Appendix VI
Aquatic Baseline Report

Aquatic baseline report for the BusConnects project, Dublin City

Prepared by Triturus Environmental Ltd. for Scott Cawley

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Table of contents

1. Introduction

1.1 Background

Triturus Environmental Ltd. were contracted by Scott Cawley to undertake a baseline aquatic and fisheries survey along numerous watercourses in the footprint of the proposed BusConnects project, Dublin City.

The surveys were undertaken to establish the importance of the watercourses in the footprint of the project from an aquatic ecological perspective. This included an appraisal of the fisheries, biological water quality data, macrophyte composition and an evaluation of the presence or absence of white-clawed crayfish (*Austropotamobius pallipes*). This would help inform mitigation to minimise impacts to sensitive aquatic receptors relative to the proposals. Proposed infrastructure includes the crossing of riverine and artificial watercourses via the installation of pedestrian footbridges and cycle bridges as well as road culvert extension (instream works) and local road widening.

1.2 Project description

BusConnects is the National Transport Authority's programme to greatly improve bus services in Irish cities. It is a key part of the Government's policy to improve public transport and address climate change in Dublin and other cities across Ireland. BusConnects Dublin includes the Network Redesign and Implementation of 16 Core Bus Corridors throughout the city. The Core Bus Corridor Projects will see the roll-out of 230km of continuous bus priority and 200km of cycle routes.

It aims to overhaul the current bus system in Dublin through a 10-year programme of integrated actions to deliver a more efficient, reliable and better bus system for more people. This will be achieved by;

- Building a network of new bus corridors to make journey's faster and more reliable.
- New network of cycle lanes/tracks.
- Redesign of the Dublin area bus network to provide a more efficient network with high frequency spines, new orbital routes and increased bus services.
- Develop a state -of-the-art ticketing system.
- Implementation of a cashless payment system.
- Simpler fare structure.
- New bus stops and shelters with better signage and information
- Provision of bus-based Park-and-Ride sites in key locations.
- New bus livery providing a common style across different operators.
- Transitioning to a new bus fleet with low emission vehicle technologies.

2. Methodology

2.1 Desktop review

A desktop review was undertaken to collate and review available information, datasets and documentation sources pertaining to the natural environment of the aquatic survey sites. Records available on the National Biodiversity Data Centre and National Parks and Wildlife Service websites were reviewed.

2.2 Walkover surveys

Site visits of *n*=11 aquatic survey sites were conducted in October and November 2020 by Triturus Environmental Ltd. (two staff). Survey sites were located on the River Tolka, Owendoher River, River Dodder, River Camac and River Poddle as well as a single site on the Royal Canal (**Table 2.1, Figure 2.1**). Each site was assessed in terms of fisheries habitat, white-clawed crayfish habitat, and biological water quality (Q-sampling) in the vicinity of the proposed watercourse crossings and works areas. Rare, protected and or conservation interest aquatic species such as otter were also noted, where encountered. This holistic approach informed the overall aquatic ecological evaluation of each site in context of the proposed project infrastructure.

A broad aquatic habitat assessment was conducted at each site utilising elements of the methodology given in the Environment Agency's 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003' (EA, 2003) and the Irish Heritage Council's 'A Guide to Habitats in Ireland' (Fossitt, 2000). All sites were assessed in terms of:

- Channel width and depth and other physical characteristics
- Substrate type, listing substrate fractions in order of dominance, i.e. bedrock, boulder, cobble, gravel, sand, silt etc.
- Flow type, listing percentage of riffle, glide and pool in the survey area
- In-stream macrophyte and aquatic bryophytes occurring and the prominence of each (DAFOR scale)
- General riparian vegetation composition

Table 2.1 Location of *n*=11 aquatic sites surveyed to inform the Bus Connects project, Dublin City

Site no.	EIAR Reference	Watercourse	EPA code	Location / townland	ITM (x)	ITM (y)
T1	CBC0005AR001	River Tolka	09T01	N3 culvert, Blachardstown Bypass	707833	739035
T2	CBC0005AR002	River Tolka	09T01	N3 culvert, Blachardstown Bypass	708112	738804
T3	CBC0002AR001	River Tolka	09T01	Frank Flood Bridge, Drumcondra	716107	736766
RC1	CBC0304AR001	Royal Canal	n/a	Phibsborough Road, Phibsborough	715117	736258
O1	CBC1012AR003	Owendoher River	09O01	Owendoher Green, Rathfarnham	714220	728778
O2	N / A	Owendoher River	09O01	Butterfield Avenue, Rathfarnham	714187	728876
O3	CBC1012AR002	Owendoher River	09O01	Rathfarnham Mill, Rathfarnham	714121	728953
D1	CBC1012AR001	River Dodder	09D01	Rathdown Park, Terenure	714292	729657
C1	CBC0809AR001	River Camac	09C02	Yellowmeadows, Nangor Road	707780	732083
C2	CBC0809AR002	River Camac	09C02	Nangor Road, Clondalkin	708581	732055
P1	CBC0809AR003	River Poddle	09P03	Bancroft Park, Tallaght	709543	728096

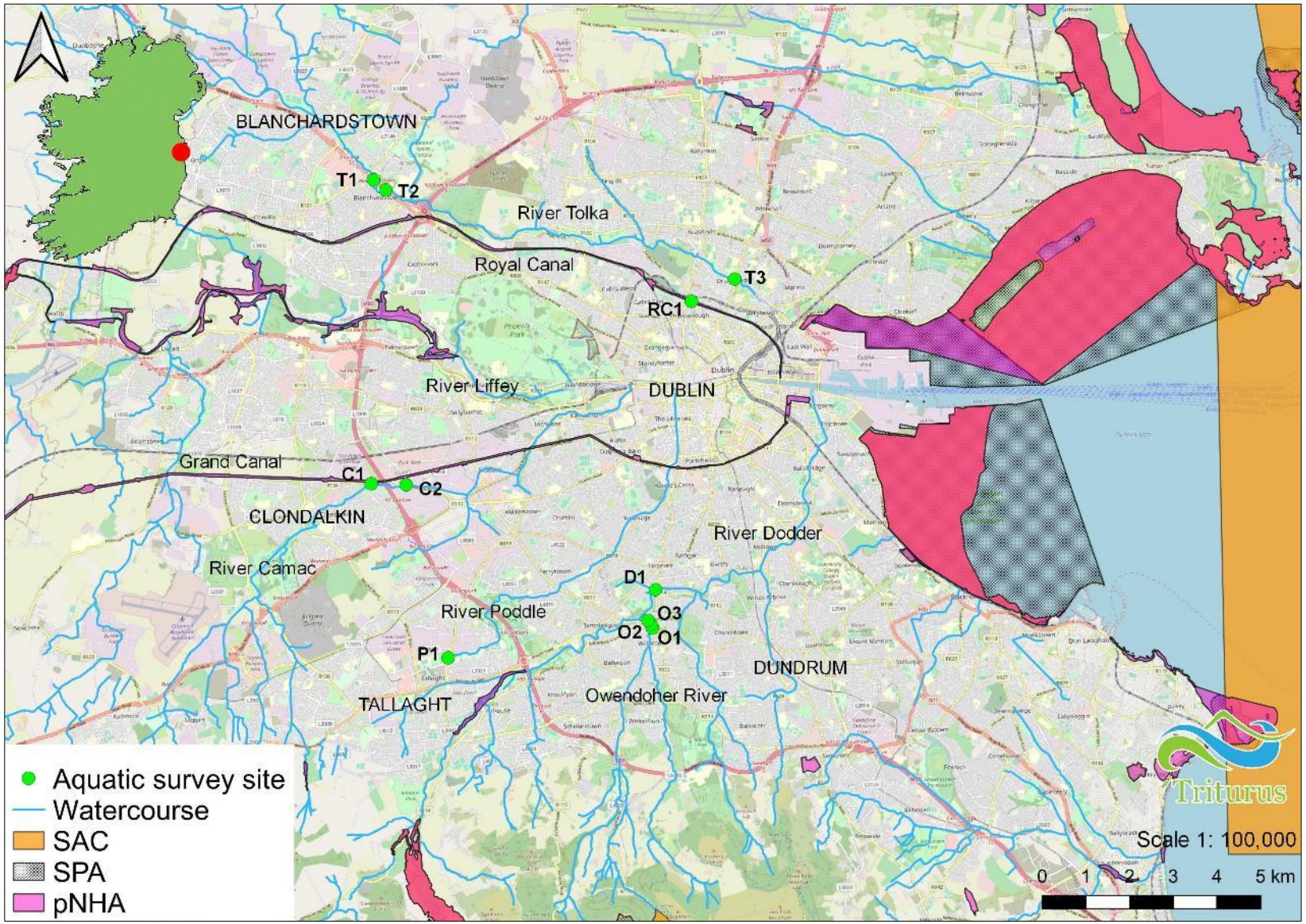

Figure 2.1 Location of aquatic sites surveyed to inform the Bus Connects project, Dublin City.

