment input due to bank destabilisation during the proposed road widening works. Without appropriate mitigation this has potential to permanently alter the fish macroinvertebrate, and a macrophyte communities which would have a significant impact on the aquatic receptors present in these watercourses. Due to the presence in the wider catchment there is potential for impacts to otters from increased disturbance to foraging otter due to encroachment of road to the watercourse in increased vehicle activity. Seven highways improvement areas for the TR3 access associated with three watercourses (Unnamed Watercourse 434, River Ribble, and Waddington Brook) were screened into the assessment but no potential significant effects to aquatic ecology features were identified at these locations. An additional 28 highways improvement areas were screened out of the assessment due to an absence of potential impact pathways to aquatic receptors

172) The Proposed Ribble Crossing has potential for significant effects to the macrophyte, fish, and macroinvertebrate communities, and otter populations in the River Ribble and River Ribble tributaries (Coplow Brook, Greg Sike, and Unnamed Watercourse 2097), during the enabling works, construction, and decommissioning phases in the absence of additional mitigation. Potential impacts identified include pollution from increased sediment mobilisation, habitat loss, disturbance and habitat fragmentation from noise and vibration, and disturbance during site clearance. Therefore, it was necessary to identify mitigation measures to minimise the potential impacts.

173) The proposed mitigation identified for works at the watercourses that would be affected by the highways works and the Proposed Ribble crossing with potential for significant effects to aquatic ecology includes silt and pollution control measures, best practice biosecurity measures, timing of works to avoid sensitive periods for spawning and migratory fish, pre-works checks for protected species, ECoW supervision for vegetation clearance and in river works, and bank reinstatement and or realignment to prevent instability following completion of the works. Following incorporation of all mitigation measures the magnitude, probability, scale, and duration of the impacts to aquatic ecology receptors would be reduced to minor for the residual effects to aquatic ecology receptors of the River Ribble, Ribble tributaries, Bonstone Brook, and Unnamed Watercourse 2096.

9.11 Glossary and Key Terms

174) Key phrases and terms used within this technical chapter relating to Aquatic Ecology are defined within Appendix 1.2: Glossary and Key Terms.