



Canal Bridge Project

Natura Impact Statement

January 2021

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1 Introduction

1.1 Overview

Limerick City and County Council proposes the construction of a new bridge crossing of the Park Canal, in Limerick. The proposed crossing is aimed at improving the pedestrian, cyclist and vehicle crossing facilities of the canal. Currently, the canal is crossed between Canal Bank Road and the Lower Park Road by the existing Park Bridge. Park Bridge is a single span masonry arch bridge which was constructed circa 1760 (humpback masonry deck was replaced with a steel-concrete composite deck during the 1960's). The existing bridge is narrow, allowing only a single vehicle to cross in either direction at any one time. The existing bridge is a shared crossing for pedestrian, cyclist and vehicular movements. There is a 3-ton weight restriction on the bridge. This current arrangement has limited capacity and the separation of vehicular traffic from pedestrians is sought.

1.2 Requirement for Appropriate Assessment

Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive) is European Community legislation regarding nature conservation. The intention of the Directive is to aim to ensure biodiversity through the conservation of natural habitats and wild fauna and flora in Europe. The Habitats Directive is transposed into Irish law by the European Communities (Birds and Natural Habitats) Regulations 2011, as amended and the Planning and Development Act 2000, as amended.

The Habitats Directive requires that where a plan or project is likely to have a significant effect on a European site, while not directly connected with or necessary to the nature conservation management of the site, it will be subject to 'Appropriate Assessment' to identify any implications for the European site in view of the site's Conservation Objectives. Specifically, Article 6(3) of the Habitats Directive states:

"Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public".

Mott MacDonald Ireland Ltd. prepared a report for screening for Appropriate Assessment (document number: 229100314-101-B) which examined the potential for the project to have significant effects on European sites. The screening report concluded a potential for the proposed project to result in significant effects on the Lower Shannon SAC (002165) and Shannon and River Fergus and River Shannon Estuaries SPA (004077). Thus, the requirement of Article 6(3) of the Habitats Directive applies, and an Appropriate Assessment is required.

An Appropriate Assessment, as carried out by the Competent Authority (in this case an Board Pleanála), is a detailed assessment of the impacts of a plan or project (either alone or in combination with other projects or plans) on European sites to determine whether the impacts could have an adverse effect on the integrity of the European sites. The integrity of a European sites is defined by the conservation objectives of the site and its structure and function.

This Natura Impact Statement (NIS) has been produced to inform the competent authority in carrying out their Appropriate Assessment of the proposed project. The NIS considers in greater detail those elements of the proposed project which have been identified through the screening assessment as having potential for significant effects on European sites, and further examines the implications of the project on the integrity of the European sites with respect to the site's conservation objectives. Where adverse impacts on a European site's integrity are identified, mitigation measures are prescribed to avoid these impacts or reduce them to a level where they will no longer adversely affect the integrity of the site.

1.3 Assessment Methodology

This NIS has been prepared in accordance with all relevant guidance and legislation including:

- EC (2001) Assessment of plans and projects significantly affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC;
- EC (2007) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC: Clarification of the concepts of alternative solutions and imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the Commission;
- DEHLG (December 2009, revised February 2010) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities;
- EC (2018) Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive 92/43/EEC Commission Notice C (2018) 7621;
- European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011), as amended; and
- Court of Justice of the European Union (CJEU) and Irish Case Law pertaining to the Habitats Directive.

