MOTT MACDONALD

# Baseline aquatic ecology assessment - Otley Bridge

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| **Project:** | Otley Bridge, Otley | | |
| **Our reference:** | 100413589-008-PAEA-OB-V1 | | |
| **Prepared by:** | BN | **Date:** | 22 November 2024 |
| **Approved by:** | BC | **Checked by:** | AM |
| **Subject:** | Preliminary aquatic ecology assessment | | |

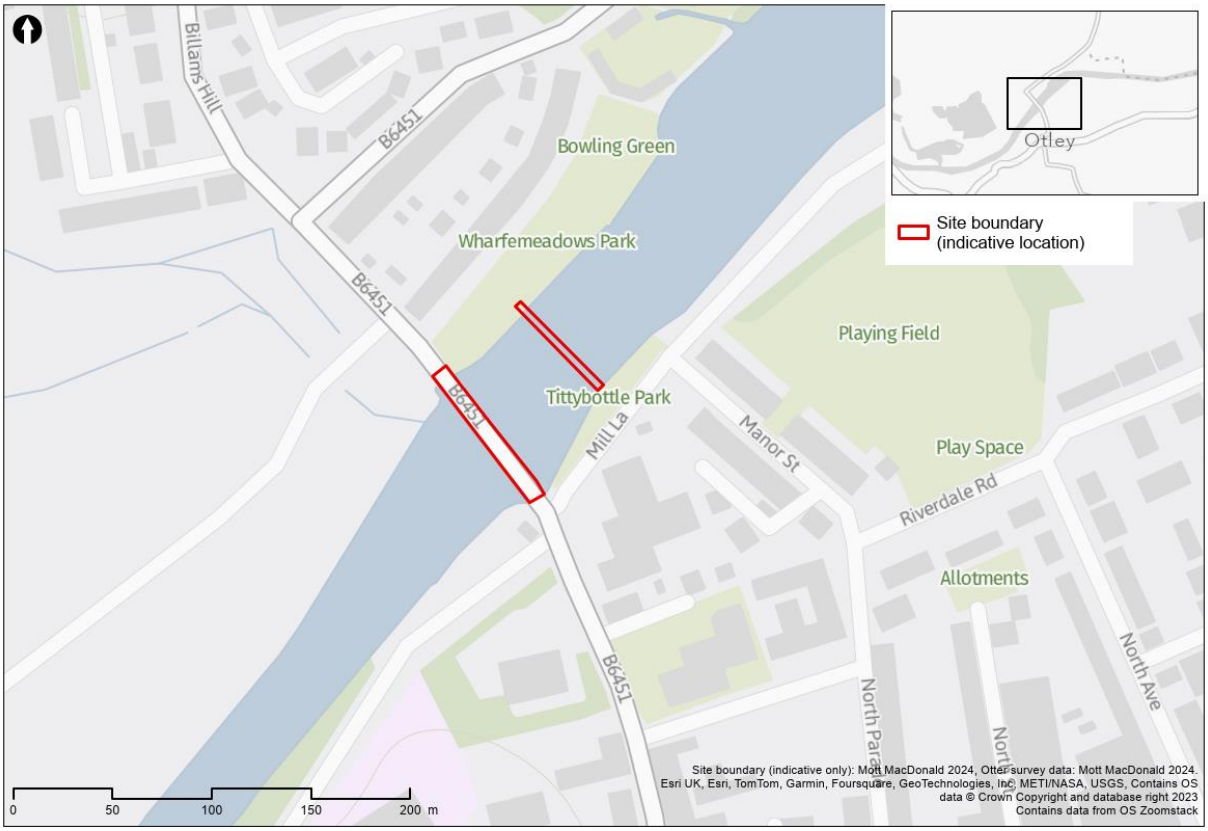
# 1 Introduction

Mott MacDonald Limited has been commissioned by Leeds City Council to undertake an to undertake a preliminary aquatic ecology assessment of the River Wharfe in relation to the construction of a temporary bridge during the replacement of the current footbridge at Otley Bridge.

The works will involve the creation of a temporary crossing point approximately 50m downstream of the existing bridge (at British National Grid reference SE 20123 45864) which will be supported from a pier set into the river. Otley Bridge and this temporary bridge will hereby be referred to as the 'site'. This is shown below in Figure 1.1. This will comprise three steel tubes installed into the riverbed using a mixture of percussion and vibration. The pier will be in use for approximately three to four months while works to replace the footbridge at Otley Bridge are completed.

The initial purpose of the assessment was to collect initial baseline information to highlight further survey requirements and inform the design and construction process by undertaking a preliminary aquatic ecology assessment. This consisted of an aquatic habitat walkover survey and desk study in July 2024. Following this assessment, additionally surveys were undertaken in September 2024 to provide additional baseline data relevant to the scheme. This technical note sets out the results of the preliminary assessment and subsequent environmental DNA (eDNA) and macroinvertebrate surveys recommended.

**Figure 1.1: Map of red line boundary**



Source: Mott MacDonald, 2024. Data sources are listed inset.

# 2 Methodology

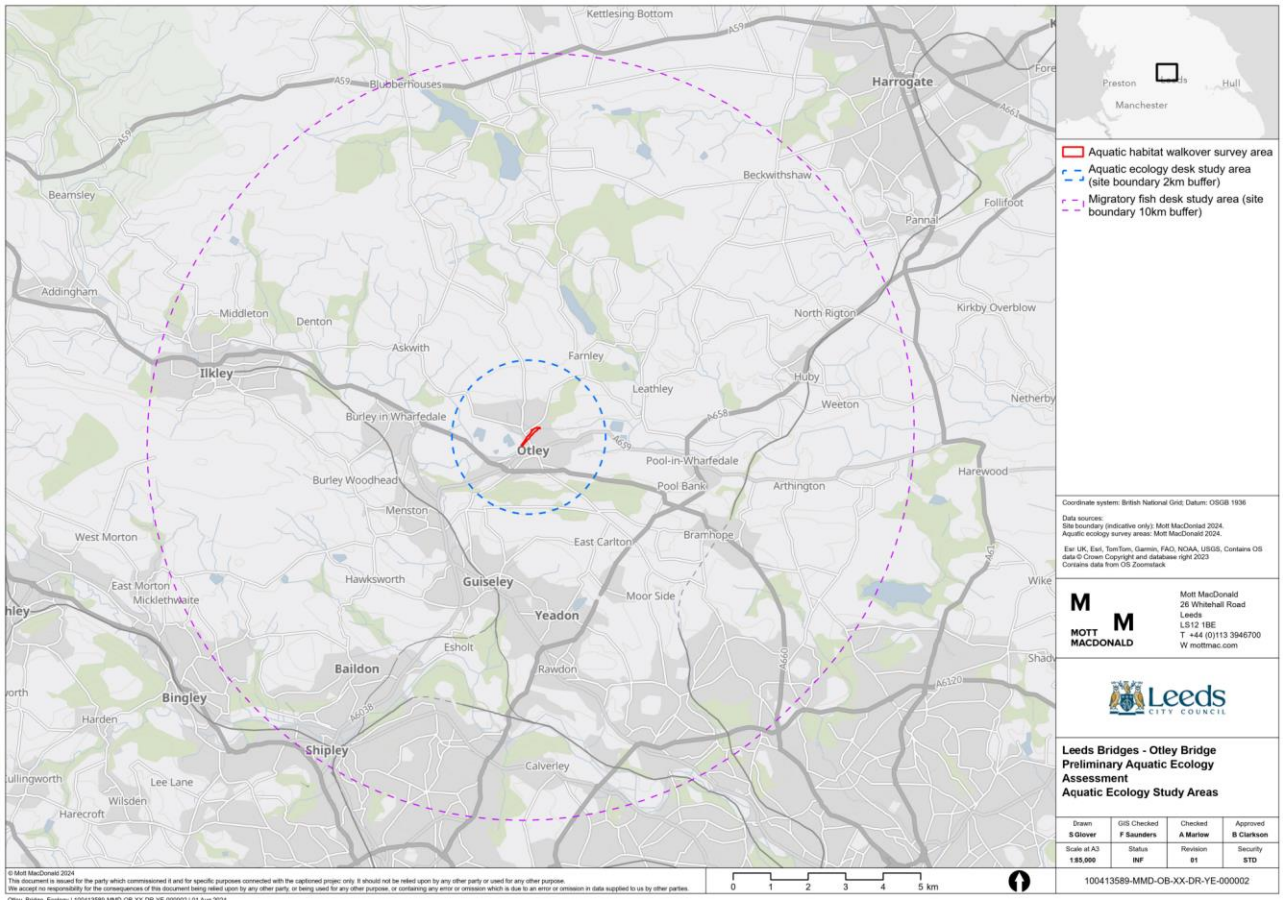
## 2.1 Study area

The study area comprised the area within the site boundary and the following additional buffers:

- A 250m buffer for the walkover survey, to understand risks to habitats and species outside of the site boundary which may feasibly be impacted by the works
- A 2km buffer for the aquatic species desk study, to capture existing records which may be impacted by the works and account for the mobility of aquatic species
- A 10km buffer to identify migratory fish which may be present or migrate through the site boundary

The study area is depicted in Figure 2.1Figure 2.1

**Figure 2.1: Study area**




Source: Mott MacDonald, 2024. Data sources are listed inset.