2.3 Fisheries habitat

A fisheries habitat appraisal of the watercourses in the footprint of the BusConnects project was undertaken to establish their importance for salmonid, lamprey, European eel and other fish species. The baseline assessment considered the quality of spawning, nursery and holding habitat within the vicinity of the survey sites using Life Cycle Unit (salmonids) and Lamprey Habitat Quality Index scores (lamprey). A broad appraisal / overview of the upstream and downstream habitat at each aquatic survey site was also undertaken to evaluate the wider contribution to salmonid and lamprey spawning and general fisheries habitat.

2.3.1 Salmonids

Fisheries habitat for salmonids was assessed using the Life Cycle Unit method (Kennedy, 1984; O'Connor & Kennedy, 2002) to map survey sites as nursery, spawning and holding water, by assigning quality scores to each type of habitat. Those habitats with poor quality substrata, shallow depth and a poorly defined river profile received a higher score. Higher scores in the Life Cycle Unit method of fisheries quantification are representative of poorer value, with lower scores being more optimal, despite this appearing counter-intuitive. Overall scores are calculated as a simple function of the sum of individual habitat scores.

Table 2.1 Life Cycle Unit scoring system for salmonid nursery, spawning and holding habitat value (as per Kennedy, 1984 & O'Connor & Kennedy, 2002)

Habitat quality	Habitat score	Total score (three components)
Poor	4	12
Moderate	3	9-11
Good	2	6-8
Excellent	1	3-5

2.3.2 Lamprey species

Lamprey habitat evaluation for each survey site was undertaken using the Lamprey Habitat Quality Index (LHQI) scoring system, as devised by Macklin et al. (2018). The LHQI broadly follows a similar rationale as the Life Cycle Unit score for salmonids. Those habitats with a lack of soft, largely organic sediment areas for ammocoete burrowing, a shallow sediment depth (<10cm) or of a compacted sediment nature, receive a higher score. Higher scores in this index are thus of poorer value (in a similar fashion to the salmonid Life Cycle Unit Index), with lower scores being more optimal. Overall scores are calculated as a simple function of the sum of individual habitat scores.

Larval lamprey habitat quality as well as the suitability of adult spawning habitat is assessed based on the information provided in Maitland (2003) and other relevant literature (e.g. Gardiner, 2003). Unlike the salmonid Life Cycle Unit index, holding habitat for adult lamprey is not assessed

owing to their different migratory and life history strategies, and that electro-fishing surveys routinely only sample larval lamprey.

The LHQI scoring system provides additional information compared to the habitat classification based on the observations of Applegate (1950) and Slade et al. (2003), which deals specifically with larval (sea) lamprey settlement habitat. Under this scheme, habitat is classified into three different types: preferred (Type 1), acceptable (Type 2), and not acceptable for larvae (Type 3) (Slade et al. 2003). Type 1 habitat is characterized by soft substrate materials usually consisting of a mixture of sand and fine organic matter, often with some cover over the top such as detritus or twigs in areas of deposition. Type 2 habitat is characterized by substrates consisting of shifting sand with little if any organic matter and may also contain some gravel and cobble (lamprey may be present but at much lower densities than Type 1). Type 3 habitat consists of materials too hard for larvae to burrow including bedrock and highly compacted sediment. This classification can also be broadly applied to other lamprey species ammocoetes, including *Lampetra* species.

Table 2.2 Lamprey Habitat Quality Index (LHQI) scoring system for lamprey spawning and nursery habitat value (Macklin et al., 2018).

Habitat quality	Habitat score	Total score (two components)
Poor	4	8
Moderate	3	6-7
Good	2	3-5
Excellent	1	2

2.3.3 General fisheries habitat

A broad appraisal / overview of the upstream and downstream habitat at each site was also undertaken to evaluate the wider contribution to salmonid and lamprey spawning and general fisheries habitat. River habitat surveys and fisheries assessments were also carried out utilising elements of the approaches in the River Habitat Survey Methodology (Environment Agency, 2003) and Fishery Assessment Methodology (O'Grady, 2006) to broadly characterise the river sites (i.e. channel profiles, substrata etc.).

2.4 White-clawed crayfish

A survey for white-clawed crayfish (*Austropotamobius pallipes*) habitat across *n*=10 riverine sites and one canal site was undertaken in October 2020 (**Table 2.1; Figure 2.1**).

The crayfish survey was undertaken under the National Parks and Wildlife (NPWS) under license no. C79/2020, as prescribed by Sections 9, 23 and 34 of the Wildlife Act (1976-2012) to capture and release them to their site of capture under condition no. 5 of the licence. As per best practice, crayfish sampling began at the uppermost site on each watercourse/sub-catchment in the study

area to prevent the transfer of pathogens or invasive species in an upstream direction. An aquatic biosecurity protocol was also applied for equipment use in water (refer to section 2.3 below).

2.4.1 Sweep netting/hand-searching

Sweep netting and hand-searching (following Reynolds et al., 2010) was utilised at each survey site to detect both adult and juvenile crayfish. Sweep netting involves the sampling of more stable refugia such as boulder and cobble accumulations, in addition to macrophyte beds and other potential habitat such as tree root systems. A second operator (with sweep net) was present to capture escape-swimming crayfish observed following the initial sweep or refuge search. To estimate the relative density of crayfish at each site, searches were undertaken (moving upstream) in ten objectively suitable refugia per 1-20m^2 of habitat (as per Peay, 2003). Following capture, all crayfish were held temporarily in a retaining tank containing fresh river water. Each crayfish was sexed, measured (carapace length, to nearest mm) and general condition noted before being released in-situ.

2.4.2 Mustelid spraint (visual) inspection

Further to physical crayfish survey methods, riparian walkover surveys were undertaken to examine any spraint from mustelids (i.e. otters & mink) feeding along riparian corridors. Given that mustelids hunt large areas of river, they can forage cryptic prey present at low densities not easily detectable via conventional survey methodologies (e.g. sweep netting). Whilst not quantitative, riparian walkover/spraint surveys are useful for clarifying the presence or absence of crayfish at a particular site.

2.5 Biological water quality (macro-invertebrates)

To evaluate biological water quality across the survey area, Q-sampling was carried out at *n*=9 riverine sites, namely sites T1, T2 & T3 (River Tolka), O1, O2 & O3 (Owendoher River), D1 (River Dodder), C1 & C2 (River Camac) and P1 (River Poddle) (**Table 2.1, Figure 2.1**). Macro-invertebrate samples were converted to Q-ratings as per Toner et al. (2005). All riverine samples were taken with a standard kick sampling hand net (250mm width, 500µm mesh size) from areas of riffle/glide utilising a two-minute sample, as per ISO standards for water quality sampling (ISO 10870:2012). Large cobble was also washed at each site, where present.

Site RC1 (Royal Canal) was unsuitable for Q-sampling (more lacustrine habitat) and thus a macrophyte sweep was undertaken to collate data on the macro-invertebrate community present. The sample was taken with a standard kick sampling hand net (250mm width, 500µm mesh size) which was used to sweep macrophytes to capture macroinvertebrates. The net was also moved along the canal bed to collect epibenthic and epiphytic invertebrates from the substratum (as per Cheal et al., 1993). A 3-minute sampling period was divided amongst the range of canal meso-habitats present to get the best representative sample.

All samples were elutriated and fixed in 70% ethanol for subsequent laboratory identification. Any rare invertebrate species were identified from the NPWS Red List publications for beetles

(Foster et al., 2009), stoneflies (Feeley et al., 2020), mayflies (Kelly-Quinn & Regan, 2012) and other relevant taxa (i.e. O'Connor, 2020; Byrne et al., 2009; Nelson et al., 2011).

Table 2.4 Reference Categories for EPA Q-Ratings (Q1 to Q5)

Q Value	WFD Status	Pollution Status	Condition
Q5 or Q4-5	High Status	Unpolluted	Satisfactory
Q4	Good Status	Unpolluted	Satisfactory
Q3-4	Moderate Status	Slightly polluted	Unsatisfactory
Q3 or Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2 or Q1	Bad	Seriously polluted	Unsatisfactory

2.6 Aquatic ecological evaluation

The evaluation of ecological receptors contained within this report uses the geographic scale and criteria defined in the Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009).

2.7 Biosecurity

A strict biosecurity protocol following the Check-Clean-Dry approach was employed during the survey. Equipment and PPE used was disinfected with Virkon® between survey sites to prevent the transfer of pathogens and/or invasive species between survey areas. Where feasible, equipment was also be thoroughly dried (through UV exposure) between survey areas. Particular cognisance was given towards preventing the spread or introduction of crayfish plague (*Aphanomyces astaci*), given the known distribution of a particularly valuable peri-urban population of white-clawed crayfish (*Austropotamobius pallipes*) in the River Camac catchment. As per best practice, surveys were undertaken at sites in a downstream order (i.e. uppermost site surveyed first etc.) to prevent the upstream mobilisation of invasive propagules and pathogens. Any invasive species recorded within or adjoining the survey area were geo-referenced.

3. Results

The following section summarises each aquatic survey site in terms of aquatic habitats, physical characteristics and overall value for fish, macro-invertebrates and macrophyte communities. Biological water quality results (riverine sites only) are also summarised. Habitat codes are according to Fossitt (2000). Scientific names are provided at first mention only. An evaluation of the ecological importance of each survey site based on the aquatic surveys is provided below and summarised in **Table 3.4**.

