Appendix 5.1. Fisheries Assessment Report, 2021

Fisheries assessment of Mortarstown WWTP upgrade works, Co. Carlow

Prepared by Triturus Environmental Ltd. for Atkins

September 2021

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1. Introduction

1.1 Background

Triturus Environmental Ltd. were contracted by Atkins to undertake a baseline fisheries assessment of the River Barrow in the vicinity of proposed upgrade works to Mortarstown Wastewater Treatment Plant (WWTP) (licence no. D0018-01) near Carlow Town, Co. Carlow (**Figure 2.1**).

The upgrades (see section 1.2 below) involve works to the riverbank of the River Barrow and within the channel of the Barrow in the vicinity of the proposed WWTP outfall chamber and outfall pipe. The proposed works area is located within the River Barrow and River Nore SAC (002162), a site designated for a range of aquatic qualifying interests including Atlantic salmon (*Salmo salar*) and lamprey species (NPWS, 2011). Given that the proposed project will require a cofferdam and dry instream working area, the proposed project has the potential to impact juvenile lamprey (ammocoetes) during the construction period, if they are present within the footprint of the instream working area (i.e., within soft sediment along river margins).

Therefore, the survey was undertaken to establish baseline fisheries data used in the preparation of the NIS for the proposed works. A bathymetric survey of the River Barrow was also undertaken within the wider works footprint to identify the presence of and evaluate the quality of lamprey habitat not accessible by electro-fishing operators (i.e., due to depth constraints). The electro-fishing and bathymetry survey on the River Barrow in vicinity of the proposed works area are summarised on **Table 2.1 & Figure 2.1**. Whilst the survey focused primarily on assessing value for lamprey ammocoetes, electro-fishing also provided baseline information on the general fisheries habitat and value of the area in vicinity of the proposed works. The surveyed helped to inform impact assessment and any subsequent mitigation for the project.

1.2 Proposed works description

1.2.1 Mortarstown WWTP

The principal objective of the works associated with Mortarstown WWTP is to ensure that the treatment process can produce a treated effluent which satisfies the conditions of the Wastewater Discharge Licence (D0028-01). The works shall be designed to cater for 58,000 p.e. and achieve ELV's of 15 mg/L BOD, 35 mg/L SS, 2 mg/L Ammonia and 1 mg/L Total Phosphate.

The WWTP was commissioned in 1986 as a conventional extended aeration WWTP with a design capacity of 28,500PE. The aeration basins were upgraded in 2003 to a A20 bioreactor system (anaerobic, anoxic, aerobic) which provides an additional treatment capacity of 7,500PE in the bioreactors. Therefore, the WWTP had inadequate capacity to cater for future demand and much of the existing mechanical and electrical equipment is at end of serviceable life and is no longer functioning.

In addition, the Supervisory Control and Data Acquisition (SCADA) system is defunct and the systems for automatic control and measurement of the storm return and surplus sludge are not operational. The plant requires greater manual input than was originally intended.

As part of the upgrade works all flows to the WWTP will be subjected to preliminary treatment comprising coarse screening, fine screening, grit removal and storm water storage. Biological treatment for carbonaceous and nitrogen removal will be achieved by supplementing the existing activated sludge process with upstream primary treatment. Phosphorus removal will be achieved using a combination of biological and chemical treatment and all treated effluent will discharge by either gravity or pressure into the River Barrow.

A summary of the works required is as follows;

- Provision of 1 no. 540 kWh terminal pump station.
- Provision of 4 no. raw sewerage pumps inclusive of MEICA works.
- Provision of 1 no. odour control unit.
- Provision of 1 no. surge protection vessel.
- Provision of new inlet works to include coarse screening, fine screening and grit removal.
- Provision of 1 no. stormwater storage tank and 2 no. stormwater return pumps.
- Refurbishment of peripheral half-bridge scrapers in existing final settlement tanks.
- Refurbishment of RAS/WAS pumping station and provision of 2 No. stormwater return pumps.
- Provision of 4 no. primary settlement tanks and 4 No. chain and flight tank scraper systems.
- Provision of 4 no. primary sludge pumps.
- Provision of 5 no. air blowers and modifications to existing air delivery pipework.
- Provision of 2 no. final settlement tanks with half-bridge scrapers.
- Provision of new RAS/WAS pumping station and 2 No. (each) RAS/WAS pumps.
- Refurbishment of existing picket fence thickener and conversion to sludge blending tank.
- Provision of 1 no. additional picket fence thickener.
- Provision of 1 no. new centrifuge, polymer prep unit and polymer dosing pumps.
- Provision of 2 no. final effluent pumps.
- Provision of 1 no. new outfall chamber and outfall pipe.