## 2.2 Desk study

Open-source macroinvertebrate, macrophyte (aquatic plant) and fish data from the last 25 years was obtained for the study area using the Environment Agency (EA) Ecology & Fish Data Explorer (Environment Agency, 2021) and NBN Atlas online records system (NBN Trust, 2024). Records from within the last 10 years (2014-2024) were considered most representative of present populations; however, due to limited survey results and the potential to highlight additional recorded species, records dating back to 1999 were also considered relevant.

This assessment has been undertaken within the context of the following relevant legislative instruments and planning policies relating to protected species and habitats:

- The Conservation of Habitats and Species Regulations 2017 (as amended)
- The International Union for the Conservation of Nature (IUCN) Red List of Threatened Species 2010
- Natural Environment and Rural Communities Act 2006, Section 41 of which provides a list of habitats and species of principal importance for nature conservation in England
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
- The Salmon and Freshwater Fisheries Act 1975 (as amended)
- The Eels Regulations (England and Wales) 2009
- The Wildlife and Countryside Act 1981
- The Bern Convention Appendix 3, under which special protection through 'appropriate and necessary legislative and administrative measures' is applied to listed wild fauna species
- Habitats Directive Annex II and Annex V

In addition, legislation relating to invasive non-native species (INNS) was also considered which includes but is not limited to the following points:

- Under the Wildlife and Countryside Act 1981 (as amended), it may be an offence to:
  - Release or allow to escape into the wild any animal which 'is of a kind which is not ordinarily resident in and is not a regular visitor to Great Britain in a wild state'; or is included in Part I of Schedule 9
  - Plant or otherwise cause 'to grow in the wild any plant which is included in Part II of Schedule 9'
- Under the Invasive Alien Species (Enforcement & Permitting) Order 2019, it may be an offence to release, cause to escape, plant, or grow species of animal or plant 'not ordinarily resident in' and 'not a regular visitor to Great Britain in a wild state', or otherwise listed in Schedule 2
- Guidance from the Water Framework Directive UK Technical Advisory Group (WFD UK-TAG, 2021) categorising the impact of aquatic INNS

## 2.3 Aquatic habitat walkover survey

### 2.3.1 Field survey methodology

A walkover survey was undertaken on the River Wharfe on 05 July 2024. In order to fully describe the relevant features, the survey was conducted along the reach of river present within the site boundary plus a minimum of 250m upstream and downstream. The details of the survey are presented in Table 2.1.

**Table 2.1: Site information for walkover survey.**

| Site | Date surveyed | Start NGR | End NGR | Approximate length surveyed |
|---|---|---|---|---|
| River Wharfe | 05/07/2024 | SE 19980 45640 | SE 20440 46140 | 0.7km |

Source: Mott MacDonald, 2024

The survey was conducted by accessing the banks of the watercourse in order to view each survey stretch and record its features. The survey aimed to characterise the waterbody within the survey area, therefore

changes in general character throughout the reach were recorded in addition to specific features of interest. Features of interest were documented using a camera to take photographs, and grid references were collected for these features using a hand-held satellite-based navigation device. The features of interest recorded included:

- The general character of watercourse and changes to this character
- Approximate widths and depths
- Any in-channel features such as pools, bars, or islands
- Substrate types (either recorded in-channel or estimated based on visible features)
- Flow types and diversity
- Riparian vegetation and shading
- In-channel vegetation
- Areas of cover for fish, such as woody debris and overhanging vegetation
- Channel and bank modifications, such as artificial structures or channel re-alignment
- The bankside and surrounding land-uses
- Lateral connectivity to other aquatic habitats such as wetland areas
- Connectivity to other watercourses
- Outfalls or inputs from other sources
- Notable features to be protected
- Potential sources of point source or diffuse pollution
- Suitability of the stretch for various life stages and species of fish
- Suitability to support populations of white-clawed crayfish (*Austropotamobius pallipes*)
- Any other features or considerations noted on site such as protected/notable species, or INNS

## 2.4 Environmental DNA surveys

### 2.4.1 Sample collection methodology

Sampling was undertaken to detect the presence of fish, crayfish and crayfish plague[1] eDNA in the River Wharfe. Two water samples were collected at the sample site and sample material was extracted using sampling kits provided by Nature Metrics. A summary of the survey details is presented below in Table 2.3.

**Table 2.3: eDNA sampling information**

| Site | Sample date | Grid reference |
|---|---|---|
| River Wharfe | 02/09/2024 | SE 20251 46062 |

Source: Mott MacDonald, 2024.

Water sampling was composed of sub-samples taken across the watercourse at the target location, incorporating areas of different habitats and flow types where possible. Up to 2,000mL of sampled water was filtered through encapsulated disk filters immediately upon collection using a syringe. A preservative solution was then added to the filter units and samples were sent to Nature Metrics for analysis.

[1] Crayfish plague (*Aphanomyces astaci*) is a fungus-like organism which is frequently found within populations of non-native crayfish, and is often fatal to native white-clawed crayfish.

### 2.4.2 Laboratory processing

Laboratory processing of eDNA samples was conducted by Nature Metrics. Commercially available extraction kits were used to extract eDNA from the disk filters and to purify the extractant to remove inhibitors. Signal crayfish (*Pacifastacus leniusculus*) and white-clawed crayfish were targeted using species-specific primers and probes, then amplified by quantitative polymerase chain reaction (qPCR).

For fish, a metabarcoding approach was used to screen for positive records of species present in the fish community. Purified DNA was amplified with polymerase chain reaction (PCR) using an appropriate gene region. As a means of quality control, analysis of samples included replicates and positive and negative controls which determine, respectively, whether the assay is working correctly, and if PCR reactions are contaminated.

## 2.5 Macroinvertebrate sampling

### 2.5.1 Field survey site information

It was considered possible that macroinvertebrate communities and habitats sensitive to sedimentation within the River Wharfe could be affected by the proposed works; therefore, macroinvertebrates were sampled at the nearest accessible location of the River Wharfe downstream the scheme boundary.

The survey details are as shown in Table 2.2.

**Table 2.2: Site information for macroinvertebrate surveys**

| Site | Date surveyed | NGR | Method | Site conditions | Image |
|---|---|---|---|---|---|
| River Wharfe | 02/09/2024 | SE 20251 46062 | Kick sample | Site was downstream of the weir. The channel was approximately 7m wide and 0.2m deep. Substrate was approximately 40% cobble, 30% pebble and 30% gravel. The water was clear and considered to be normal level. Habitats included riffle and run, and channel vegetation consisted of 1% cover of macrophyte and 2% cover of moss. |  |

Source: Mott MacDonald, 2024.

### 2.5.2 Guidance documents

The following survey guidance has been taken into account during macroinvertebrate sampling and taxonomic analysis:

- BS EN ISO 10870:2012 (The British Standards Institution, 2012) – best practice guidance for the undertaking of aquatic macroinvertebrate surveys
- Procedure for Collecting and Analysing Macro-invertebrate Samples – Environment Agency (Murray-Bligh, 1999) – detailing sampling and analysis procedures

- River Invertebrate Prediction and Classification System (RIVPACS) procedures (EU-STAR, 2004)

### 2.5.3 Macroinvertebrate survey methodology

Macroinvertebrate sampling consisted of three minutes of sampling using a pond net, and a one-minute manual search to record invertebrates from any distinct habitats (such as those organisms attached to vegetation, submerged objects such as cobbles and woody debris, or surface-dwelling taxa). As the River Wharfe was wadable at the time of survey, a kick-sampling technique was used, whereby the net is held in the water whilst the substrate is disturbed underfoot to capture dislodged invertebrates.