3.1 Desktop review

A desktop review of aquatic flora and fauna covering 10km grid squares adjoining the survey area (i.e. O02, O03, O12 & O13) revealed records for a number of protected (freshwater) aquatic species in the vicinity of the proposed watercourses crossings.

In terms of aquatic invasive species, records were available for curly waterweed (*Lagarosiphon major*) and fringed water-lily (*Nymphoides peltata*) in isolated ponds. Invasive plant species associated with aquatic habitats such as Himalayan balsam (*Impatiens glandulifera*) and Japanese knotweed (*Fallopia japonica*) were common in the respective grid squares. New Zealand pigmyweed (*Crassula helmsii*) was known from several locations on the Grand Canal (NBDC data), with the rare and protected opposite-leaved pondweed (*Groenlandia densa*) known from several locations on the Royal Canal (BEC, 2011; NBDC data).

The River Tolka, Owendoher River, River Dodder and River Camac were known to support a range of fish species such as brown trout (*Salmo trutta*), European eel (*Anguilla anguilla*), minnow (*Phoxinus phoxinus*), stone loach (*Barbatula barbatula*), three-spined stickleback (*Gasterosteus aculeatus*) and *Lampetra* sp. lamprey (Matson et al., 2018, 2019; Kelly et al., 2011, 2014; Triturus unpublished data). Atlantic salmon (*Salmo salar*) parr were recorded from the lower reaches of the River Camac by Triturus in September 2020 (unpublished data). Atlantic salmon records were also available for the River Dodder (Kelly et al., 2014) and the River Tolka. The River Poddle was only known to support three-spined stickleback, with significant instream fish migration barriers present (Aquafact, 2020).

White-clawed crayfish (*Austropotamobius pallipes*) records were available from the River Camac (NBDC data), with a particularly healthy population known in the Camac and selected tributaries (Triturus, 2020; Sweeney, 2018).

Otter (*Lutra lutra*) records were widespread across grid squares O02, O03, O12 & O13 (NBDC data), with the River Tolka, Owendoher River, River Dodder, River Camac known to be particularly important watercourses for the species (Macklin et al., 2019; Brazier & Macklin, 2020).

3.2 Site descriptions

3.2.1 Site T1 – River Tolka (EIAR Reference CBC0005AR001)

The River Tolka at site T1 was a semi-natural lowland depositing watercourse (FW2) with evident historical deepening and bank modification works. These included gabion basket scour protections and a concrete culverted bed at the N3 road crossing. The river profile mainly comprised of deep glide (60% area) and pool (30%) with more localised riffle (10%). The channel averaged 5-8m wide, with a variable depth of 0.3-1.5m deep. The channel bed comprised rendered concrete under the road crossing. However, downstream of the culvert, the substrata were dominated by boulder and cobble with pockets of very localised medium and fine gravels. The substrata were heavily bedded with 30% cover of filamentous green algae, indicating enrichment. The bed suffered from heavily siltation, albeit swift flows reduced the visible deposition levels on instream substrata. The macrophyte community was limited to small patches of emergent branched-bur reed (*Sparganium erectum*) and watercress (*Rorripa nasturtium-aquaticum* agg.). The coarse substrata on the bed also supported the aquatic moss species *Cinclidotus fontinaloides* and *Platyhypnidium riparoides* locally. The riparian habitats supported mainly scrub habitat (WS1) and rank grassy areas (GS2) with frequent nettle (*Urtica dioica*), butterbur (*Petasites hybridus*), thistles (*Cirsium* spp.) and red osier dog wood (*Cornus cericea*). Riparian trees were scattered along the banks with crack willow (*Salix fragilis*) and sycamore (*Acer psuedoplatanus*) being the most frequent species.

The river was considered a moderate quality brown trout nursery, with some localised deeper pools (including immediately downstream of the culvert) providing good holding habitat. Spawning habitat for both salmonids and lamprey was locally good (c.110m downstream of the culvert in the tailing of a pool where mobile gravel was identified, ITM 707825, 738930). The site offered poor lamprey ammocoete habitat given the high flow rates and predominance of hard substrata. European eel habitat was moderate overall. The deeper pool areas locally would support European eel (*Anguilla anguilla*). White-clawed crayfish are not present in the River Tolka (no known records) and were not recorded during the survey. Otter spraint (1 site (3 spraints)) was recorded under the culvert in a muddy area of the west bank (ITM 707817, 739019).

Biological water quality, based on Q-sampling, was calculated as **Q3** (**poor status**) (**Appendix A**). The nearest EPA biological monitoring stations RS09T010800 (c.1.5km upstream) and RS09T011000 (c.1.8km downstream) achieved Q2-3 (poor status) and Q3 (poor status) in 2019, respectively (EPA data).

In summary, the salmonid habitat of this site T1 was considered to be of moderate quality. Equally the European eel habitat present was of moderate value. Additionally it is of value to QI species otter, which regularly uses the site .

Plate 3.1 Representative image of site T1 on the River Tolka (facing upstream towards culvert)

3.2.2 Site T2 – River Tolka (EIAR Reference CBC0005AR002)

The River Tolka at site T2 was a semi-natural lowland depositing watercourse (FW2) with a swift flow and a well-defined thalweg downstream of the bridge crossing and associated culvert. Located approx. 0.5km downstream of site T1, the river profile was dominated by glide (50%) and riffle (40% area) with more localised pool 10%. The channel width was variable between 6m and 14m wide. The depth was also variable and recorded between 0.4m and 1.0m deep. The good semi-natural character for an urban river, however, was diminished by riverine substrata that were in poor condition due to siltation pressures. Furthermore, hydro-morphologically the river had been altered at the N3 crossing with the channel bed comprising of rendered concrete with little gravel or cobble deposition under the road crossing. Downstream of the culvert, the bed comprised bedrock, boulder and cobble with very localised pockets of medium and fine gravels. The substrata were very however, heavily bedded and covered by filamentous green algae (205 surface area cover, indicating enrichment). While the bed suffered from heavily siltation, the swift flows reduced the visible deposition levels on the visible instream substrata (as with other areas on the River Tolka). The macrophyte community comprised locally frequent watercress (*Rorrippa nasturtium-aquaticum* agg.) and lesser water parsnip (*Berula erecta*) in the margins. The coarse substrata on the bed also supported *Cinclidotus fontinaloides* and *Platyhipnidium riparoides* locally. The riparian habitats supported mainly scrub habitat and rank grassy areas with frequent winter heliotrope, nettle, bramble (*Rubus fruticosus* agg.), bracken (*Pteridium aquilinum*), buddleja (*Buddleja davidii*), hemp agrimony (*Eupatorium cannabinum*), spear thistle (*Cirsium vulgare*) and hogweed (*Heracleum sphondylium*). The banks supported a few scattered mature crack willow (*Salix fragilis*), with a more mature treeline downstream of the survey area. The river upstream of the culvert was narrower, very fast flowing and heavily overgrown with scrub. Historical bank works were evident with gabion baskets present.

The river was considered a moderate brown trout nursery, with some localised deeper pools providing good holding habitat. Spawning habitat for both salmonids and lamprey was poor given substrata compaction and bedding. Swift flows largely precluded sediment deposition but some superficial silts were present marginally which provided some limited suitability for *Lampetra* sp. ammocoetes. European eel habitat was moderate overall albeit compaction of the bed and swift flows provided for less optimal refugia. White-clawed crayfish are not present in the River Tolka (no known records) and were not recorded during the survey. Regular otter spraint sites were recorded on the concrete path on the downstream side (ITM 708122, 738814) and upstream side of the culvert (ITM 708095, 738790).

Biological water quality, based on Q-sampling, was calculated as **Q3** (**poor status**) (**Appendix A**). The nearest EPA biological monitoring stations RS09T010800 (c.2km upstream) and RS09T011000 (c.1.2km downstream) achieved Q2-3 (poor status) and Q3 (poor status) in 2019, respectively (EPA data).

The site T2 was found to be of moderate salmonid and European eel quality, with observable utilisation by otter**.**

Plate 3.2 Representative image of site T2 on the River Tolka (facing upstream towards culvert)

3.2.3 Site T3 – River Tolka, Frank Flood Bridge (EIAR Reference CBC0002AR001)

The River Tolka at site T3 was a semi-natural lowland depositing watercourse (FW2) with a swift flow. Despite being located in a heavily urbanised area with high retaining walls, the river profile was surprisingly natural downstream of the bridge (upstream being glide dominated, held between retaining walls and with less natural character). The river profile was dominated by glide (30%) and riffle (50%) with more localised pool 20% (the largest of which was located immediately downstream of the bridge apron/weir). The channel width was variable between 15m and 20m wide, being narrower downstream where marginal riparian stands of osier (*Salix viminalis*), grey

willow (*Salix cinerea*) and crack willow were present alongside reed canary grass (*Phalaris arundinacea*) and scattered invasive Himalayan balsam (*Impatiens glandulifera*) on the north bank. The depth was also variable, ranging between 0.3-1.3m. The channel bed comprised rendered concrete under the road crossing but downstream of the bridge the substrata were mainly boulder and cobble with pockets of medium and fine gravels (in pools). The substrata were bedded but large pockets of well-sorted medium and coarse gravels were present at the pool tailing downstream of the weir at the bridge apron. The bed suffered from moderate siltation and eutrophication pressures were evident with 20% filamentous algae cover. The macrophyte community included locally frequent emergent watercress, lesser water parsnip and blue water speedwell (*Veronica anagallis-aquatica*). A single stand of bulrush (*Typha latifolia*) was present on the river margin 50m downstream of the bridge. The coarse substrata on the bed also supported *Cinclidotus fontinaloides* and *Platyhipnidium riparoides* locally.