1.3 Fisheries asset of the survey area

The River Barrow is Ireland's second-longest river, flowing for some 192km and draining an area of approx. 3010km^2 (Delanty et al., 2017). The main channel, estuary and many of the sub-catchments are located within the River Barrow and River Nore SAC (site code: 002162). The following fish and aquatic invertebrate species are listed as qualifying interest species for the SAC (NPWS, 2011);

- Freshwater pearl mussel (*Margaratifera margaritifera*) [1029]
- White-clawed crayfish (*Austropotamobius pallipes*) [1092]
- Sea lamprey (*Petromyzon marinus*) [1095]
- Brook lamprey (*Lampetra planeri*) [1096]

- River lamprey (*Lampetra fluviatilis)* [1099]
- Twaite shad (*Alosa fallax*) [1103]
- Atlantic salmon (*Salmo salar*) (only in fresh water) [1106]
- Nore freshwater pearl mussel (*Margaritifera durrovensis*) (River Nore catchment only) [1990]
- Otter (*Lutra lutra*) [1355]

1.3.1 Lamprey species (Annex II)

All three of the lamprey species recorded in Ireland, brook (*Lampetra planeri*), river (*Lampetra fluviatilis*) and sea lamprey (*Petromyzon marinus*), are all listed on Annex II of the European Union (EU) Habitats Directive (92/43/EEC). Atypically for Ireland, all three species are known to occur in the River Barrow and are each listed as conservation objectives for the River Barrow and River Nore SAC (002162). All of these lamprey species are semelparous, i.e. breed once in their lifetimes and then die.

A dedicated catchment-wide lamprey survey (King, 2006) found that the River Barrow was poor in terms of ammocoete distribution, with a greater number of negative sites encountered than in other surveys of large Irish river catchments. Over 50% of sites did not contain juvenile lamprey and none were recorded on the main Barrow channel. Likewise, Delanty et al. (2017) found similar results, with over half the sites returning negative results (i.e. no ammocoetes) and none recorded in the main river channel. According to Inland Fisheries Ireland, sea lamprey favour the turbulent aerated sections of the river for spawning, areas that are now largely restricted to the tail race of weir structures along the River Barrow (IFI, 2011). Sea lamprey occupy a very limited distribution in the Barrow catchment and were historically known to spawn below the weirs at Graiguenamanagh, Tinnahinch, Bahana and, particularly, St. Mullins (Kurz & Costello, 1999; pers. obs.). The latter is accepted as being the last remaining important spawning site for the species in the Barrow. Population sizes are, however, accepted as typically being small on the main River Barrow channel (King, 2006).

The nearest good-quality lamprey habitat to the Mortarstown WWTP survey area was identified via electro-fishing surveys in 2018 immediately below Carlow Weir (1.6km upstream; Macklin et al., 2018), where relatively high densities of *Lampetra* sp. were recorded (i.e., > 30 per m^2). A low density of *Lampetra* sp. ammocoetes (2.6 per m^2) was also recorded on the Barrow at Clongrennan lock, approx. 1.6km downstream of the proposed works area, in September 2020 (Triturus, 2020).

2. Methodology

2.1 Fish stock assessment (electro-fishing)

Triturus Environmental Ltd. made an application under Section 14 of the Fisheries (Consolidation) Act, 1959 as substituted by Section 4 of the Fisheries (Amendment) Act, 1962, to undertake an electro-fishing survey in the footprint of the proposed Mortarstown WWTP upgrade works. Permission was granted on Friday 2nd July 2021 and the survey was undertaken on Thursday 15th July 2021, following notification to Inland Fisheries Ireland and under the conditions of a Department of Communications, Climate Action & Environment (DCCAE) licence. A single anode Smith-Root LR24 backpack (12V DC input; 300V, 100W DC output) was used to electro-fish the River Barrow in the footprint of the proposed Mortarstown WWTP upgrade works. Soft sediment areas within the vicinity of the proposed works area were evaluated in terms of their suitability for lamprey ammocoetes.