Environmental data for the sampling area, banks, and surrounding area was collected. This data included the predictor variables (watercourse width, depth, substrate composition) required for subsequent data analysis (EU-STAR, 2004). The sample was kept cool and preserved within 24 hours in industrial methylated spirit (with reference to the guidance listed in 2.5.2), before being analysed in a laboratory by APEM.

### 2.5.4 Sample processing

In the laboratory, the macroinvertebrate sample was analysed to RIVPACS Taxonomic Level 5 (TL5; Davy-Bowker et al., 2010). This is predominantly to species-level, with exceptions where this is either not possible (such as many true fly larvae), or would involve disproportionate effort (for example, aquatic worms). Within this framework, specimens are identified to the highest taxonomic level possible given their life stage and condition. This level of taxonomic resolution enables calculation of the biological indices described in 2.5.5, and the detection of both INNS and species of conservation importance. Taxa present within the sample and their abundance were recorded.

### 2.5.5 Data processing

The resulting dataset was used to calculate the following biological indices in order to summarise the assemblage, and to evaluate the baseline condition of the macroinvertebrate community in the River Wharfe

- Whalley, Hawkes, Paisley and Trigg Average Score Per Taxon (WHPT ASPT) (Water Framework Directive UK Technical Advisory Group (WFD-UKTAG), 2014) – the average core for all scoring species in the WHPT index for the sample, a metric used to assess the condition of the river and likely impact of organic pollution
- WHPT Number of Taxa (WHPT NTAXA) (WFD-UKTAG, 2014) ‑ the number of taxa which score within the WHPT system for a sample, which may be affected by additional factors such as habitat disturbance
- The Lotic Invertebrate Index Flow Evaluation (LIFE) index (Extence et al, 1995) ‑ a metric used to indicate whether a riverine macroinvertebrate community is affected by changes in flow
- Proportion of Sediment-sensitive Invertebrates (PSI) index (Extence et al, 2011)‑ used to indicate whether a survey site's riverine macroinvertebrate community is affected by deposition of fine sediment
- Community Conservation Index (CCI) (Chadd and Extence, 2004) ‑ a metric that acts as a score of conservation value of freshwater habitats, based on the rarity of species found in a sample

Survey results were also screened to identify protected, notable, and invasive non-native species under the legislation and guidance listed in Section 2.2.

### 2.5.6 Constraints, limitations, and assumptions

The desk study was conducted in July 2024 and therefore considered representative of this time. However, absence of relevant records does not preclude the presence of other protected/notable or non-native species. Absence of recent species records may be due to a lack of species recording, and the potential for other species to still be present is acknowledged. Similarly, older species records may also not reflect recent presence or abundance of species; where possible, more recent records have been used to inform this assessment. Older records of particular species may be considered useful for highlighting the need for

further surveys, such as for white-clawed crayfish where the species was once present but current status is unknown.

Due to access constraints along both banks, some areas of the channel could not be viewed from the bank. However, the length of the surveyed reach was accessible from either the left or right bank with a view of the opposite bank. As the bankside character was similar across both banks, it was considered unlikely that any significantly different habitat features were missed. In addition, due to the depth and width of the river, it was not possible to ascertain the depth and substrate mid-channel.

As the walkover survey was undertaken during the vegetative season, the results of this assessment take into account the extent of vegetation during the summer, however other recorded features such as flow conditions are unlikely to be representative of all seasons.

# 3 Results

## 3.1 Desk study

### 3.1.1 Protected and notable species

A total of six distinct protected/notable fish taxa and three invertebrate species were identified within the study area in the last 10 years. Records of white-clawed crayfish were also identified within the study area from 2003. Details of these records are presented in Table 3.1.

**Table 3.1: Protected species identified within the study area.**

| Species name | Taxon group | Data source | Number of records | Locality | Most recent record | Nearest record to site | Protection |
|---|---|---|---|---|---|---|---|
| Brown/sea trout (*Salmo trutta*) | Fish | EA NBN[2] | 31 | River Wharfe | 03/09/2014 | SE 20255 46062 (0.2km downstream) | Natural Environment Research Council Section 41 |
| | | | | River Washburn | 26/08/2014 | SE 19100 51800 (6.0km north) | |
| | | | | Riffa Beck | 06/08/2014 | SE 25700 45900 (6.2km east | |
| | | | | Hundwith Beck | 06/08/2014 | SE 15300 48300 (5.4km west) | |
| | | | | Carr Beck | 12/09/2018 | SE 16622 45211 (3.4km west) | |
| | | | | Loadpit Beck | 10/09/2014 | SE 12886 40069 (9.4km south west) | |
| | | | | Gill Beck | 14/09/2023 | SE 15194 41358 (6.7km south west) | |

[2] Records provided by Environment Agency, accessed through NBN Atlas website.

| Species name | Taxon group | Data source | Number of records | Locality | Most recent record | Nearest record to site | Protection |
|---|---|---|---|---|---|---|---|
| | | | | Morton Beck | 11/09/2023 | SE 10309 42748 (10km west) | |
| | | | | River Aire | 25/07/2017 | SE 17695 39942 (6.5km south) | |
| Atlantic salmon (*Salmo salar*) | Fish | EA<br>NBN[2] | | River Wharfe | 01/09/2014 | SE 20255 46062 (0.2km downstream) | Bern Convention Annex III<br>Habitat Directive Annex V<br>Habitat Directive Annex II |
| | | | | Riffa Beck | 24/06/2014 | SE 25700 45900 (6.2km east) | |
| European eel including elvers (*Anguilla anguilla*) | Fish | EA<br>NBN[2 3] | 1 | River Wharfe | 01/09/2014 | SE 20255 46062 (0.2km downstream) | Natural Environment Research Council Section 41 |
| | | | | Riffa Beck | 06/08/2014 | SE 25700 45900 (6.2km east) | |
| | | | | River Aire | 25/07/2017 | SE 13061 38381 (10km south west) | |
| Grayling (*Thymallus thymallus*) | Fish | EA<br>NBN [2 3 4] | 11 | River Wharfe | 03/09/2014 | SE 20255 46062 (0.2km downstream) | Bern Convention Annex III<br>Habitat Directive Annex II<br>Habitat Regulations Schedule 4 |
| Lamprey species (ammocoetes[5]) *Petromyzontidae spp.* | Fish | EA | 3 | River Wharfe | 01/09/2014 | SE 22700 45800 (3.2km downstream) | Habitat Directive Annex II<br>Bern Convention Annex III |
| | | | | Riffa Beck | 06/08/2014 | SE 25318 46474 (6.9km east) | |
| Lamprey species (ammocoetes) (*Lampetra spp.*) | Fish | EA | 1 | River Wharfe | 23/06/2014 | SE 23200 45600 (3.5km downstream) | Habitat Directive Annex II<br>Bern Convention Annex III |
| Bullhead (*Cottus gobio*) | Fish | EA<br>NBN[2] | 30 | River Wharfe | 01/05/2018 | SE 20255 46062 (0.2km downstream) | Habitat Directive Annex II |

[3] Records provided by Biological Records Centre, accessed through NBN Atlas website.

[4] Records provided by Freshwater Fish Recording Scheme, accessed through NBN Atlas website.

[5] The juvenile stage of lamprey species

| Species name | Taxon group | Data source | Number of records | Locality | Most recent record | Nearest record to site | Protection |
|---|---|---|---|---|---|---|---|
| White-clawed crayfish (*Austropotamobius pallipes*) | Invertebrate | NBN [3] [3] | 3 | River Wharfe | 16/07/2003 | SE 21200 46100 (1.2km downstream) | Bern Convention Annex III<br>Wildlife and Countryside Act Schedule 5<br>Wildlife and Countryside Act Schedule 9<br>Habitat Directive Annex V<br>Habitat Directive Annex II<br>Natural Environment Research Council Section 41 |
| Water snipefly (*Atherix ibis*) | Invertebrate | EA | 2 | River Wharfe | 11/10/2021 | SE 187884 5491 (1.6km upstream) | Nationally Scarce (includes Red list data) [6] |
| Moss beetle (*Ochthebius exsculptus*) | Invertebrate | EA | 1 | River Wharfe | 08/10/2018 | SE 187884 5491 (1.6km upstream) | Nationally Scarce (excludes Red list data)[7] |
| Aquatic beetle (*Riolus subviolaceus*) | Invertebrate | EA | 1 | River Wharfe | 08/10/2018 | SE 187884 5491 (1.6km upstream) | Nationally Scarce (excludes Red list data) |

Source: Environment Agency 2021, NBN Trust 2024, Bern Convention A3, Wildlife and Countryside Act 1981, Habitats Directive Annex 2, Habitats Directive Annex 5, Natural Environment Research Council Section 41, OSPAR, Habitat Regulations Schedule 4, Red List Great Britain, and Mott MacDonald, 2024.