Downstream of the bridge, the river was considered a good brown trout nursery and good holding area for adult fish. Spawning for both salmonids and lamprey was considered locally good, despite siltation pressures. Upstream of the bridge the river was mainly a holding area for salmonids with deeper glide habitat held between retaining walls. Lamprey ammocoete habitat was sparse given the high energy nature of the site. European eel habitat was good downstream of the bridge owing to ample boulder refugia and deeper pool areas. White-clawed crayfish are not present in the River Tolka as previously described for other survey areas and none were recorded during the survey. A regular otter spraint site (1(6), mixed age) was recorded on the bridge apron downstream of the bridge (south bank) (ITM 716124, 736756).

Biological water quality, based on Q-sampling, was calculated as **Q3** (**poor status**) (**Appendix A**). The nearest EPA biological monitoring station RS09T011100 (c.2.3km upstream) achieved Q3 (poor status) in 2019 (EPA data).

In summary, habitat of good salmonid and European eel quality, and regular utilisation by otter, was observed at this site.

Plate 3.3 Representative image of site T3 on the River Tolka at Frank Flood Bridge (facing upstream)

3.2.4 Site RC1 – Royal Canal, Phibsborough (EIAR Reference CBC0304AR001)

The Royal Canal between the 4th and 5th lock (level 4, Phibsborough) was a uniform 10-12m wide and 1.5-2.5m deep, with a centrally deeper navigation channel in most areas. The substrata were dominated by silt with high clay fractions (often >0.3m in depth), with scattered boulder and localised marginal cobble/gravel areas (e.g. along boat gangway). The 300m section of canal (between the 4th and 5th locks) was typified by narrow riparian fringes bordered by urban areas and built land (BL3). The riparian zones supported a range of common species such as great willowherb (*Epilobium hirsutum*), nettle, meadowsweet, yarrow (*Achillea millefolium*), marsh ragwort (*Jacobaea aquatica*), hedge bindweed (*Calystegia sepium*), creeping thistle, hogweed and occasional teasel (*Dipsacus fullonum*). Non-native Canadian fleabane (*Conyza canadensis*) and buddleja were both occasional. Intermittent planted treelines of sycamore and cherry (*Prunus* sp.) were present in maintained grassland strips (WD5 parkland habitat). The canal margins were lined by narrow linear strips dominated by reed sweet grass (*Glyceria maxima*) with frequent stands of iris (*Iris pseudacorus*) and occasional reed canary grass. Instream, the macrophyte community was dominated by yellow lily (*Nuphar lutea*) (both submerged and emergent forms), with common duckweed (*Lemna minor*) and ivy-leaved duckweed (*Lemna trisulca*) being frequent. Also frequent was Canadian pondweed (*Elodea canadensis*), Nuttall's pondweed (*Elodea nuttallii*), whorled-water milfoil (*Myriophyllum verticillatum*) and stonewort species *Chara sp*. Amphibious bistort (*Persicaria amphibia*) was occasional on bank and in margins. The rare and protected opposite-leaved pondweed (*Groenlandia densa*) is known from this area of the Royal Canal (BEC, 2011; NPWS data) but no stands were observed during the survey (October 2020). It is considered likely that the species is still present but given it is a dark green, submerged pondweed that often sprawls along the bottom, its detection can be difficult.

Overall, site RC1 offered excellent coarse fish habitat for a range of common species including roach (*Rutilus rutilus*), bream (*Abramis brama*), perch (*Perca fluviatilis*) and pike (*Esox lucius*). Well-vegetated canal sections such as this provide valuable nursery habitat for numerous fish species, in addition to good spawning substrata in the spring/early summer months. European eel are known from this section of canal and habitat was considered good. No white-clawed crayfish are known from the eastern extent of the Royal Canal in Dublin City (NBDC, NPWS data, pers. obs.), despite some good physical habitat and physiochemical suitability. No otter signs were recorded during the site visit although suitable marking areas were largely absent.

There is no biological water quality available for canal sites from the EPA. No rare or protected macro-invertebrate species were recorded in a sweep netting sample of the site (**Appendix B**).

In summary, this site on the Canal and situated within the Royal Canal pNHA (002103), exhibited high coarse fish habitat, high European eel habitat, and of high quality for otter as a foraging area.

Plate 3.4 Representative image of site RC1 on the Royal Canal at Phibsborough (5th lock)

3.2.5 Site O1 – Owendoher River, Owendoher Green (EIAR Reference CBC1012AR003)

The Owendoher River at site O1 was located approx. 100m upstream of the R114 road bridge (site O2). The upland eroding watercourse (FW1) was swift flowing and averaged 6-7m wide and 0.2-0.5m deep, with localised deeper pool and glide areas to 1m. The river flowed through a semi-natural V-shaped incised valley with bankfull heights of 7-8m (steep sided). The site was characterised by shallow glide (30%) and riffle (60%) with occasional pool areas, usually associated with large instream boulders. The substrata were dominated by partially bedded cobble (40%) with clean sand and fine to medium gravels atop (40% overall). Large boulder was frequent (20%). Siltation was very low with any accumulations of finer substrata dominated by sand. Erosion from floods and human access was evident along both banks. Although adjoined by urban areas (BL3, GA2 etc.), the river was isolated from human activity with poor access via steep

banks. The banks supported mature treelines dominated by sycamore, ash (*Fraxinus excelsior*) and elder (*Sambucus nigra*), with occasional cherry laurel (*Prunus laurocerasus*). The scrubby escarpments supported abundant nettle, hedge bindweed, bramble and ivy (*Hedera helix*), with pendulous sedge (*Carex pendulata*), angelica (*Angelica sylvestris*) and hogweed all common. The invasive Japanese knotweed (*Reynoutra japonica*) was common throughout the site with occasional butterbur and winter heliotrope. Despite low shading, macrophyte growth was absent given mobile sand/gravel substrata on top of loose cobble. The aquatic moss layer was poorly developed with only localised *Platyhypnidium riparoides*. Filamentous algae was present (2% cover) indicating some relatively low levels of enrichment.

Overall, site O1 offered excellent salmonid habitat, with particularly good spawning opportunities given abundant clean substrata. Whilst limited in extent (site was typically shallow riffle), some very good holding habitat was present in localised small pools (with brown trout evidently plentiful). The site was also a good salmonid nursery. Whilst the site offered some good physical suitability for lamprey spawning, the swift flows and general eroding/spate nature precluded fine sediment deposition and larval habitat was largely absent. European eel habitat was moderate. White-clawed crayfish are not known in the Owendoher, despite some good physical suitability. Otter suitability was very high given low disturbance and good prey resources (but no signs were recorded at this site).

Biological water quality, based on Q-sampling, was calculated as **Q3-4** (**moderate status**) (**Appendix A**). The nearest EPA biological monitoring station RS09O011700 (c.0.2km downstream) achieved Q3-4 (moderate status) in 2019 (EPA data).

In summary, habitat of excellent salmonid quality, and moderate lamprey and European eel habitat was observed at this site.

Plate 3.5 Representative image of site O1 on the Owendoher River (facing upstream)

3.2.6 Site O2 – Owendoher River, Butterfield Avenue

The Owendoher at site O2 was located at the R114 road bridge/culvert, approx. 100m downstream from site O1. Here, the river averaged 6-7m wide and 0.3-0.6m deep, with localised deeper pool and glide areas to 1.2m. The river flowed through a semi-natural V-shaped valley with bankfull heights of 7-8m (steep sided) and was bound by masonry retaining walls under the bridge. In contrast to site O1 upstream, the site was characterised by slower, deeper glide and pool. Downstream of the weir, riffle predominated. The substrata were dominated by partially bedded cobble (30%) with clean sand (30%) and well-sorted gravels (20% overall). There were extensive beds of coarse sand locally. Large boulder was frequent (20%). Siltation was low with any accumulations of finer substrata dominated by sand. Erosion from floods and human interference was evident along both banks. As per site O1, the river was isolated from human activity with poor access via steep banks. The banks supported mature treelines dominated by sycamore, crack willow, ash and elder (*Alnus glutinosa*), with occasional cherry laurel. Buddleja was present downstream of the bridge. The scrubby escarpments supported bramble and ivy with angelica and hedge bindweed. Japanese knotweed and winter heliotrope was scattered throughout the site (but more prevalent upstream). Riparian shading was relatively high and macrophytes were absent. The aquatic moss layer was poorly developed with only localised *Platyhypnidium riparoides* present, with *Hygroamblystegium tenax* on the weir face. The bridge retaining walls did not support vegetation.