Both river and holding tank water temperature was monitored continually throughout the survey to ensure temperatures of 20°C were not exceeded, thus minimising stress to the captured fish due to low dissolved oxygen levels. A portable battery-powered aerator was also used to further reduce stress to any captured fish contained in the holding tank. Captured larval lamprey and other incidental fish species were transferred to a holding container with oxygenated fresh river water following capture. To reduce fish stress levels, anaesthesia was not applied to captured fish. All fish were measured to the nearest millimetre and released in-situ following a suitable recovery period. Electro-fishing methodology followed accepted European standards (CEN, 2003) and adhered to best practice (e.g. CFB, 2008).

The electro-fishing survey was undertaken at *n*=2 sites within the vicinity of the proposed WWTP outfall works (**Table 2.1, Figure 2.1**).

Table 2.1 Electro-fishing survey site locations in the vicinity the proposed Mortarstown WWTP upgrade works, Carlow

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
A	River Barrow	14B01	Near proposed Mortarstown WWTP outfall	671109	674928
B	River Barrow	14B01	Downstream of proposed Mortarstown WWTP outfall	671077	674894

2.1.1 Lamprey

Electro-fishing for lamprey ammocoetes was conducted using targeted quadrat-based electro-fishing (as per Harvey & Cowx, 2003) in objectively suitable areas of soft sediment, where encountered. As lamprey take longer to emerge from sediment and require a more persistent approach, they were targeted at a lower frequency (30Hz) burst DC pulse setting which also allowed the safe capture of European eel and other fish species, if present. Settings for lamprey followed those recommended and used by Harvey & Cowx (2003), APEM (2004) and Niven &

McAuley (2013). Using this approach, the anode was placed under the water's surface, approx. 10–15 cm above the sediment, to prevent immobilising lamprey ammocoetes within the sediment. The anode was energised with 100V of pulsed DC for 15-20 seconds and then turned off for approximately five seconds to allow ammocoetes to emerge from their burrows. The anode was switched on and off in this way for approximately two minutes. Immobilised ammocoetes were collected by a second operator using a fine-mesh hand net as they emerged. Lamprey species were identified to species level, where possible, with the assistance of a hand lens, through external pigmentation patterns and trunk myomere counts as described by Potter & Osborne (1975) and Gardiner (2003).

2.1.2 General fisheries habitat

A broad appraisal of the upstream and downstream habitat in vicinity of the survey site was undertaken to evaluate the wider contribution to salmonid and lamprey spawning and general fisheries habitat. River habitat surveys and fisheries assessments were carried out utilising elements of the approaches in the River Habitat Survey Methodology (EA, 2003) and Fishery Assessment Methodology (O'Grady, 2006) to broadly characterise the survey area (i.e., channel profile, substrata etc.).

2.2 SONAR survey

To determine the bathymetry and substrata-type (i.e., bottom hardness) within the vicinity of the proposed WWTP outfall area, a SONAR survey was undertaken during July 2021. Primarily, this approach helped to estimate the extent of and elucidate any potential (soft sediment) larval lamprey areas that maybe present in poorly-accessible deeper water zones (i.e., >1.3m in depth, beyond scope of backpack electro-fishing). However, the survey also provided information on the wider fisheries habitat present in the vicinity of works area. A Lowrance Elite 9HDS-Live SONAR unit was mounted on a 3m RIB equipped with a total-scan transducer to log bathymetry and bottom hardness. Reefmaster v2.0 software was used to generate point clouds for map creation in QGIS v3.18.

2.3 Biosecurity

A strict biosecurity protocol including the Check-Clean-Dry approach was adhered to during surveys for all equipment and PPE used. Disinfection of all equipment and PPE before and after use with Virkon™ was conducted to prevent the transfer of pathogens or invasive propagules between survey sites. The outboard engine was an electric 56lb thrust engine (i.e. no impeller water cooling), thus minimising bilge water transfer associated with traditional outboard models. The engine, being small in size, was easy to clean in a barrel of Virkon before and after use to prevent the spread of invasive species and pathogens. Particular note was taken of the possibility of spreading crayfish plague (*Aphanomyces astaci*), known within the River Barrow since 2017 (NPWS, 2017, 2019).