### 3.1.2 Invasive and non-native species

Seven aquatic INNS were also identified within the study area – three plant species and four invertebrates – these records are presented below in Table 3.2.

[6] Nationally Scarce – Occurring in 16-100 hectads in Great Britain. Includes rare species qualifying under the main IUCN criteria.

[7] Nationally Scarce – Occurring in 16-100 hectads in Great Britain. Excludes rare species qualifying under the main IUCN criteria.

**Table 3.2: INNS identified within the study area.**

| Species name | Taxon group | Data source | Number of records | Locality | Most recent record | Nearest record to site | Status |
|---|---|---|---|---|---|---|---|
| Himalayan balsam (*Impatiens glandulifera*) | Riparian aquatic plant | NBN [2 8 9] | 23 | River Wharfe | 13/07/2018 | SE 21000 46100 (0.8km downstream) | UKTAG – High impact<br>Wildlife and Countryside Act 1981 Schedule 9<br>EU species of special concern<br>Invasive Alen Species Order 2019 Schedule 2 |
| Giant hogweed (*Heracleum mantegazzianum*) | Riparian aquatic plant | NBN[2 9] | 5 | River Wharfe | 01/05/2018 | SE 21000 46100 (0.9km downstream) | UKTAG – High impact<br>Invasive Alen Species Order 2019 Schedule 2 |
| Canadian waterweed (*Elodea canadensis*) | Macrophyte | NBN[2] | 2 | River Wharfe | 14/09/2009 | SE 18788 45491 (1.6km upstream) | UKTAG – Moderate impact<br>Wildlife and Countryside Act 1981 Schedule 9 |
| Acute bladder snail (*Physella acuta*) | Macro-invertebrate | NBN[2 10] | 2 | River Wharfe | 08/08/2020 | SE 18700 45400 (1.7km upstream) | UKTAG – Unknown impact |
| Tadpole bladder snail (*Physella gyrina*) | Macro-invertebrate | NBN[10] | 1 | River Wharfe | 08/08/2020 | SE 21880 46280 (1.8km downstream) | UKTAG – Unknown impact |
| Northen River/Florida crangonyctid (*Crangonyx pseudogracilis/floridanus*)[11] | Macro-invertebrate | EA<br>NBN[2] | 3 | River Wharfe | 11/10/2021 | SE1878845491 (1.7km upstream) | UKTAG – Low impact |
| Jenkins spire shell (*Potamopyrgus antipodarum*) | Macro-invertebrate | EA<br>NBN[2 10] | 41 | River Wharfe | 11/10/2021 | SE 20000 46000 (0.2km upstream) | UKTAG – Moderate impact |

Source: NBN Trust (2024), WFD-UKTAG (2021), Wildlife and Countryside Act 1981, Invasive Non-Native Species (Amendment etc.) (EU Exit) Regulations, Invasive Alien Species (Enforcement and Permitting) Order 2019, and Mott MacDonald, 2024.

[8] Records provided by National Plant Monitoring Scheme - England, Scotland, Wales, accessed through NBN Atlas website.

[9] Records provided by Botanical Society of Britain & Ireland, accessed through NBN Atlas website.

[10] Conchological Society of Great Britain & Ireland (2024), Conchological Society of Great Britain & Ireland: non-marine mollusc records. Occurrence dataset on the NBN Atlas

[11] *C. pseudogracilis* is listed at Low impact (Water Framework Directive UK-TAG, 2021); however, although non-native (Morvisseau et al., 2018), *C. floridianus* is not currently listed. *C. floridianus* is grouped with *C. pseduogracilis* when determination to species level has not been recorded.

### 3.1.3 Aquatic fish community

In addition to the protected species shown in Table 3.1, records of stone loach (*Barbatula barbatula*) and minnow (*Phoxinus phoxinus*) within the last 10 years were also returned. Therefore, the fish community is considered a predominantly salmonid community, with additional migratory species and minor species also present.

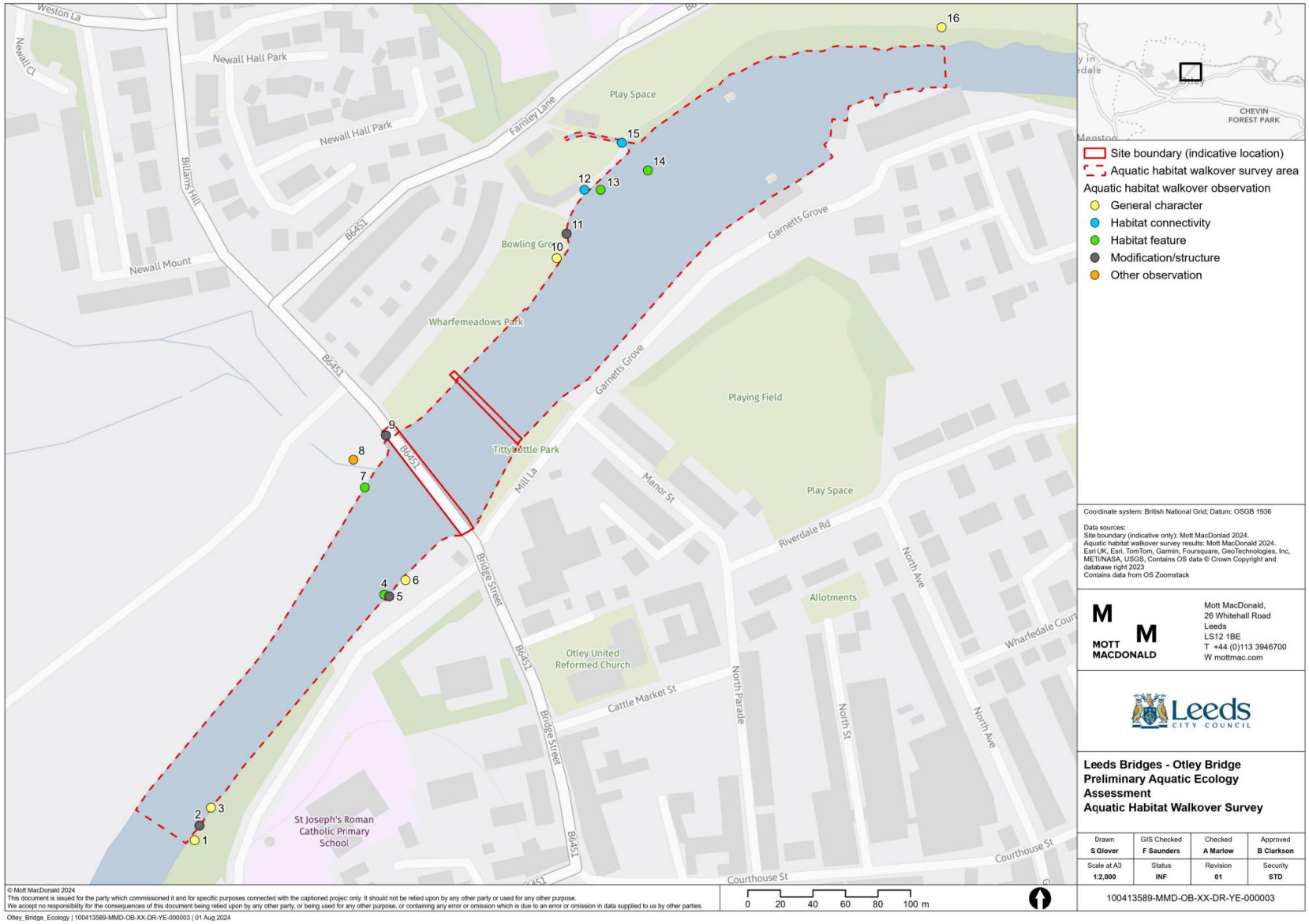
## 3.2 Aquatic habitat walkover survey

The surveyed reach of the River Wharfe was noted as a wide river with a steady flow running through an urban environment. Within the upstream survey reach, the river was noted to be 40-60m wide with predominately rippled flow at the time of survey. The substrate was predominately gravel and sand at the banks with lesser amounts of silt and gravel/pebble. River depth, as measured from the bank, typically varied from 1.0m to 1.2m. The surrounding land use consisted of mostly urban/suburban and parks/gardens along the right bank and agricultural land along the left bank. Both banks had a substantial riparian buffer populated by dense woodland and scrub, creating extensive areas of overhanding vegetation and branches. No in-channel macrophytes or mosses were noted as observed from the banks. Evidence of historic modification in the form of stone reinforced banks was noted along the right bank.