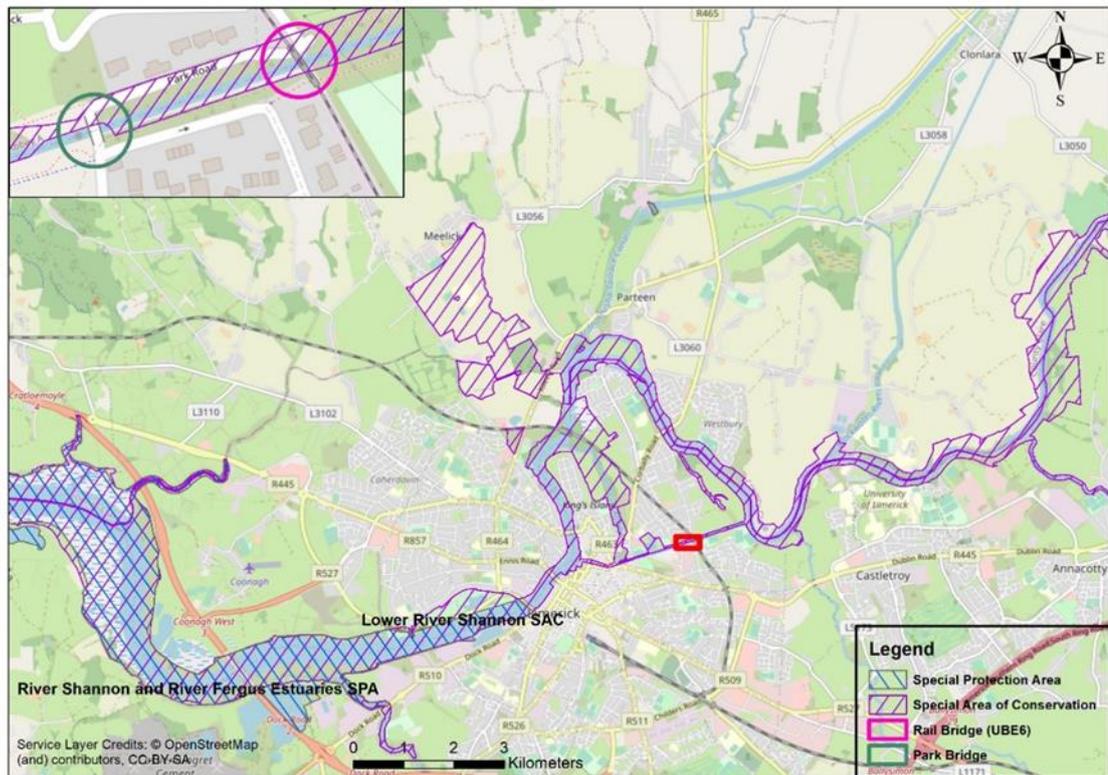
2 Project Characteristics

2.1 Project Location

Park Bridge is a single span masonry arch bridge which carries a local road over Park Canal in Limerick City. A new bridge is proposed to be constructed approximately 140m upstream of the existing bridge and will be situated parallel to the existing railway bridge crossing of the canal.

The Park Canal is part of the Lower River Shannon SAC (002165). The construction of the proposed new bridge crossing and associated local road improvements will require works on the bank of the canal and may require in-stream works. Therefore, the proposed project is located both within and immediately adjacent to the Lower River Shannon SAC. The River Shannon and River Fergus Estuaries SPA (004077) is ca. 2 km downstream (hydrological route) of the proposed bridge. The location of the works area relative to European sites is presented in Figure 2.1.

Figure 2.1: Proposed New Bridge Crossing and European Sites



Source: Open StreetMap

2.2 Baseline Description

Historical Records Within Park Canal

A desktop survey was carried out by Triturus Environmental Ltd as part of the aquatic assessment that was undertaken. Results are presented hereunder. The full report is provided in Appendix A.

Numerous historical and contemporary records exist for opposite leaved pondweed (*Groenlandia densa*) and triangular club rush (*Scirpus triqueter*) within the lower River Shannon and selected tributaries. A single historical record for the nationally rare plant species pennyroyal (*Mentha pulegium*), a short-lived perennial mint species which favours winter-inundated and marshy ground, was also available for the grid square. A single record was also available for meadow barley (*Hordeum secalinum*), a terrestrial species of dry alluvial grassland. All four species are listed as 'endangered' on the Irish Red-list (Curtis & McGough, 1988) and are protected under the Flora (Protection) Order, 2015 (S.I. No. 356/2015). None of these plants are known to occur in the study area with the exception of opposite leaved pondweed.