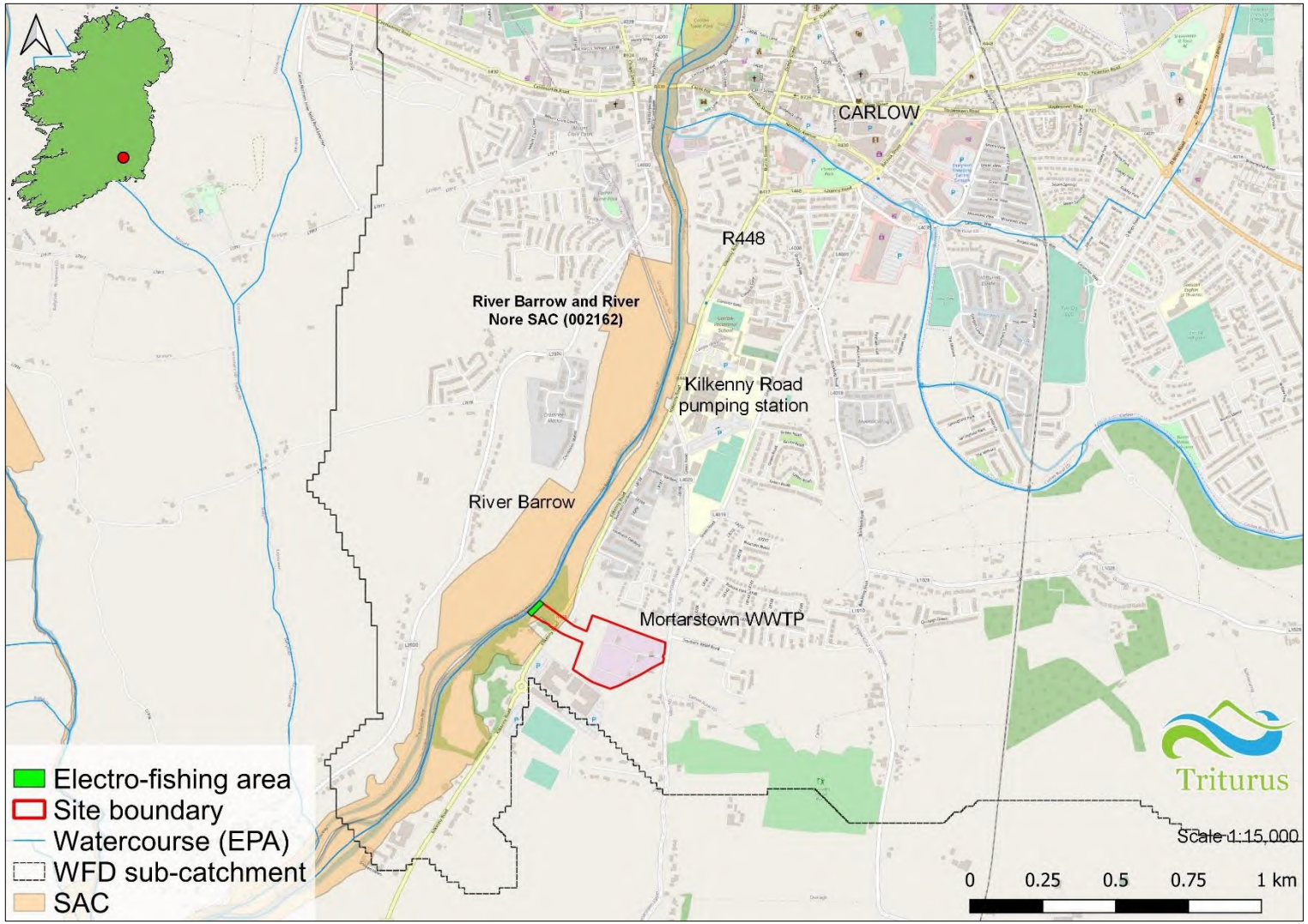

Figure 2.1 Location of the electro-fishing area in vicinity of the proposed Mortarstown WWTP upgrade works

Figure 2.2 Location of the electro-fishing spot points A and B in vicinity of the proposed Mortarstown WWTP upgrade works

3. Results

A targeted electro-fishing survey for lamprey ammocoetes was undertaken in the footprint of the proposed works on Wednesday 15th July 2021 following notification to Inland Fisheries Ireland. The results of the survey are discussed below in terms of fish population structure, population size and the suitability and value of the surveyed areas as nursery and spawning habitat for lamprey and other fish species. Scientific names are provided at first mention only.