The downstream part of the survey reach exhibited very similar characteristics to the upstream section up to the large weir located at SE 20296 46051. Upstream of this location, the river width was over 50m with uniform steady, rippled flow. The weir itself was noted to be a significant structure, running diagonally across the channel and was approximately 175m in length. Both banks where heavily modified with stone reinforcement. Downstream of the weir, the river characteristic demonstrated a noticeable change with a faster flow and variation in hydro-morphological features; here a vegetated gravel bar was noted which split the channel into two main channels and several smaller braided channels. The downstream reach was of coarser material with predominantly gravel/pebble and cobble substrate, with areas of boulder also noted immediately downstream of the weir. It was not possible to measure the depth in the downstream reaches due to the height of the banks, however the depth was noticeably shallower – approximately 30cm – and the reach in-channel habitat types consisted of predominantly riffles, with rippled flow with areas of chute flow over the weir and boulders. Limited in-channel macrophytes were observed, though extensive areas of overhanging branches and grasses were present on the left banks and mid-channel gravel bar. Scattered cover of the INNS Himalayan balsam was also observed along both banks.

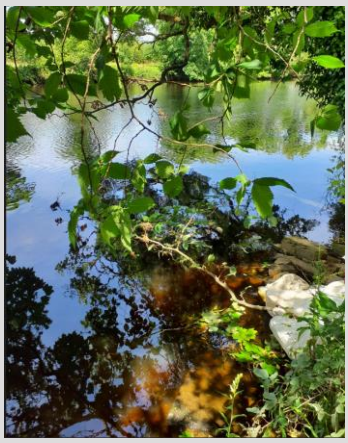
Selected features of the walkover are shown below in Figure 3.1 and Table 3.3.

## Figure 3.1: Selected walkover features

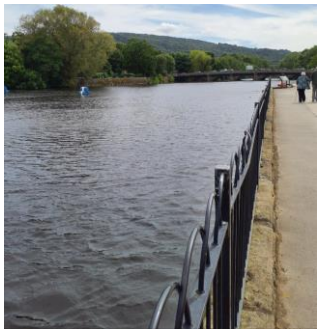


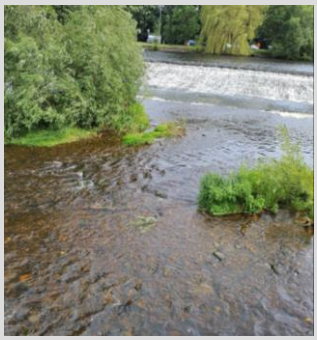

Source: Mott MacDonald, 2024. Data sources are listed inset.

## Table 3.3: Features of note recorded in the survey reach

| Feature number | Feature of note | Grid reference | Description | Photograph |
|---|---|---|---|---|
| 1 | General character | SE 19980 45640 | Start of survey showing view of River Wharfe from right bank. The channel was wide and deep with smooth flow. The right bank was densely vegetated providing shade and cover for fish. The bank profile was vertical and reinforced with stone blocks, which may reduce overall habitat availability and diversity on bank. |  |
| 2 | Modification /structure | SE 19990 45660 | An example of the historical stone reinforcement along right bank – reinforcement here was approximately 2.5 m long. The walls consisted of large stone blocks with small gaps. Other examples of stone reinforcement were noted at several points along the right bank, the majority of which were located below water level. |  |
| 3 | General character | SE 19990 45660 | The surrounding land use and riparian zone observations noted the bank was stepped and approximately 10m high. Dense vegetation cover was noted with mature trees and scrub which will act as a pollution and sediment buffer. The trees provide significant shading and overhanging vegetation to channel margins. |  |
| 4 | Habitat feature | SE 20097 45791 | Several areas of shallow (~0.1m deep) habitat were noted along right bank with slack flow. Substrate was noted as predominately sand and/or silt. Overhanging vegetation was also present. Juvenile fish (fry) were also observed in these habitats. Marginal dead water was noted, which may be good habitat for invertebrates and fry. |  |

| Feature number | Feature of note | Grid reference | Description | Photograph |
|---|---|---|---|---|
| 5 | Modification /structure | SE 20100 45790 | View of the bridge from right bank. The bridge here likely provides localised areas of flow diversity and shading in contrast to lack of diverse habitat in centre of channel. |  |
| 6 | General character | SE 20110 45800 | View of left bank from right bank. Scattered vegetation was present along left bank which may provide cover for fish. A poached bank also noted which may be a source of sediment input. |  |
| 7 | Habitat feature | SE 20085 45857 | Silt beds were observed on left bank with a shallow steady flow. This may be utilised by burrowing fish species such as juvenile lamprey. |  |
| 8 | Other observation | SE 20078 45874 | Drainage channel/tributary was observed flowing from underneath car park area. The channel appeared artificial/modified and may be a source of pollution, however it may provide localised areas of different habitat for juvenile fish or invertebrates. |  |

| Feature number | Feature of note | Grid reference | Description | Photograph |
|---|---|---|---|---|
| 9 | Modification /structure | SE 20098 45889 | The channel bed was reinforced with brick/laid stone under bridge. The river was shallow with silt and gravel deposits. This may provide localised areas of cover for juvenile fish. |  |
| 10 | General character | SE 20203 45998 | Upstream view of river showing the potential location of temporary bridge. Adjacent land was paved through parkland which may contribute to surface runoff. |  |
| 11 | Modification | SE 20209 46013 | Glide flow was noted upstream of weir. The weir was noted to be approximately 175m long and 5m high. A fish pass was noted along right bank. Common reed (*Phragmites australis*) and the INNS Himalayan balsam (Impatiens *glandulifera*) were noted growing on/around the weir. |  |
| 12 | Habitat connectivity | SE 20220 46040 | A small channel joins the River Wharfe which may provide important connectivity to habitat. |  |

| Feature number | Feature of note | Grid reference | Description | Photograph |
|---|---|---|---|---|
| 13 | Habitat feature | SE 20230 46040 | Downstream of weir, the river was shallower with greater diversity in features including riffles and unbroken standing wave flow type. The substrate consisted of mostly gravel and cobble and may be suitable spawning ground for salmonids and lamprey. |  |
| 14 | Habitat feature | SE 20259 46052 | A large mature gravel bar was located in channel, of approximately 120m long and 20m wide with overhanging vegetation and flow diversity which likely provides important habitat for fish. |  |
| 15 | Habitat connectivity | SE 20243 46069 | Tributary joins River Wharfe. The channel was heavily modified with concrete sides and bed but may provide connectivity to additional habitat. |  |
| 16 | General character | SE 20440 46140 | End of survey. Side bars were present along right bank with overhanging vegetation, which may provide suitable habitat for juvenile fish. |  |

Source: Mott MacDonald, 2024

The river was noted to have significant modifications to the banks and was relatively uniform for the majority of the surveyed reach, however some habitat diversity was noted throughout. As the whole surveyed reach was dominated by coarse substrate, the site boundary and surrounding area has the potential to support salmonids with particularly good examples of salmonid spawning habitat noted downstream of the weir. This section contained faster rippled flow was and diversity of in-channel habitat due to the presence of the mid-channel gravel bar and overhanging vegetation, which likely provide important cover for fish. This habitat may also support spawning lamprey due to the variation in substrate size. The diversity in habitat was also noted to have the potential to support white-clawed crayfish. Diversity of habitat was also noted upstream of

the weir in the eroded bank margins where shallower silty banks with overhanging vegetation cover were present, which may be important for juvenile fish and eels. The INNS Himalayan balsam was also present along both banks.

## 3.3 Environmental DNA surveys

The results of the eDNA analysis to determine species within the fish communities in the River Wharfe are presented below in Table 3.4 and corroborate the findings of the desk study.

In total, eleven distinct fish taxa were identified through eDNA sampling. Environmental DNA from four family groups was also identified. The identification of *Cottus* sp. and *Gasterosteus* sp. are likely to be genus-level detection of bullhead (*Cottus gobio*) and three spined stickleback (*Gasterosteus aculeatus*) as these are the only freshwater members of this family known within Britian. Detection of lamprey (*Lampretra sp.*) highlights the presence of either brook lamprey (*Lampetra planeri*) or river lamprey (*Lampetra fluviatilis*) in the River Wharfe.

Additionally, the genus Oncorhynchus was also identified from the sampling which could potentially constitute the INNS rainbow trout (*Oncorhynchus mykiss*) or pink salmon (*Oncorhynchus gorbuscha*).