Opposite leaved pondweed is known from the northern bank of the River Shannon at the Shannon (New) Bridge, Dock Road Area (drainage channels) and from King's Island. The species is also known from the Park Canal. According to Reynolds et al. (2006), the species is known "near the River Shannon at its north-east end to the lock gates at its southwest end". This distribution is also reflected on the most recent records are documented by Ecofact (2011) from the confluence of the Park Canal with the Abbey River (i.e. western extent). The species is likely to be more widespread in the tidal stretches of the Shannon and other rivers, as well as in marginal ditches and drainage channels.

The growth and distribution of opposite-leaved pondweed in the lower River Shannon has been strongly associated with horned pondweed (*Zannichellia palustris*), water starworts (*Callitriche spp.*), water pepper (*Persicaria hydropiper*) and triangular club rush (*Schoenoplectus triqueter*) (Reynolds et al., 2006). In the Limerick Canal, opposite leaved pondweed is known to be associated with whorled water milfoil (*Myriophyllum verticillatum*) and *Callitriche spp.*, in addition to arrowhead (*Sagittaria sagittifolia*), stonewort species (*Chara spp.*), yellow water lily (*Nuphar lutea*), curled pondweed (*Potamogeton crispus*), broad-leaved pondweed (*Potamogeton natans*) and various fine leaved *Potamogeton* species (Reynolds et al., 2006). However, despite dedicated snorkel surveys the species was not identified within the study area (see survey results below) but is likely to occur at the confluence of the Park Canal with the River Shannon where most recent records for the species have been detected (Ecofact, 2011). Records are also available for otter (*Lutra lutra*) (including on the River Shannon, downstream of the Park Canal confluence).

Aquatic Assessment of Park Canal

Surveys of the Park Canal were carried out in June 2020 by Triturus Environmental Ltd. The survey divided the canal into three sections (Figure 2.2.). The footprint of the proposed development falls within section B. Results of the survey are presented below. The full survey report is provided in Appendix A.

Figure 2.2: Park Canal Survey Sections



Source: Triturus 2020

Survey Section A

The Park Canal at Richmond had steep V-shaped 10-12m embankments adjoining a U-shaped channel. The channel width was approximately 8-10m wide and between 2m and 3m deep. The water was very slow moving and turbid at the time of survey. The substrata were dominated by silt. The riparian composition comprised of semi mature and mature alder (*Alnus glutinosa*), grey willow (*Salix cinerea*) and hawthorn (*Crataegus monogyna*) with bramble (*Rubus fruticosus* agg.) and reed canary grass (*Phalaris arundinacea*) in the understories with frequent bulrush (*Typha latifolia*), great willowherb (*Epilobium hirsutum*), lesser pond sedge (*Carex acutiformis*), tufted vetch (*Vicia cracca*) and marsh horsetail (*Equisetum palustre*).

The macrophyte growth of section A in the Lower Park area/ Rebogoe area was dense, with pondweeds (*Potamogeton* species) and arrowhead (*Sagittaria sagittifolia*) being well represented. The macrophyte composition included frequent broad-leaved pondweed (*Potamogeton natans*) with the large pondweed shining pondweed (*Potamogeton lucens*) being locally frequent. The invasive pondweed *Elodea nuttalli* was recorded as occasional. Other species recorded included arrowhead *Sagittaria sagittifolia* that was abundant and most represented by the *heterophyllous* submerged strap-like form. Yellow water lily (*Nuphar lutea*) was also frequent with a proliferation of large submerged leaves given the higher turbidity of the canal. Blue water speedwell (*Veronica anagallis-aquatica*) was recorded locally in the margins. The duckweed species, ivy-leaved duckweed (*Lemna trisulca*) was abundant in submerged beds under pondweeds and arrowhead with the invasive duckweed (*Lemna minuta*) being more frequent floating in the margins of the canal. The margins of the canal supported locally

emergent bulrush (*Typha latifolia*) with small patches of branched bur reed (*Sparganium erectum*).

Despite a dedicated transect search by snorkelling, opposite leaved pondweed (*Groenlandia densa*) was not recorded in survey section A.