3.1 Fish stock assessment (electro-fishing)

3.1.1 Site A (within proposed works area)

Site A was located on the east bank of the River Barrow, in the vicinity of the proposed outfall pipe works area (**Figure 2.2**). The river was a large lowland depositing watercourse (FW2; Fossitt, 2000) that averaged 30-35m wide and ranged from 1.2m deep in the margins to >3m in the central channel. The area was dominated by deep slow-flowing glide with localised area of deeper pool in the centre channel. The littoral area supported low flows and featured steeply-sloping banks of soft sediment (silt), which were invariably very deep (up to 0.3-0.4m) and near-anoxic in most areas. The littorals adjoined mixed coarse gravels with occasional cobble and boulder at the base of the marginal slope. The east bank of the river supported dense overhanging grey willow (*Salix cinerea*), crack willow (*Salix fragilis*) and osier (*Salix viminalis*). Riparian shading was high and this resulted in only limited macrophyte growth along the margins of the channel. Occasional submerged arrowhead (*Sagittaria sagittifolia*) was present in addition to non-native Nuttall's pondweed (*Elodea nuttallii*) recorded as rare.

Minnow (*Phoxinus phoxinus*) and three-spined stickleback (*Gasterosteus aculeatus*) were the only fish species recorded via electro-fishing from site A that was situated in the footprint of the proposed outfall area (**Figure 3.1**). Despite the presence of abundant, organic-rich soft sediment areas, no lamprey ammocoetes were recorded from targeted electro-fishing of 3 no. contiguous $1m^2$ areas. Dense overhanging growth of willow species had resulted in little to no flows along the river margins and very heavy shading thus creating conditions inimical to larval lamprey. The site, however, had some value as a coarse fish nursery habitat.

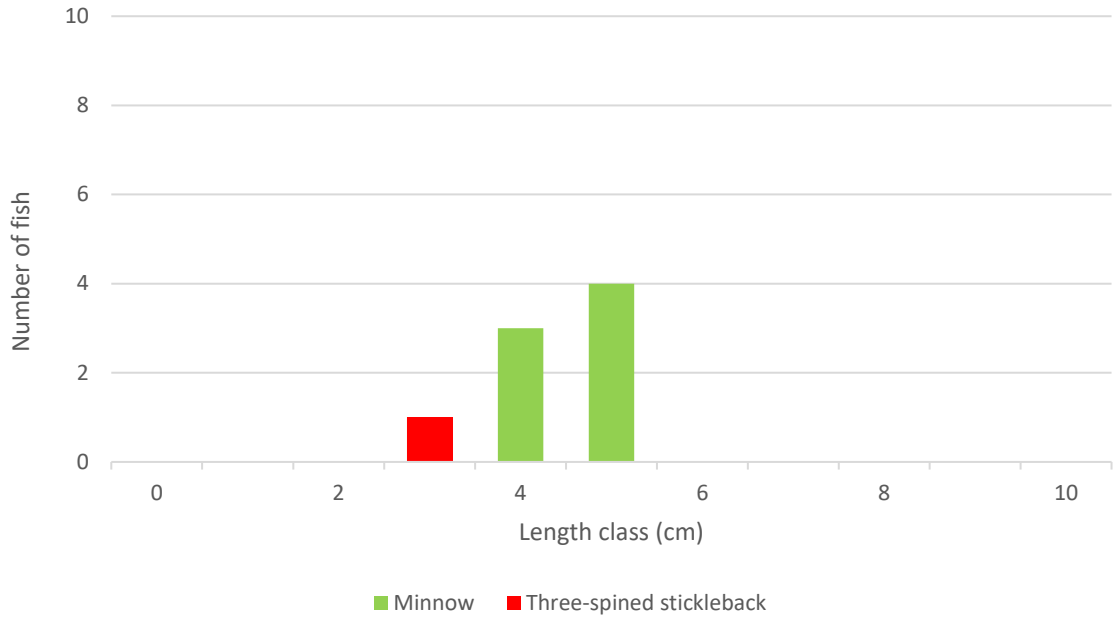

Figure 3.1 Length frequency distribution recorded via electro-fishing at site A on the River Barrow, July 2021