**Table 3.4: Fish eDNA survey results**

| Species | Designations | INNS | Identified in desk study |
|---|---|---|---|
| European eel (*Anguilla anguilla*) | OSPAR<br>Natural Environment Research Council Section 41 | No | Yes |
| Stone loach (*Barbatula barbatula*) | N/A | No | No |
| Bulhead (*Cottus* sp.) | Habitat Directive Annex II | No | Yes |
| Three spined stickleback (*Gasterosteus aculeatus*) | N/A | No | No |
| Stickleback (*Gasterosteus sp.*) | N/A | No | No |
| Gudgeon (*Gobio gobio*) | N/A | No | No |
| Lamprey species *(Lampetra* sp.) | Habitat Directive Annex II<br>Bern Convention Annex III | No | Yes |
| Pacific salmon/trout (*Oncorhynchus* sp.) | N/A | Yes | No |
| Minnow (*Phoxinus phoxinus*) | N/A | No | No |
| Brown/sea trout (*Salmo trutta*) | Natural Environment Research Council Section 41 | No | Yes |
| Chub (*Squalius cephalus*) | N/A | No | No |
| Grayling (*Thymallus thymallus*) | Bern Convention Annex III<br>Habitat Directive Annex II<br>Habitat Regulations Schedule 4 | No | Yes |

Source: NatureMetrics and Mott MacDonald, 2024.

The eDNA analysis targeting crayfish and crayfish plague in the River Wharfe indicated the presence of American signal crayfish and crayfish plague in the River Wharfe. The native white-clawed crayfish was not detected in the sample. These results are summarised in Table 3.5.

**Table 3.5: Crayfish eDNA survey results**

| Species | Result |
|---|---|
| White clawed crayfish (*Austropotamobius pallipes*) | Negative |
| American signal crayfish (*Pacifastacus leniusculus*) | Positive |
| Crayfish plague (*Aphanomyces astaci*) | Positive |

Source: Nature Metrics and Mott MacDonald, 2024.

## 3.4 Macroinvertebrate sample analysis

The observed scores for macroinvertebrate biotic indices for the River Wharfe are shown below in Table 3.7.

**Table 3.7: Biotic indices from River Wharfe**

| Site | Score |
|---|---|
| BMWP Score | 155 |
| WHPT NTAXA | 27 |
| WHPT ASPT | 5.74 |
| LIFE (species) | 8.68 |
| CCI | 13.19 |
| PSI (species) | 72.8 |

Source: APEM, and Mott MacDonald, 2024.

The BMWP, WHPT ASPT and WHPT NTAXA score suggest that the invertebrate community is highly diverse and of high ecological value, likely consisting of species sensitive to organic pollution. Taxa observed in the sample included more pollution sensitive taxa such as mayfly and caddisfly. A large number of taxa recorded were associated with fast flowing, gravelly rivers. The caddisfly *Agapetus fuscipes* was also noted which is typically only found in natural unimpacted streams (Nijboer, 2004). The CCI score of 13.19 indicates the macroinvertebrate community is of a fairly high conservation value with some higher value taxa such as the caddisfly *Brachycentrus subnubilus* and the leech *Trocheta pseudodina (bykowskii*) (both conservation score 5) present. However, no protected or notable species were recorded in the sample.

The PSI score reflects a community associated with slight sedimentation suggesting there is limited pressure on macroinvertebrates due to fine sediment deposition, consistent with the field observation of cobble/gravel and boulder dominated substrate within the channel.

Interpretation of LIFE scores is limited where not compared to a reference value and using long term datasets; however the value of 8.68 indicates the community is associated with fast flowing water. The Moderate impact (WFD-UKTAG, 2021) INNS Jenkins' spire shell (*Potamopyrgus antipodarum*) was present in the sample.

# 4 Discussion and Recommendations

## 4.1 Discussion

The surveyed reach of the River Wharfe contains moderately diverse habitat is likely able to support the protected/notable species identified within the desk study at several life stages.

As majority of the study area was coarse gravel habitat and several salmonid species were noted, there is the potential these species may utilise the area with and around the site boundary. Salmonids have complex lifecycles and different species share similar habitat requirement for each life stage. The salmonids brown/sea trout, Atlantic salmon, and grayling were identified in the desk study and representative habitat was noted throughout the River Wharfe. Atlantic salmon and brown/sea trout spawn in freshwater in autumn and winter, and require a high flow and un-impacted gravel with a grain size >25mm for trout and up to 80mm for salmon. Grayling spawn slightly later (in spring) and have an optimal substrate size of 16-32mm. Salmonid spawning success may be impacted as fine sediment as sediment pollution on spawning gravels can smother salmonid redds[12] preventing oxygen from reaching embryos and alevins[13] and also potentially trapping emerging alevins. Fry (0+ years) and parr (<1+ years) typically prefer 20-30cm deep fast flowing water with a turbulent surface and coarse substrate and are frequently found in riffle and glide habitats (Jonsson and Jonsson, 2011; Hendry & Cragg-Hine 2003). Young salmonids, in particular grayling, may also inhabit deeper (>40cm) slower flowing (<10cm/s) pooled areas with a high proportion of sand and silt (Cove *et al*. 2018).

There are three species of lamprey known in Britain, all of which have critical habitat requirements for spawning and nursey habitat. All lamprey species spawn over coarse substate (with smaller lamprey species preferring gravel and larger species preferring cobble) with a flow velocity ranging from 0.2m/s to 2m/s. The larvae of all three species are typically found in sand/silt beds with a slower flow (Maitland, 2003). Potential lamprey spawning habitat was noted within the surveyed reach of the River Wharfe, notably the faster flowing, shallow riffle habitat located downstream of the weir. Areas of deeper sand and silt were also noted upstream of the weir, however the large size of the weir may act as a barrier to migration, particularly for smaller species of lamprey which are unable to swim at accelerated speeds for long periods of time (Tummers, 2022). However, no other barriers to mitigation (such as additional weirs) were identified between records of lamprey downstream of the River Wharfe and the weir included within the surveyed reach. Therefore, the surveyed reach likely has suitability for lamprey habitat, with key areas centred around the gravel beds located downstream of the weir.

Bullhead is a short-lived species and require various habitats throughout the different life stages. During spawning (February to June), a coarse, clean substrate is essential and also provides important protection from predation. Adults prefer sheltered areas with woody debris and vegetation cover and individuals have been found to typically move less than 10m from their home site over a number of months. Therefore, bullhead may be less likely than other species to move away from an area due to a perceived threat (Tomlinson and Perrow, 2003). The deposition of fine sediments is a threat to bullhead population as siltation over hard, coarse substrate reduces the available habitat utilised by bullhead for reproduction and shelter.

European eel can inhabit a variety of freshwater habitats, though elvers have been found to utilise silty marginal areas with dense overhanging vegetation and root systems and sometimes coarse gravel substrate. European eels are highly mobile, therefore overall, the likelihood of impact is deemed to be low, however retention of diverse areas of bank habitat will help to support populations (Walker, 2017).

The additional eDNA sampling undertaken in September 2024, corroborated the findings of the desk study, indicating the majority of protected fish species identified within the desk study are still likely present within the area. Atlantic salmon was not identified however this is considered likely due to the timing of the survey.

Several additional species were also detected within the study area, indicating the community is moderately diverse and contains several minor species and a limited community of coarse fish.

Many of the fish species identified within the study area are migratory, dependent on clean gravels for spawning, and sensitive to the impacts of sedimentation. Undertaking noisy in-channel works likely to disturb fish or cause sedimentation between 16 June and 30 September would avoid the salmonid and lamprey

[12] A redd is a nest that salmonids dig when they spawn in which eggs are deposited.

[13] A newly spawned salmon or trout still carrying the yolk.

migration and spawning seasons (typically from October to March for brown/sea trout and Atlantic salmon, and March to May for grayling and lamprey species) in addition to the coarse fish spawning season and prevent disturbance to spawning or migrating fish. Sedimentation and surface runoff should be avoided to prevent pollution of the river, which may negatively impact fish through water quality changes or sedimentation of spawning gravels. In addition, as there is the potential the location of the proposed works is in the vicinity of suitable bullhead habitat there may be a localised impact to this species; therefore, it is recommended that in-channel works are not undertaken between dusk and dawn, to prevent disturbance to bullhead or migratory fish during periods of activity.