Site O2 offered excellent salmonid habitat, with particularly good spawning opportunities given abundant clean substrata. Holding habitat was also excellent (particularly underneath the bridge) although the weir was a significant barrier to fish migration (no fish pass present). Brown trout were plentiful. The site was also a good salmonid nursery (likely brown trout only given known migration barriers downstream). Whilst the site offered some good physical suitability for lamprey spawning, the swift flows and general eroding/spate nature precluded fine sediment deposition and larval habitat was largely absent. European eel habitat was moderate. White-clawed crayfish are not known in the Owendoher. Old otter spraint (1(2)) was recorded under the bridge structure on the west bank (ITM 714179, 728878).

Biological water quality, based on Q-sampling, was calculated as **Q3-4** (**moderate status**) (**Appendix A**). The nearest EPA biological monitoring station RS09O011700 (c.0.17km downstream) achieved Q3-4 (moderate status) in 2019 (EPA data).

In summary, site O2 showed some excellent salmonid habitat with good spawning gravels. The presence of otter was also noted within the boundaries of the site.

Plate 3.6 Representative image of site O2 on the Owendoher River (facing downstream towards road bridge with point source evident in right foreground)

3.2.7 Site O3 – Owendoher River, Rathfarnham Mill (EIAR Reference CBC1012AR002)

Site O3 on the Owendoher River was located approx. 100m downstream from the R114 road bridge (site O2). Here, the swift-flowing river averaged 6-8m wide and 0.2-0.4m deep, with locally deeper pool to 0.8m. The site was typified by shallow fast glide and riffle (both 40%), with only localised small pools present. The substrata featured more in the way of cobble (40%) and boulder (30%) in comparison to upstream areas, although coarse sands and finer gravels were still frequent (30% overall). Siltation was low and any fine sediment accumulations present were sand-dominated. The river flowed in a semi-natural deep U-shaped valley with steep banks colonised by mature treelines supporting sycamore, elder, hawthorn (*Crataegus monogyna*), alder and ash with occasional crack willow and cherry laurel. The understories featured common species such as ivy, pendulous sedge, tutsan (*Hypericum androsaemum*), wood avens (*Geum urbanum*), pignut (*Conopodium majus*), hogweed and ferns. Non-native three-cornered garlic (*Allium triquetrum*), listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011-2015, was present locally along with winter heliotrope. Non-native Abraham-Isaac-Jacob (aka. oriental borage) (*Trachystemon orientalis*) had escaped from an adjacent garden and was present along the river (west bank). Riparian shading was relatively high and macrophytes were absent (as per upstream). *Platyhypnidium riparoides* was present locally on larger boulder. Filamentous algae was also present (1% cover only). The liverworts *Marchantia polymorpha* and *Conocephalum conicum* were present on muddy banks.

Overall, the site offered good salmonid habitat, although spawning and holding habitat was superior upstream at sites O2 and O1. Nursery was good overall and brown trout were evidently plentiful. European eel habitat was, again, moderate. White-clawed crayfish are not known in the Owendoher. A potential otter holt (and couch) was recorded along the west bank approx. 75m

downstream of the road bridge (ITM 714135, 728929). The holt appeared inactive at the time of survey and was located under a mature ash tree, 1.5m above water level.

Biological water quality, based on Q-sampling, was calculated as **Q3-4** (**moderate status**) (**Appendix A**). The site (station RS09O011700) achieved Q3-4 (moderate status) in 2019 (EPA data).

In summary, site O3 showed excellent salmonid habitat with good habitat in particular. Additionally, habitat with high otter potential (including a possible breeding area) was also noted.

Plate 3.7 Representative image of site O3 on the Owendoher River (facing downstream)

3.2.8 Site D1 – River Dodder, Rathdown Park (EIAR Reference CBC1012AR001)

The River Dodder at site D1 was located downstream of Bushy Park pond in a mature woodland setting. The lowland depositing watercourse (FW2) averaged 10-12m wide and 0.3-0.6m deep, with locally deeper glide and pools to >1m. The site was dominated by swift flowing shallow glide (70%) with occasional riffle areas and very localised pool (small, where present). The habitat was generally homogenous upstream and downstream of the survey site. The river had been straightened historically with 3-4m high embankments on both banks but good natural recovery was evident. The substrata were dominated by cobble (30%) and well-sorted gravels (30%), with occasional larger boulder (20%). Sand was frequent locally. Overall levels of siltation were low and accumulations were sand-dominated, where present. The substrata were mobile and largely free from silt. The site was bordered by open parkland (WD5) to the south (Brookvale) and mature mixed broadleaved woodland (WD1) to the north (Bushy Park). The riparian zone supported mature treelines on both banks, dominated by sycamore with alder, ash, crack willow and occasional hawthorn. The mixed broad-leaved woodland (north bank) also supported beech (*Fagus sylvatica*), wych elm (*Ulmus glabra*), elder and lime (*Tilia* sp.). Cherry laurel encroachment was present in the woodland at the survey site. The understories and riparian zone supported

abundant ivy with bramble scrub, pendulous sedge, nettle, hogweed, angelica, hemp agrimony and frequent winter heliotrope. Given the loose substrata and mature tree canopy, macrophyte growth was not present at the survey site. However, some localised *Platyhypnidium riparoides* and *Cinclidotus fontinaloides* was present locally on larger boulder. *Conocephalum conicum* and *Pellia* sp. liverworts were abundant on exposed muddy banks.

Site D1 offered excellent salmonid habitat overall, particularly in terms of spawning. Nursery and holding habitat was of good quality. Lamprey habitat was limited to spawning substrata, with no suitable silt accumulations for ammocoetes present. European eel value was moderate overall. White-clawed crayfish are not present in the River Dodder. Despite known utilisation by otter locally (Macklin et al., 2019), no otter signs were recorded at the survey site (likely due to high human disturbance levels at the site).

Biological water quality, based on Q-sampling, was calculated as **Q3** (**poor status**) (**Appendix A**). The nearest EPA biological monitoring station RS09D010620 (c.1.3km upstream) achieved Q3-4 (moderate status) in 2019 (EPA data).

In summary, given the excellent salmonid habitat - in particular spawning gravel, with other areas of good quality nursery and holding habitat observed at this site. Otter activity was not seen at this site during survey, but it is thought that habitat potential at this site was high for this species.

Plate 3.8 Representative image of site D1 on the River Dodder at Rathdown Park

3.2.9 Site C1 – River Camac, Yellowmeadows (EIAR Reference CBC0809AR001)

The River Camac at Yellowmeadows was a lowland depositing watercourse (FW2). The section had been historically straightened and heavily modified, with a sloping retaining wall present along the south bank of the river (adjoining residential areas). Bankful heights were 2-3m. The channel averaged 3-4m wide and 0.2-0.3m, with locally deeper glide and to 0.5m. Shallow fast

glide predominated with occasional riffle area (20%) and very little pool (5%). The channel featured an open masonry culvert in the vicinity of the survey site with only localised accumulations of cobble and medium to coarse gravels on top. Sand was occasional. Siltation was moderate overall with some accumulations in association with marginal and mid-channel macrophyte beds. Boulder was almost entirely absent. The site was bordered by parkland (WD5) to the south and built land (BL3) to north (Nangor Road). The open parkland banks supported a low diversity of common species such as dandelion (*Taraxacum officinale* agg.), wild carrot (*Daucus carota*), bramble, hogweed, angelica, broad-leaved dock (*Rumex obtusifolius*), great willowherb and rank grasses. The north bank was heavily scrubbed with primarily ornamental species like red osier dogwood and *Cotoneaster* sp. with frequent buddleja and hedge bindweed. Downstream, a mature willow-dominated treeline was present along the river, with ash and sycamore. The river margins were dominated by linear belts of reed canary grass with abundant nettle. Lesser water parsnip, watercress and localised brooklime (*Veronica beccabunga*) were present in the margins. Instream macrophytes were rare given the concrete riverbed. Cobble zones supported occasional spiked water milfoil (*Myriophyllum spicatum*). Bryophytes were poorly represented. Filamentous algal cover was relatively high (20%) indicating enrichment. Numerous point sources were present locally, adjoining from the Nangor Road bank.

Overall, the site offered some moderate value for salmonids but the river provided far superior habitat both upstream and (especially) downstream. Spawning and nursery value was limited but nonetheless present (moderate value only). Holding habitat as good despite the lack of pool areas given the undercut banks/overhanging reed canary grass vegetation. White-clawed crayfish were present at a 'low' density >0 to <1 per 10 refugia; Peay, 2003). A total of *n*=2 crayfish were recorded via sweep netting, with two males (32mm and 35mm carapace length, respectively) captured from areas overhung by reed canary grass vegetation. Three-spined stickleback (*Gasterosteus aculeatus*) were abundant. Lamprey ammocoete habitat was present very locally also but spawning habitat was poor (few finer gravels present given high flows rates and concreted bed). No otter sings were recorded during the site visit but the River Camac in the vicinity of the survey site is known to support otter (Macklin et al., 2019).

Biological water quality, based on Q-sampling, was calculated as **Q3** (**poor status**) (**Appendix A**). The nearest EPA biological monitoring station RS09C020310 (c.0.8km upstream) and RS09C020500 (5.4km downstream) both achieved Q3 (poor status) in 2019 (EPA data).