Plate 3.1 Electro-fishing soft sediment littorals at site A for lamprey ammocoetes, July 2021

Plate 3.2 Snorkelling the River Barrow margins between survey sites A and B to further evaluate lamprey habitat quality, July 2021

Plate 3.3 Minnow recorded from site A, July 2021

3.1.2 Site B (downstream of proposed works area)

Site B was located in a small bay on the east bank of the River Barrow, approx. 30m downstream of the proposed outfall pipe works area (**Figure 2.2**). The site represented one of the few areas accessible to backpack electro-fishing in the vicinity of the proposed outfall works (i.e., <1.3m in depth). As per upstream, the river depths ranged from 1.2-1.3m in the margins to >3m in the central channel. The area was dominated by deep slow-flowing glide with localised area of deeper pool in the centre channel. The marginal substrata were dominated by organic-rich silt and sand (up to 0.2m in depth), grading into mixed gravels and occasional cobble and boulder at the base of the steep marginal slope. The site adjoined a residential property garden (GA2) and was more open that site A (historical tree clearance), with lower cover of overhanging trees. Thus, the area received some influence from currents, given the absence of overhanging trees and limbs which would otherwise restrict flow. Macrophytes were limited to occasional submerged arrowhead, with emergent water mint (*Mentha aquatica*) and reed canary grass (*Phalaris arundinacea*) along channel margins.

Minnow and *Lampetra* sp. ammocoetes were the only fish species recorded from site B via electro-fishing (**Figure 3.2**). In addition to low numbers of minnow, very low densities of *Lampetra* sp. ammocoetes were recorded, equating to a density of 1 per m^2 of targeted habitat fished. The increased marginal flows and reduced riparian shading compared with site A provided improved ammocoete habitat. However, this was still considered sub-optimal given the narrow extent of the burial habitat at the top of the littoral zone. The site was of most value as a coarse fish nursery habitat.

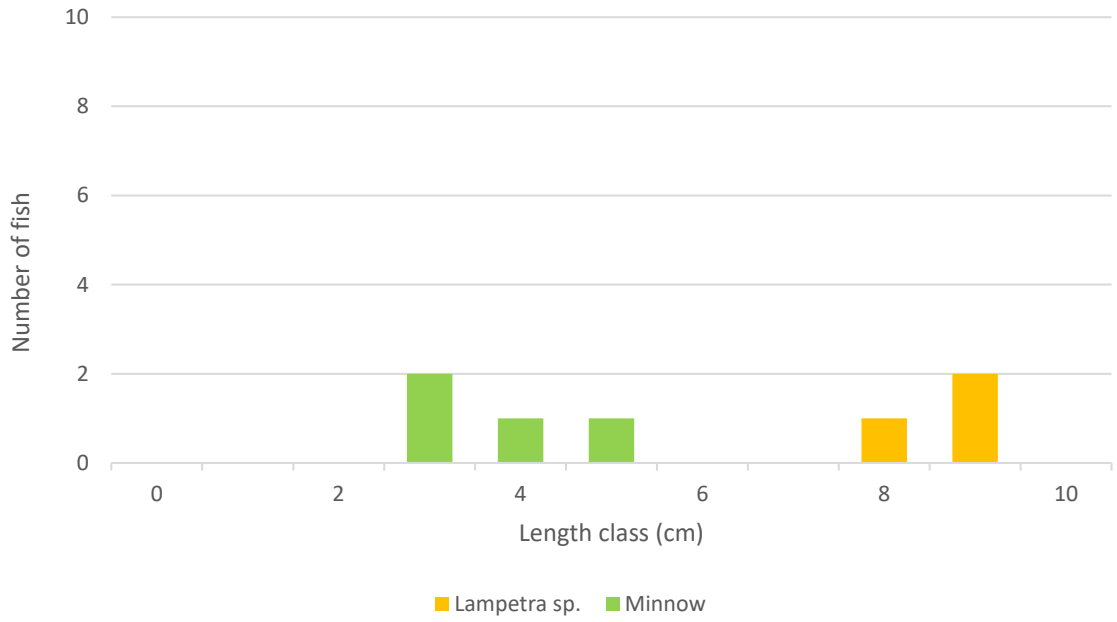

Figure 3.2 Length frequency distribution recorded via electro-fishing at site B on the River Barrow, July 2021