Records of the protected/notable invertebrates such as water snipefly (*Atherix ibis*), moss beetle (*Ochthebius exsculptus*) and the aquatic beetle *Riolus subviolaceus* were also identified within the study area. Water snipefly is associated with very slow flowing/standing water, whereas the beetles noted are associated with faster flows (Extence et al. 1999). The aquatic beetle has been noted to be moderately sensitive to sedimentation whereas both water snipefly and moss beetle are highly sensitive and may be adversely impacted by sediment pollution (Extence *et al*. 2011).

The analysis of the macroinvertebrate sample indicated the community is of a high ecological value and generally reflects the environmental conditions identified with this area of the River Wharfe (high flow with clean, coarse substrate). Several sensitive taxa were identified so it is likely this community may react negatively to sedimentation or pollution inputs, therefore it is recommended sedimentation and pollution prevention measures are implemented to prevent impact to the macroinvertebrate community or habitats during the works. No additional protected or notable species were identified in the sample.

Several INNS were also identified within the desk study. Two of these species – Himalayan balsam and giant hogweed – are considered High Impact species, the former of which was noted at several locations on both banks throughout the survey reach. As these are riparian plants, these species are particularly at risk of further spread or disturbance during proposed works. The risk of Himalayan balsam spread is particularly prevalent due to the ejection of seeds of seeds when disturbed. Management of these invasive plant species should be considered during works to the bridge with consideration of reduction or eradication from the immediate area to reduce the risk of disturbance. Other INNS identified within the study area include several species of aquatic snail (acute bladder snail, common bladder snail, and Jenkin's spire shell), the aquatic crustacean Northen River/Florida crangonyctid, and the aquatic macrophyte Canadian waterweed. Jenkins spire shell was also identified within the macroinvertebrate sample.

The results of the eDNA surveys also indicated the presence of American signal crayfish and crayfish plague which has likely displaced the population of native white-clawed crayfish (GB Non-native Species Secretariat, 2019) identified within the desk study. While non-native crayfish are only likely to be disturbed or spread during any in-channel works, biosecurity measures should be implemented to prevent these species from being transferred to other waterbodies within the area.

Furthermore, eDNA of the pacific trout/salmon genus O*ncorhynchus* was identified within the River Wharfe, which likely constitutes the species rainbow trout or pink salmon. Both of these species are considered non-native and invasive in the UK. Rainbow trout is widely stocked in UK lakes and some rivers for farming and sport, therefore the presence of this species could be attributed to contamination. Pink salmon is not currently known to be widely distributed within the UK, however sightings of this species are increasing and there is the potential this species has become established (Environment Agency, 2023), therefore any sightings of this species should be reported to the EA.

# 5 Conclusions and recommendations

## 5.1 Conclusions

A summary of the desk study findings is as follows:

- A total of six distinct protected fish taxa were identified within the study area. These are: brown/sea trout, Atlantic salmon, European eel, grayling, lamprey, and bullhead. In addition, the protected/notable invertebrates water snipefly (*Atherix ibis*), moss beetle (*Ochthebius exsculptus*) and the aquatic beetle *Riolus subviolaceus* were noted, identified within the last 10 years. In addition, one historical record of white-clawed crayfish was noted.
- A total of seven INNS were identified within the study area within the last 10 years. These are the riparian plants Himalayan balsam and giant hogweed, and aquatic invertebrates acute bladder snail, tadpole bladder snail, Northen River/Florida crangonyctid, and Jenkins spire shell. One older record of Canadian waterweed was also identified.
- Fish records indicate the additional presence of stone loach and minnow.

A summary of the walkover findings is as follows:

- The River Wharfe was characterised as a wide, deep river with a predominately steady rippled flow. The substrate was predominantly coarse with some areas of marginal gravel and silt. Large proportions of the left and right bank were modified with artificial stone banks. There was a distinct change in character downstream of the weir, where the river become shallower with more variation in flow features.
- The area downstream of the weir is likely important for salmonids and lamprey species.
- Areas of marginal habitat along the banks, including overhanging vegetation and marginal dead water are likely to provide important habitat for juvenile fish and eels.

A summary of the eDNA findings is as follows:

- A total of 11 distinct fish taxa were identified, corroborating the findings of the desk study. Additional minor species and chub were also detected. The invasive non native fish genus O*ncorhynchus* was also noted.

A summary of the macroinvertebrate survey is as follows:

- The community is of high ecological value and contains several species associated with a fast flowing river and diverse habitat, with species also likely sensitive to sedimentation and pollution.

## 5.2 Recommendations

**Project design considerations and mitigation**

- Due to the presence of protected spawning and migratory fish (including lamprey species), in-channel works should avoid the salmonid and lamprey migration and spawning seasons (1 October to 15 June inclusive). Significant noise (including vibration) and artificial light disturbance should also be avoided during fish spawning and migration periods.
- Surface run-off should be avoided to prevent pollution of all watercourses in the River Wharfe, which may negatively impact protected fish species and macroinvertebrate communities through water quality changes or sedimentation of spawning gravels. Best practice pollution prevention should be incorporated to prevent any disturbance of watercourses which may result in release of sediment which could smother gravel substrate and reduce the suitability of these habitats.
- Bankside habitat including overhanging vegetation should be retained where possible as this likely provides important areas of cover for juvenile fish.

**Biosecurity recommendations**

- Biosecurity measures should be implemented during the design phase and construction in order to prevent any transmission of INNS to new areas. Management with the aim of eradication (if feasible) should be considered to control any invasive riparian plants present in the area, to prevent establishment in the area and ensure maximum biodiversity benefits.
- Any sightings of the INNS Pacific pink salmon should be reported to the Environment Agency.

# 6 References

British Standards Institution, 2012. BS EN ISO 10870:2012. Water Quality – Guidelines for the selection of sampling and devices for benthic macroinvertebrates in fresh waters. London: BSI.

Chadd, R., and Extence, C., 2004. The Conservation of Freshwater Macroinvertebrate Populations: a Community-Based Classification Scheme. Aquatic Conservation: Marine and Freshwater Ecosystems. 14, pp.597-624.

Council of Europe. 2017. Appendices of the Convention and Amendments to the Appendices. Bern Convention. [online] Available at: <https://www.coe.int/en/web/bern-convention/appendices> [Accessed 19 July 2024]

Cove, R., Taylor, R, Gardiner, R. 2018. European Grayling Conservation Ecology and Management. A Practical Conservation Guide for the United Kingdom. [pdf] Available at: https://irp-cdn.multiscreensite.com/e233e288/files/uploaded/Grayling-Conservation-Guide_2018_v2.pdf

Davy-Bowker, J. Arnott, S. Close, R., Dobson, M. , Dunbar, M., Jofre, G., Morton, D., Murphy, J., Wareham, W., Smith, S. & Gordon, V., 2010. Further Development of River Invertebrate Classification Tool. Scotland & Northern Ireland Forum for Environmental Research. Project WFD100 report. Pp. 48 & 10 Appendices. Available at < https://static1.squarespace.com/static/621616256950454546689e6d/t/623c6823cf53f72674a4f25c/1648125991930/WFD100+FINAL+Report.pdf> [Accessed 07 November 2024].

Environment Agency, 2021. Ecology & Fish Data Explorer. [online] Available at: <https://environment.data.gov.uk/ecology/explorer/> [Accessed 19 July 2024].

Environment Agency, 2023. Pacific Pink Salmon (*Oncorhynchus gorbuscha*) Advisory note - 2023 update. [pdf]. Available at: < https://anglingtrust.net/wp-content/uploads/2023/06/Pacific-Pink-Salmon-Guidance-note-2023-Final-draft-190623.pdf> [Accessed 06 November 2024]

European Council, 2007a. Annex V: animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures. [online] Available at: <https://eunis.eea.europa.eu/references/2327/species> [Accessed 19 July 2024].

European Council, 2007b. Annex II: animal and plant species of community interest whose conservation requires the designation of special areas of conservation. [online] Available at: < <https://eunis.eea.europa.eu/references/2325/species> [Accessed 19 July 2024].

EU-STAR, 2004. UK Invertebrate sampling and analysis procedure for STAR project, RIVPACS Macroinvertebrate sampling protocol. [pdf] Available at: <http://www.eu-star.at/pdf/RivpacsMacroinvertebrateSamplingProtocol.pdf

Extence, C A, Chadd, R P, England, J, Dunbar, M J, Wood, P J and Taylor, E D, 2011. The Assessment of Fine Sediment Accumulation in Rivers Using Macro-invertebrate Community Response. River Research and Applications. 29 (1), pp17-55.