In summary, salmonid habitat was found to be of moderate quality, with moderate quality lamprey habitat and low densities of Annex II white-clawed crayfish at this site.

Plate 3.9 Representative image of site C1 on the River Camac (facing upstream)

3.2.10 Site C2 – River Camac, Nangor Road (EIAR Reference CBC0809AR002)

The River Camac at site C2 was a lowland depositing watercourse (FW2) which had been historically straightened and modified upstream and downstream of the existing R134 road culvert. However, good recovery was evident instream, despite being surrounded by industrial/urban areas. Upstream of the culvert, the river averaged 3-4m wide and 0.5-1m deep with locally deeper glide and pools to 1.2m. The profile was 90% deep glide with localised pool areas. The substrata were dominated by relatively clean, unbedded/mobile fine to coarse gravels (70%) with low siltation (only light plumes underfoot). Cobble and small boulder was occasional (10%). Silt beds were present marginally and in association with abundant growth of instream macrophytes. Downstream of the R134 culvert (an extensive twin-bore 3m metal pipe, 75m long) the river was 3m wide on average and 0.4-0.6m deep, with locally deeper pools to 0.8-1m. The flow was greater than upstream and fast glide predominated (60%), with occasional riffle areas and localised pools (10%). Given the high flow rates, the substrata were dominated by cobble (50%) with occasional boulder. Medium to coarse gravels were frequent (30%) and present in small patches locally and interstitially. Sand/silt accumulations were present in pool slacks near the culvert. Overall siltation was moderate. The substrata were relatively compacted (in contrast to upstream slower glide habitat). Downstream, riparian shading was high given dense bramble-dominated scrub with mature treelines on both banks of sycamore, poplar (*Populus* sp.), crack willow, osier and elder. Dogwood, angelica, ivy, nettle and hogweed were abundant also. Winter heliotrope was frequent along both banks. Upstream, the open banks sloped to the river and supported abundant reed canary grass and occasional bramble scrub. Macrophyte growth was dominated by abundant spiked water milfoil (50% cover) and *Potamogeton crispus* (20%), with the margins and riparian slopes dominated by reed canary grass. Downstream, given high shading, instream macrophytes were limited to marginal watercress. Aquatic mosses were limited to localised *Cinclidotus fontinaloides*. The aquatic bryophyte community was poorly represented.

Site C2 offered some very good salmonid habitat (brown trout only). Upstream of the culvert provided excellent quality spawning and nursery habitat (among the best on the entire river) with very good holding habitat for abundant adult trout in undercut banks/under overhanging reed canary grass. A single mature crack willow immediately upstream of the culvert also provided an excellent deep holding pool for adult salmonids. Downstream, whilst spawning and nursery value was somewhat reduced, adult holding habitat was very good given undercut banks and prominent submerged tree roots (willow and sycamore). These also offered excellent refugia for white-clawed crayfish, which were recorded at 'moderate' densities (≥1 to <3 per 10 refugia; Peay, 2003). A total of *n*=8 crayfish were recorded via sweep netting, with males, females and juveniles present, ranging from 19-41mm carapace length. Lamprey ammocoete habitat was present both upstream and downstream of the culvert, usually in association with instream macrophyte beds. European eel habitat was good throughout but better upstream. Despite known utilisation of the river and abundant prey resource, no otter signs were recorded during the site visit (few suitable marking sites present).

Biological water quality, based on Q-sampling, was calculated as **Q3** (**poor status**) (**Appendix A**). The nearest EPA biological monitoring station RS09C020310 (c.1.7km upstream) and RS09C020500 (4.5km downstream) both achieved Q3 (poor status) in 2019 (EPA data).

The presence of a healthy Annex II white-clawed crayfish population, in addition to excellent brown trout habitat and good lamprey habitat summarizes the key habitats found at this site.

Plate 3.10 Representative image of site C2 on the River Camac (upstream of the culvert)

Plate 3.11 Representative image of site C2 on the River Camac (downstream of the culvert)

3.2.11 Site P1 – River Poddle, Bancroft Park, Tallaght (EIAR Reference CBC0809AR003)

The uppermost reaches of the River Poddle at site P1 represented a small, lowland depositing watercourse (FW2). Adjoining Bancroft Park, the river had been historically straightened and deepened, with a two-stage channel evident. The river emerged from an extensive underground culvert at the R819 road crossing. Bankful heights in the deep U-shaped channel were 2.5-3m. The river averaged ≤1m wide in a 2.5-3m wide channel. The site was shallow with depths averaging 0.1-0.2m with only very localised, small pool to 0.3m. Shallow glide predominated (60%) with occasional riffle zones and localised small pool. The substrata were dominated by cobble (30%) and small boulder which were heavily silted and compacted. Some medium to coarse gravels were present interstitially (30%). Siltation was high overall although sediment accumulations were largely absent at the swift flowing site. Hydrocarbon and silt plumes were evident underfoot, locally. Natural bank erosion was evident and was contributing to siltation in addition to surface water run-off from adjoining hard standing areas (BL3). The site was bordered by scattered trees and parkland habitat (WD5) with ornamental hedging. The riparian areas were scrubbed over with nitrophilous species such as great willowherb, nettle, hedge bindweed, meadowsweet, meadow buttercup (*Ranunculus acris*), common knapweed (*Centaurea nigra*), creeping thistle, tormentil (*Potentilla erecta*), wild carrot, dog rose (*Rosa canina*), gorse (*Ulex europaeus*), ragwort (*Jacobaea vulgaris*) and rank grasses. Very dense bramble scrub was present in the vicinity of the R819 road culvert. Encroachment of the small channel by terrestrial species was relatively high and shading resulted in a lack of macrophyte growth. Filamentous algae was profuse (30% cover), indicating heavy enrichment.

Overall site P1 offered low fisheries value. Salmonid habitat was of poor quality (although brown trout were not known from the river). The small channel was heavily silted and provided poor spawning and poor holding opportunities for salmonids. Nursery value was also poor given the small nature of channel and lack of macrophyte and other refugia. Lamprey habitat was poor, with only very localised patches of sub-optimal sediment present. Given evidently poor water quality and siltation levels, the site was likely only of value for three-spined stickleback. No white-clawed crayfish were recorded and none were known from river. The site was not of value to otter.

Biological water quality, based on Q-sampling, was calculated as **Q2-3** (**poor status**) (**Appendix A**). There was no contemporary EPA biological water quality monitoring data available for the River Poddle (Q3, (poor status) recorded at station RS09P030400 in 2007 only).

Site P1 was found to have low fisheries value and poor water quality, and of low overall aquatic ecological value.

Plate 3.12 Representative image of site P1 on the upper reaches of the River Poddle (heavily scrubbed-over, facing upstream to road crossing)

3.3 Fisheries habitat

3.3.1 Salmonid habitat

Salmonid habitat ranged from moderate to excellent value across the majority of riverine survey sites (**Table 3.1**). Sites O1 and O2 (Owendoher River), D1 (River Dodder) and C2 (River Camac) offered excellent quality habitat based on Life Cycle Unit scores (i.e. combinations of nursery, spawning and holding habitat). Sites T1 and T3 (River Tolka) and O3 (Owendoher River) provided good quality salmonid habitat. Moderate quality habitat was present at sites T2 (River Tolka) and C1 (River Camac). Site P1 on the River Poddle offered poor water quality and poor salmonid habitat overall (in fact, salmonids were likely not present). Site RC1 on the Royal Canal was not assessable using Life Cycle Unit scores (lacustrine environment) although brown trout are known occasionally from the Royal Canal (pers. obs.).

Table 3.1 Life Cycle Unit scores for salmonid habitat at the sites surveyed for the BusConnects project, Dublin City, September 2020.

Site no.	Salmonid habitat value	Spawning	Nursery	Holding	Total score
T1	Good	3	3	2	**8**
T2	Moderate	4	3	2	**9**
T3	Good	2	2	2	**6**
RC1	n/a – canal habitat	n/a	n/a	n/a	**n/a**
O1	Excellent	1	2	2	**5**

Site no.	Salmonid habitat value	Spawning	Nursery	Holding	Total score
O2	Excellent	1	2	1	**4**
O3	Good	2	2	2	**6**
D1	Excellent	1	2	2	**5**
C1	Moderate	3	3	3	**9**
C2	Excellent	2	2	1	**5**
P1	Poor	4	4	4	**12**

3.3.2 Lamprey habitat

Lamprey habitat ranged from poor to good quality across the survey sites (Table 3.2). Only sites T1 (River Tolka) and C2 (River Camac) offered combinations of good quality spawning and ammocoete habitat. The majority of sites provided moderate quality habitat, generally due to a lack of suitable ammocoete burial habitat (i.e. soft sediment areas). Site P1 on the River Poddle featured poor quality lamprey habitat with little if any potential for *Lampetra* species. The Royal Canal site (RC1) was not suitable for lamprey species given the lacustrine-like environment present.

Table 3.2 Lamprey Habitat Quality Index (LHQI) scores at the sites surveyed for the BusConnects project, Dublin City, September 2020.