Plate 3.4 Representative image of site B on the River Barrow, July 2021 (located immediately downstream of the proposed outfall works area)

Plate 3.5 *Lampetra* sp. ammocoete recorded from site B (downstream of the proposed outfall works area), July 2021

3.2 Bathymetric (SONAR) survey

3.2.1 Bathymetry

The SONAR survey confirmed the high average mean depth of the River Barrow (2.4m ± 0.54m SD) in vicinity of the proposed outfall works area (**Figure 3.4**). As illustrated in Figure 3.3, the River Barrow follows a typical trapezoidal profile, with shallow margins steeply grading into a deeper centre channel of >3m. The minimum depth logged along the proposed works area (east bank) was 1.5m, although instream wading of marginal areas not accessibly by boat revealed a typical depth of approx. 1.2m under the overhanging willow canopy on a steeply-sloping river margin.

3.2.2 Bottom (substrate) hardness

The plot of bottom (substrate) hardness (**Figure 3.4**) shows a mixture of both soft and harder substrata (gravels, cobble, occasional boulder) in the footprint of the proposed works area. The areas of softer sediment (lighter shading) were restricted to the depositing channel margins along the east bank (that are covered by an extensive willow canopy and limbs that encourage deposition). While this habitat can support lamprey ammocoetes (chosen for burial by juveniles), snorkelling and electro-fishing carried out by wading the margins confirmed the near-anoxic soft sediment in this area was invariably deep (up to 0.4m in depth) with very limited aeration due to restricted flow. A narrow band of soft sediment was also present along the east bank downstream of the proposed works area (i.e., in site B). However, the depth was shallower (maximum of 0.2m) given less deposition with well-mixed sand, silt and organic matter visibly lighter in colour, indicating greater oxygenation due to higher flow rates. This area was situated outside the main bathymetric study area but the pattern of softer substrata can be seen in the south western proportion of the sounding plot on **Figure 3.4**.

Figure 3.3 Bathymetry map of the proposed Mortarstown WWTP outfall works area, July 2021 (darker shading indicates deeper water)

Figure 3.4 Bottom hardness map of the proposed Mortarstown WWTP outfall works area, July 2021 (lighter shading indicates softer substrata)

4. Discussion

There was no suitability for lamprey ammocoetes within the proposed Mortarstown WWTP outfall works area (site A) despite the presence of soft substrata that could support lamprey ammocoetes (Figure 3.4 results). The soft sediment overlapping the proposed works area was considered unsuitable for lamprey ammocoetes, given high shading, poorly-oxygenated sediment and poor flow rates (refer to section 3.2.2 of results). Some peripheral, sub-optimal ammocoete habitat (site B) existed a short distance downstream of the proposed outfall area and a very low density (1 per m^2) of *Lampetra* sp. ammocoetes was recorded via electro-fishing. The recorded density at site B was significantly lower than densities recorded downstream of Carlow Weir 1.6km upstream of the study area where >30 lamprey ammocoetes per m^2 were recorded in 2018 (Macklin et al., 2018). However, overall, the area of river channel in vicinity of the proposed works were of low value to lamprey in terms of both spawning (no value) and nursery habitat (sub-optimal). In this respect, lamprey ammocoetes require the deposition of fine, organic-rich sediment ≥5cm in depth in which to burrow and mature (Gardiner, 2003; Goodwin et al., 2008; Aronsuu & Virkkala, 2014). Furthermore, their survival depends on a permanent unidirectional water flow, to supply them with the proper nutrients, while promoting the exchange of respiratory gases and metabolic residues (Hardisty & Potter 1971; Ferreira et al., 2013). The narrow band of soft sediment areas along the east bank of the River Barrow within the vicinity of proposed works area supported very low flows given high riparian shading from willow trees and limbs, thus encouraging more anoxic sediments. Evidently, this resulted in conditions inimical to larval lamprey (none recorded via electro-fishing). Site B, located approx. 30m downstream of the proposed works area, was a more open habitat with higher flows and mixed silt, sand and organics. Consequently, this area supported more favourable conditions for lamprey (i.e., organic-rich, better-oxygenated soft sediment). While conditions were improved at site B, the area only supported a very low density of *Lampetra* sp. ammocoetes at 1 larva per m^2 of soft sediment habitat. The low density is considered resultant of low flow rates and poor mixing of currents (albeit better conditions that site A). No finer well oxygenated gravels were present in the vicinity of the study area, indicating an absence of suitable spawning areas near or adjoining soft sediment burial habitat.