Extence, C., Balbi, D. and Chadd, R.,1999. River flow indexing using British benthic macroinvertebrates: a framework for setting hydroecological objectives. Regulated Rivers: Research & Management, 15(6), pp.545-574.

GB Non-native Species Secretariat, 2019. Signal crayfish *Pacifastacus lenisculus*. [online] Available at: <https://www.nonnativespecies.org/non-native-species/information-portal/view/2498> [Accessed 19 July 2024].

Hendry, K. and Cragg-Hine, D., 2003. Ecology of the Atlantic Salmon. Conserving Natura 2000 Rivers Ecology Series No. 7. English Nature, Peterborough

Jonsson, B and Jonsson, N. 2011. B. Jonsson and N. Jonsson, Ecology of Atlantic Salmon and Brown Trout: Habitat as a Template for Life Histories, Fish & Fisheries, Series 33, DOI 10.1007/978-94-007-1189-1_3 [Accessed 19 July 2024].

Maitland, P. 2003. Ecology of the River, Brook and Sea Lamprey: Conserving Natura 2000 Rivers Ecology Series No. 5. [pdf]. Peterborough: English Nature. Available at: < http://publications.naturalengland.org.uk/file/118013>. [Accessed 19 July 2024].

Morvisseau, Q. Davy-Bowker, J., Bryson, D., Souch, G. R., Burian, A., and Sweet, M., 2018. First detection of a highly invasive freshwater amphipod Crangonyx floridianus (Bousefield, 1963) in the United Kingdom. BioInvasions Records. 8.

Murray-Bligh, J. A. D., 1999. Procedure for Collecting and Analysing Macro-invertebrate Samples. Quality Management Systems for Environmental Monitoring: Biological Techniques BT001. Version 2.0. Bristol: Environment Agency.

Natural Environment and Rural Communities (NERC) Act, 2006. List of priority habitats and species in England ('Section 41 habitats and species') for public bodies, landowners and funders to use for biodiversity conservation. [online]. Available at: < https://www.gov.uk/government/publications/habitats-and-species-of-principal-importance-in-england > [Accessed 19 July 2024].

NBN Trust, 2024. National Biodiversity Network Atlas. [online] Available at: <https://nbnatlas.org/> [Accessed 19 July 2024].

Nijboer, R., 2004. The ecological requirements of Agapetus fuscipes Curtis (Glossosomatidae), a characteristic species in unimpacted streams [online]. *Limnologica,* 34(3), pp 213-223. Available at: < https://doi.org/10.1016/S0075-9511(04)80046-X> [Accessed 06 November 2024].

Salmon and Freshwater Fisheries Act, 1975. [online] Available at: <https://www.legislation.gov.uk/ukpga/1975/51/contents> [Accessed 19 July 2024].

The Conservation of Habitats and Species Regulations, 2017. [online] Available at: <https://www.legislation.gov.uk/uksi/2009/3344/made> [Accessed 19 July 2024].

The Eels (England and Wales) Regulations, 2009. [online] Available at: <https://www.legislation.gov.uk/uksi/2009/3344/made> [Accessed 19 July 2024].

The Invasive Alien Species (Enforcement and Permitting) Order, 2019. [online] Available at: <https://www.legislation.gov.uk/uksi/2019/527/made> [Accessed 19 July 2024].

The Invasive Non-native Species (Amendment etc.) (EU Exit) Regulations, 2019. [online] Available at: <https://www.legislation.gov.uk/uksi/2019/223/made> [Accessed 19 July 2024].

Tomlinson, M., and Perrow, M., 2003. Ecology of the Bullhead. Conserving Natura 2000 River Ecology series No. 4. [pdf] English Nature, Peterborough. Available at: < https://publications.naturalengland.org.uk/publication/69042> . [Accessed 19 July 2024].

Tummers, J. 2022. Migration pathways and bottlenecks for river lamprey in the Grift - a study on fish migration. [online]. Knowledge journal, Edition 2. Available at: < https://www.h2o-watermatters.com/includes/partials/printArticle.php?ed=202212&art=03_Artikel#:~:text=Fish%20passes%20and%20lamprey%20tiles&text=Fish%20passes%20can%20be%20effective,others%2C%20have%20low%20sprint%20capacity> [Accessed: 19 July 2024].

Walker, P., 2017. Habitat preferences of the critically endangered European eel - Inside Ecology. [online] Available at: https://insideecology.com/2017/12/22/habitat-preferences-of-the-critically-endangered-european-eel/> [Accessed 19 July 2024].

WFD-UKTAG, 2014. *UKTAG River Assessment Method. Benthic Invertebrate Fauna. Invertebrates (General Degradation): Whalley, Hawkes, Paisley & Trigg (WHPT) Metric in River Invertebrate Classification Tool (RICT)*. Stirling: Water Framework Directive UK Technical Advisory Group.

WFD-UKTAG, 2021, UK Technical Advisory Group on the Water Framework Directive Revised classification of aquatic alien species according to their level of impact. [online] Available at: <https://www.wfduk.org/sites/default/files/Media/Assessing%20the%20status%20of%20the%20water%20environment/UKTAG%20classification%20of%20alien%20species%20working%20paper%20v7.6.pdf> [Accessed 19 July 2024].

Wildlife and Countryside Act, 1981. [online] Available at: <https://www.legislation.gov.uk/ukpga/1981/69/contents> [Accessed 19 July 2024].

# 7 Macroinvertebrate sample taxa list

| Taxa name | Count |
|---|---|
| *Nematoda* | 1 |
| *Gastropoda* | 2 |
| *Theodoxus fluviatilis* | 60 |
| *Potamopyrgus antipodarum* | 108 |
| *Lymnaeidae* | 9 |
| *Ampullaceana balthica* | 11 |
| *Ancylus fluviatilis* | 48 |
| *Ancylus* group (*Ancylus, Ferrissia & Acroloxus*) | 1 |
| *Sphaerium sp.* | 10 |

| | |
|---|---|
| *Pisidium/Euglesa/Odhneripisidium sp.* | 8 |
| *Oligochaeta* | 69 |
| *Glossiphoniidae* | 2 |
| *Erpobdellidae* | 1 |
| *Trocheta pseudodina* (*bykowskii*) | 1 |
| *Hydracarina* | 9 |
| *Asellidae* | 1 |
| *Gammaridae* | 1 |
| *Baetidae* | 1 |
| *Baetis sp.* | 47 |
| *Baetis atlanticus/rhodani* | 56 |
| *Baetis scambus/fuscatus* | 38 |
| *Heptageniidae* | 10 |
| *Rhithrogena sp.* | 16 |
| *Heptagenia sp.* | 130 |
| *Ecdyonurus sp.* | 44 |
| *Serratella ignita* | 6 |
| *Caenis sp.* | 1 |
| *Caenis luctuosa/macrura* | 1 |
| *Leuctra sp.* | 67 |
| *Leuctra fusca* | 14 |
| *Leuctra inermis* | 4 |
| *Orectochilus villosus* | 5 |
| *Elmis aenea* | 167 |
| *Esolus parallelepipedus* | 342 |
| *Limnius volckmari* | 42 |
| *Oulimnius sp.* | 56 |
| *Oulimnius tuberculatus* | 52 |

| | |
|---|---|
| *Rhyacophila sp.* | 24 |
| *Rhyacophila dorsalis* | 15 |
| *Glossosoma boltoni* | 17 |
| *Agapetus sp.* | 77 |
| *Agapetus fuscipes* | 2 |
| *Hydroptilidae* | 1 |
| *Agraylea multipunctata* | 1 |
| *Hydroptila sp.* | 9 |
| *Polycentropus flavomaculatus* | 6 |
| *Hydropsychidae* | 1 |
| *Cheumatopsyche lepida* | 277 |
| *Hydropsyche sp.* | 16 |
| *Hydropsyche pellucidula* | 261 |
| *Hydropsyche siltalai* | 100 |
| *Brachycentrus subnubilus* | 25 |
| *Lepidostoma hirtum* | 19 |
| *Athripsodes sp.* | 2 |
| *Athripsodes albifrons group* (*bilineatus & commutatus*) | 3 |
| *Athripsodes cinereus* | 14 |
| *Ceraclea annulicornis* | 10 |
| *Diptera* | 2 |
| *Tipulidae* | 1 |
| *Limoniidae* | 8 |
| *Ceratopogonidae* | 5 |
| *Simuliidae* | 23 |
| *Chironomidae* | 529 |
| *Athericidae* | 24 |
| *Empididae* | 16 |

Source: APEM, 2024