Site no.	Lamprey habitat value	Spawning	Nursery	Total score
T1	Good	2	3	**5**
T2	Moderate	3	4	**7**
T3	Moderate	2	4	**6**
RC1	Canal site, habitat unsuitable for lamprey			**n/a**
O1	Moderate	2	4	**6**
O2	Moderate	2	4	**6**
O3	Moderate	3	4	**7**
D1	Moderate	2	4	**6**
C1	Moderate	3	3	**6**
C2	Good	2	2	**4**
P1	Poor	4	4	**8**

3.3.3 European eel habitat

European eel habitat ranged from moderate to good across the majority of survey sites. In general, surveys sites on the larger, more lowland depositing watercourses such as the River Dodder and Tolka provided the better-quality eel habitat (i.e. greater frequency of instream refugia, better prey resources, greater proportion of deeper glide/pools etc.). The Royal Canal at site RC1 provided particularly good European eel habitat. Instream barriers to eel migration are known for the River Camac and distribution within the Camac is therefore restricted (Triturus, 2020). The Owendoher sites (O1, O2 and O3) provided some moderate eel habitat given the presence of undercut banks and boulder refugia although the high-energy nature of the survey sites was better suited to salmonids than eel. European eel are not known from the River Poddle (Aquafact, 2020), where the small size and modified nature of the watercourse reduced eel (and overall fisheries) habitat quality.

3.4 White-clawed crayfish

White-clawed crayfish were only recorded from sites C1 and C2 on the River Camac during the survey period (via sweep sampling), aligning with the known distribution of the species in the wider study area (i.e. only known from the River Camac and selected tributaries). There were no historical records available for the River Tolka, Dodder, Owendoher or Poddle despite some good physical habitat suitability. Whilst crayfish are known from the western extent of the Royal Canal (near Mullingar, NBDC data), there were no records available for the Dublin City or survey area, and none were recorded from survey site RC1, despite some good habitat suitability.

3.5 Biological water quality

Q-samples were collected and analysed from the *n*=10 riverine survey sites, in addition to a sweep sample taken from site RC1 on the Royal Canal. A total of *n*=35 species across *n*=29 families were recorded in the riverine kick samples, with *n*=12 species across *n*=12 families recorded rom site RC1 on the Royal Canal. A summary of results and detailed species compositions per sample are provided in **Appendix A** and **Appendix B**.

Following the methodology of Toner et al. (2005), the Environmental Protection Agency (EPA) group invertebrates into classes whereby pollution intolerant species are denoted class A, and species with greater pollution tolerance fall into successive classes (B through E, respectively). As such, the presence or absence of these groups and their relative abundance facilitates an assessment of biological river health. Good status (Q4) unpolluted water quality is achieved according to the EPA if at least one Group A taxon is present in, at least, fair numbers (5-10% total sample composition). Group B taxa may be common or absent and *Baetis rhodani* (large dark olive mayfly) is often dominant. Other Group C taxa are never excessive and group D / E taxa are present in small numbers or absent (Toner et. al., 2005). Our results are discussed in this context in order to interpret potential changes in the macroinvertebrate community composition.

The majority of the survey sites achieved a Q-rating of **Q3 (poor status**) given the absence of EPA group A (clean water indicators) and or low numbers of EPA group B (also clean water indicators) with a dominance of class C species (moderate water quality indicators). The River Poddle had

the lowest water quality being denoted as **Q2-3 (poor status),** i.e. intermediate between Q2 (bad status) and Q3 (poor status) due to the predominance of poor water quality indicator molluscan fauna and *Asellus aquaticus* (see **Appendix A**). The Owendoher River had the best water quality of the survey sites with **Q3-4 (moderate status**) water quality recorded. This was due to the presence of small numbers of group A (clean water indicator Heptageniidae mayflies) and low numbers of poor water quality indicator species in the sample composition (see **Appendix A**).

The Royal Canal sample, which was not suitable for EPA Q-analysis being a canal sample, did not support any rare invertebrate species based on national red lists (see **Appendix B**). A synopsis of the distribution of rare molluscan fauna known from the Royal Canal is provided in the discussion.

3.6 Aquatic ecological evaluation

An evaluation of each aquatic survey site was based on the results of the aquatic surveys, and are summarised in table **3.3 below**. All of the aquatic survey sites were considered of good overall quality, with the exception of the Royal Canal and River Poddle which featured at either end of the spectrum; the Poddle being of very limited habitat value and the Canal featuring some high value habitats and rare and protected species (rare macrophytes & molluscan fauna). Overall, the majority of sites sampled exhibited the presence of moderate to good salmonid, lamprey and European eel habitat, as well as the presence of Annex II otter at some sites. Furthermore, the River Camac supported an Annex II white-clawed crayfish population at both survey sites. Site P1 on the River Poddle was classed as of low fisheries value and poor water quality (i.e. Q2-3) but is known to support otter in its downstream reaches, in the vicinity of Tymon Park. The Royal Canal, falling within a pNHA designation (site code: 002103), is considered of national importance. This evaluation is supported by the fact that the Royal Canal supports rare macrophytes, rare molluscan fauna and otter populations. The Royal Canal is also an important coarse fishery resource, in addition to supporting European eel populations.

Table 3.3 Evaluation summary of the aquatic survey sites (according to NRA, 2009 guidelines)

Site no.	Watercourse	EPA code	Rationale summary
T1	River Tolka	09T01	Moderate salmonid & European eel habitat; good lamprey habitat; utilised by otter. Q3 (poor status) biological water quality.
T2	River Tolka	09T01	Moderate salmonid, lamprey & European eel habitat; utilised by otter. Q3 (poor status) biological water quality.
T3	River Tolka	09T01	Good salmonid & European eel habitat; moderate lamprey habitat; utilised by otter; invasive Himalayan balsam recorded. Q3 (poor status) biological water quality.
RC1	Royal Canal	n/a	High coarse fish value, European eel habitat, otter habitat, rare macrophytes & molluscan fauna. Situation with Royal Canal pNHA (site code: 002103).
O1	Owendoher River	09O01	Excellent salmonid habitat, moderate lamprey habitat & moderate European eel habitat; high otter potential; invasive Japanese knotweed recorded. Q3-4 (moderate status) biological water quality.
O2	Owendoher River	09O01	Excellent salmonid habitat, moderate lamprey habitat & moderate European eel habitat; high otter potential. Q3-4 (moderate status) biological water quality.
O3	Owendoher River	09O01	Good salmonid habitat, moderate lamprey habitat & moderate European eel habitat; high otter potential with a potential holt identified in close vicinity; invasive three-cornered garlic recorded. Q3-4 (moderate status) biological water quality.
D1	River Dodder	09D01	Excellent salmonid habitat; good otter potential. Q3 (poor status) biological water quality.
C1	River Camac	09C02	Moderate salmonid habitat, moderate lamprey habitat; low densities of Annex II white-clawed crayfish present. Q3 (poor status) biological water quality.
C2	River Camac	09C02	Excellent salmonid habitat (particularly upstream of culvert), good lamprey habitat (particularly upstream of culvert); healthy population of Annex II white-clawed crayfish present throughout. Q3 (poor status) biological water quality.
P1	River Poddle	09P03	Low fisheries value and poor water quality (Q2-3, poor status).

4. Concluding Comments

4.1 Most valuable sites for aquatic ecology

In terms of aquatic ecological evaluation, the majority of survey sites all of the sites were evaluated as being of relatively good habitat quality, with the exception of the River Poddle and Royal Canal. This was based on either the known presence of salmonids, moderate to good quality salmonid habitat; moderate to good lamprey and European eel habitat; utilisation by otter as inferred by sign marking (i.e. sites T1, T2, T3, O2 & O3) and or the presence of white-clawed crayfish (i.e. sites C1 & C2 on the River Camac).

Sites O1 and O2 (Owendoher River), D1 (River Dodder) and C2 (River Camac) offered the best quality salmonid habitat (based on Life Cycle Unit scores). Only sites T1 (River Tolka) and C2 (River Camac) offered combinations of good quality lamprey spawning and ammocoete habitat. The remaining survey areas ranged from poor to moderate with regards lamprey habitat evaluation.

Site C2 on the River Camac (Nangor Road) supported moderate densities of crayfish (i.e. total of n=*8* crayfish equating to 'moderate' density per 10 refugia, according to Peay, 2003). The upstream extent of site C2 also provided among the best quality salmonid habitat observed along the River Camac catchment based on extensive knowledge of the catchment (pers. obs.). The River Camac is the last stronghold of crayfish in the wider Dublin City area and is now likely to be the last city in Ireland with an extant crayfish population given plague (*Aphanomyces astaci*) outbreaks in the Suir, Nore and Shannon catchments. Whilst site C1 on the Camac (approx. 0.8km upstream of C2) also supported white-clawed crayfish, densities were evidently very low (*n*=2 recorded) given a lack of suitable habitat (more compacted bed and modified banks). Nevertheless, in an overall context, the River Camac represents a highly valuable urban habitat for salmonids (including Atlantic salmon in the lower reaches; Triturus 2020 unpublished data), otter and white-clawed crayfish and should be protected from potential impacts as a result of the proposed BusConnects development.