Although it is becoming more widely accepted that larval lamprey may burrow at greater depths than previously thought (up to 1.5m), the optimal nursery water depth for *Lampetra* species (i.e., brook and river lamprey) is <1m and often <0.5m (Maitland, 2003). The SONAR survey confirmed that more optimal depths (i.e. <1m) are largely absent from the vicinity of the proposed outfall (Figure 3.3). *Lampetra* sp. ammocoetes in particular are known to prefer soft sediment areas with gradients no greater than 1% (Kelly & King, 2001). The marginal slopes of both the survey area, and much of the main channel of the River Barrow, are typically much steeper than this (Macklin et al., 2018; Triturus, 2017; pers. obs.) and are, thus, largely unsuitable for ammocoete settlement and burial. The exceptions being downstream of weirs and canal locks in addition to the confluence points of small tributaries and drains.

In support of previous findings on the River Barrow (King, 2006; Delanty et al., 2017; Triturus, 2017), lamprey spawning and ammocoete habitat was highly localised and limited in extent within the vicinity of the works area. Overall, the main channel of the River Barrow provides typically

poor habitat for lamprey (Delanty et al., 2017) given the predominance of deep, slow-flowing glide with steep margins. As stated previously, the nearest good-quality lamprey habitat to the Mortarstown WWTP survey area was identified via electro-fishing surveys in 2018 immediately below Carlow Weir (1.6km upstream), where relatively high densities of *Lampetra* sp. were recorded (i.e., > 30 per m^2). A low density of *Lampetra* sp. ammocoetes (2.6 per m^2) was also recorded on the Barrow at Clongrennan lock, approx. 1.6km downstream of the proposed works area, in September 2020 (Triturus, 2020).

Whilst of low value for lamprey, the wider survey Mortarstown WWTP outfall area was of value as a coarse fish habitat. The deep margins and overhanging tree canopies along the east bank of the River Barrow (i.e., proposed works area) provided good cover and nursery habitat for a range of species such as perch (*Perca fluviatilis*), dace (*Leuciscus leuciscus*) and roach (*Rutilus rutilus*). The adjoining deeper central channel (up to >3m) also provided good-quality coarse fish habitat for roach, dace, bream (*Abramis brama*) and bream hybrids, as well as adult pike (*Esox lucius*). This deeper glide was not considered to be of high value for adult salmonids (as holding habitat) or juveniles, given slow flow rates and a more homogenous profile. Better holding habitat exists in the faster flowing deep glide and pool downstream of Carlow Weir for approximately 250m. Good quality salmonid habitat also exist for juvenile salmonids (i.e., faster-flowing areas of riffle, supporting more varied cobble and boulder substrata) also exists downstream of Carlow Weir. The flows at Carlow weir also provide spawning for salmon where mixed cobble, coarse and medium gravels provide spawning opportunities in pool tailings. Further good-quality nursery, spawning and holding habitat is also present downstream, near Clongrennan Lock. In recent years, these areas were found to support moderate numbers of Atlantic salmon parr and low numbers of brown trout (Macklin et al., 2018; Triturus, 2020). On the main channel of the River Barrow outside of its tributaries, the best quality salmonid and lamprey habitat is found in the downstream vicinity of weirs, where flow rates are naturally higher (King, 2006; Delanty et al., 2017; pers. obs.).

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