The Owendoher River supported good to excellent salmonid habitat at the survey sites (O1, O2 & O3), as well as moderate status water quality (Q3-4) thus being of better status than the majority of Dublin's waterbodies that are typically of Q3 (poor status) (pers. obs.). The Owendoher is also one of the better otter habitats in Dublin City (Macklin et al. 2019) with a potential otter holt (and couch) identified along the west bank, approx. 75m downstream of the road bridge (ITM 714135, 728929). The Owendoher River also supported the IUCN endangered mayfly species, *Ephemerella notata* based on historical records (Kelly-Quinn & Regan, 2012). The species was not recorded during the current survey and its current status within the river remains unknown. The species has undergone significant declines in its range being formerly well distributed in the Liffey and Dodder catchments. All three aquatic survey sites on the Owendoher (O1, O2 & O3) were evaluated as being of good overall habitat quality. As for the Camac outlined above, the importance of the Owendoher for sensitive aquatic receptors such as salmonids and otter in an urban context should not be understated. Urban encroachment and fragmentation of the river corridor are considered a serious threat to the river.

The River Poddle at site P1 (the uppermost reaches of the river) evidently suffered from water quality impacts including siltation (Q2-3, 'poor status') and provided very poor fisheries habitat, likely only of value for three-spined stickleback. The Poddle is not a recognised salmonid watercourse according to Inland Fisheries Ireland (Nicholas O'Dwyer, 2020) and is one of the most heavily modified river channels in Dublin City. The site offered little suitability for otter given its small size, modified nature and poor water quality. However, otter are known downstream in the vicinity of Tymon Park, approx. 2km downstream of site P1 (Macklin et al., 2019). Site P1 was considered of poor overall habitat quality due to the degraded nature of the habitat and water quality.

The site on the Royal Canal (RC1) was considered a very important biodiversity corridor; supporting otter populations, rare molluscan fauna and the nationally rare macrophyte species opposite-leaved pondweed (*Groenlandia densa*) and tassel stonewort (*Tolypella intricata*).

No rare or threatened macrophytes were recorded during the current survey of the riverine sites or the Royal and Grand Canal sites. However, the rare pondweed species opposite-leaved pondweed (*Groenlandia densa*) was recorded in several sections of the Royal Canal (1st to 4th levels, inclusive) during a survey conducted in 2011 (BEC, 2011). The species is legally protected and is listed on Schedule A of the Flora Protection Order (S.I. No. 356/2015). Survey site RC1 was located in the 4th level (i.e. between the 4th and 5th locks) but no opposite leaved pondweed was recorded during the site visit. Detection in deep water sites like the Royal Canal can be difficult for this species and it is considered likely that the species is still present in this location.

The rare stonewort species, tassel stonewort (*Tolypella intricata*) has been recorded historically from the Royal Canal between Cross Gun's Bridge (5th lock) and Granard Bridge (near 12th lock), with records from 1992 (Nash & King, 1993). The species was recorded typically within 1m metre from the bank growing in silt in 0.5m water depth (Nash & King, 1993). The species was not recorded during the current 2020 survey between the 4th and 5th locks of the Royal Canal. The survey area at Phibsborough typically had water between 1.5m and 2.5m deep and thus may be unsuitable for the species.

Rare and or declining aquatic molluscan fauna have been recorded in the Royal Canal including the whirlpool ramshorn snail (*Anisus vortex*), an IUCN vulnerable species and the pygmy pea Shell (*Pisidium moitessierianum*), an IUCN endangered species (Byrne et al., 2009). The closest whirlpool ramshorn snail and pygmy pea shell records were in the Moyvalley area east of Dublin City (NBDC data, accessed 3rd December 2020). A second ICUN endangered bivalve, the false orb pea mussel (*Pisidium pseudosphaerium*) is also known from the Royal Canal from data collected by Moorkens & Killeen (2005) (Byrne et al., 2009). The nearest record for the species was also recorded from the Leixlip area (NBDC data, accessed 3rd December 2020). The ICUN endangered glutinous snail (*Myxas glutinosa*) (Byrne et al. 2009) also occurs within the Royal Canal according to data collected by Moorkens & Killeen (2005), with the nearest records from the St. Catherine's Park area (NBDC data). Records for the known rare aquatic molluscan fauna on the Royal Canal are all east of the study area (i.e. not in the 4th level of the canal).

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6. Appendix A – Q-samples

Group	Family	Species	Tolka (T1)	Tolka (T2)	Tolka (T3)	Owendoher (O1)	Owendoher (O2)	Owendoher (O3)	Dodder (D1)	Camac (C1)	Camac (C2)	Poddle (P1)	EPA Group
Mayfly	Heptageniidaee	*Ecdyonurus venosus*				1							A
Mayfly	Heptageniidaee	*Rhithrogena semicolorata*				11	9	8					A
Mayfly	Baetidae	*Baetis rhodani*	11	14	8	21	27	31	19	47	38	11	C
Stonefly	Leuctridae	*Leuctra hippopus*						2					B
Stonefly	Leuctridae	*Leuctra inermis*							3				B
Cased caddis	Odontoceridae	*Odontocerum albicorne*						2					B
Cased caddis	Seracostomatidae	*Sericostoma personatum*				2	2	3					B
Cased caddis	Limnephilidae	*Limnephilus marmoratus*								2			B
Cased caddis	Limnephilidae	*Halesus* sp.					1						B
Caseless caddis	Ryacophilidae	*Ryacophila dorsalis*	2	1		1	1			1	3		C
Caseless caddis	Hydropsychidae	*Hydropsyche siltalai*	3	9	5		2						C
Caseless caddis	Hydropsychidae	*Hydropsyche pellucidula*						2					C
Caseless caddis	Hydropsychidae	*Hydropsyche* sp.							1				C
Caseless caddis	Polycentropodidae	*Polycentropus flavomaculatus*			3				1				C
Riffle beetle	Elmidae	*Limnius volckmari*				3		3	2				C
Riffle beetle	Elmidae	*Elmis aenea*							1				C
Bivalve	Sphaeriidae	*Sphaerium corneum*		1						2	1		C
Limpet	Ancylidae	*Ancylus fluviatilis*		2		2			4	1			C
Snail	Hydrobiidae	*Potamopyrgus antipodarum*	2	1	19				3	3	31	71	C
Snail	Lymnaeidae	*Radix balthica*	1	4	7		1			1	4		D
Snail	Valvatidae	*Valvata piscinalis*		2	5								C
Shrimp	Gammaridae	*Gammarus duebenii*			48	17	15	11		201	45	5	C

Group	Family	Species	Tolka (T1)	Tolka (T2)	Tolka (T3)	Owendoher (O1)	Owendoher (O2)	Owendoher (O3)	Dodder (D1)	Camac (C1)	Camac (C2)	Poddle (P1)	EPA Group
Hoglouse	Asellide	*Asellus aquaticus*	12	18	21	1				5		34	D
Black fly	Simuliidae	*Prosimulium* sp.		1		2				42	14		C
Non-biting midge	Chironomidae	*Chironomus riparius*								1		1	E
Non-biting midge	Chironomidae	*not speciated*										1	C
Cranefly	Tipulidae	*Tipula* sp.	1	2	1					1			C
Cranefly	Pediciidae	*Dicranota* sp.				2	4		1				C
Leech	Glossiphonidae	*Glossiphonia* sp.								3		8	D
Leech	Erpobdellidae	*Erpobdella* sp.	4	2	1		1		1			3	D
Leech	Pisciolidae	*Pisciola geometra*				1							C
Aquatic worm	Tubificidae	*Limnodrilus hoffmeisteri*					1					1	E
Aquatic worm	Lumbricidae	*Eiseniella tetraedra*									1		n/a
Aquatic worm	Lumbriculidae	*Lumbriculus variegatus*		1							1		n/a
Water mite	Hydrachnidiae	not speciated					2						C
Taxon richness (n)			8	13	10	12	12	8	10	13	9	9	
Q-rating			Q3	Q3	Q3	Q3-4	Q3-4	Q3-4	Q3	Q3	Q3	Q2-3	
WFD status			Poor	Poor	Poor	Moderate	Moderate	Moderate	Poor	Poor	Poor	Poor	

7. Appendix B – Royal Canal macro-invertebrate sample

Taxon	Family	Binomial name	Royal Canal (RC1)
Coleoptera	Noteridae	*Noterus crassicornis*	1
Mollusca	Lymnaeidae	*Radix baltica*	2
Mollusca	Bithnyiidae	*Bithynia tentaculata*	22
Mollusca	Physidae	*Physa fontinalis*	3
Mollusca	Planorbidae	*Planorbis planorbis*	14
Mollusca	Sphaeriidae	Not speciated	15
Trichoptera	Limnephilidae	*Limnephilus marmoratus*	6
Isopoda	Asellidae	*Asellus aquaticus*	49
Hirudinidae	Erpobdellidae	*Erpobdella testacea*	1
Hirudinidae	Glossiphoniidae	*Glossiphonia complanta*	1
Arachnida	Hydrachnidiae	not speciated	1
Diptera	Chironomidae	not speciated	2
		Taxon richness (n)	**12**

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