No fish were observed during the snorkelling survey apart from very small numbers of roach and a single adult sea lamprey (*Petromyzon marinus*) that was assumed to be returning back from spawning grounds on the River Shannon or Mulkear tributary (heavily marked head from spawning activity). While this was an unusual encounter it, nonetheless, illustrates that the Park Canal may be used by migratory fish species such as sea lamprey, albeit fish passage is poor given the presence of lock gates.

Survey Section B

The Park Canal between Park Bridge to Railway Bridge (i.e. Section B) had steep V-shaped 10-12m embankments adjoining a U-shaped channel. The channel width was approximately 10-12m wide and between 2m and 3m deep. The water was very slow moving and turbid at the time of survey and the substrata were dominated by silt. The riparian composition comprised of alder, white willow (*Salix alba*), grey willow and osier (*Salix viminalis*) with bramble and reed canary grass in the understories. The macrophyte composition of the Park Canal in survey section B area had lush macrophyte growth as with other survey sections within the canal basin. The macrophyte composition was most well represented by floating broad-leaved pondweed that was recorded as frequent with *Potamogeton lucens* being recorded as locally frequent, and whorled water milfoil (*Myriophyllum verticillatum*) was recorded as rare. Other species recorded included arrowhead which was recorded locally (occasional). Yellow water lily was also occasional. Blue water speedwell was recorded locally in the margins. Ivy-leaved duckweed was locally frequent in submerged beds along the canal littoral.

Despite a dedicated transect search by snorkelling, opposite leaved pondweed was not recorded in survey section B.

No fish species or crayfish were observed in section B during snorkelling. It is likely that the habitat would support coarse fish such as pike, perch and roach, albeit fish density was considered low overall.

Survey Section C

The Park Canal at Abbey Lock had gently sloping V-shaped 10-12m embankments adjoining a U-shaped canal channel. The channel width was approximately 8-10m wide with depths between 1.5m and 2.5m. The substrata comprised of sand, silt and fine gravels. The water was very slow moving and turbid (as with upstream) but evidently had a lower macrophyte diversity than upstream. This may have been because of historical drainage works. The riparian composition comprised of grey willow, crack willow (*Salix fragilis*), alder and other willow species with meadow sweet (*Filipendula ulmaria*), horsetail, bramble, nettle (*Urtica dioica*) and reed canary grass in the understories. Hemlock water dropwort (*Oenanthe crocata*) was present in the canal margins alongside reed sweet grass (*Glyceria maxima*). The macrophyte composition of the canal had frequent arrowhead dominated by the submerged form and occasional unbranched bur-reed (*Sparganium emersum*). Yellow water lily was also recorded as occasional. Blue water speedwell was recorded locally in the margins. Ivy-leaved duckweed was locally frequent in submerged beds along the canal littoral.

Despite a dedicated transect search by snorkelling, opposite leaved pondweed was not recorded in survey section C.

The bridge will be accessed using the existing road. All works will be carried out from road level. Site clearance of works areas will be necessary as part of the construction. Areas of canal bank will therefore be stripped of surface vegetation.

The works will require lane closures and traffic management. The Contractor's compound will likely be established within the areas of lane closure.

The works will be carried out over a 6-month period, commencing in October 2021.

Diversion of services (Eir, ESB and Irish Water) will be required to accommodate the works. This will be carried out by or under the supervision of the individual service providers.

A small shed on the western extent of the works area will require removal to accommodate road widening. A new boundary wall and garden landscaping will be completed in association with the shed removal.

Construction of new bridge

A works area will firstly be established by sheet piling along the edge of the canal bank for approximately 5m upstream and 5m downstream from the footprint of the proposed bridge. A hardstanding area for the piling rig will be set up at road level behind the existing northern and southern banks of the canal. Trees within the footprint of the works will be cut back to stump level. Sheet piles will then be installed flush within the canal bank. The piling works will be carried out from the banks. The piling will result in locally elevated noise levels, it will take approximately two to three weeks to complete.

Following the installation of the piles, the tree stumps and roots of the cut trees will be excavated. The canal banks behind the sheet piled area will then be excavated to accommodate the construction of the new towpaths and bridge abutments. Any surplus material which is excavated and not suitable for reuse on-site will be disposed of in accordance with waste legislation. Given the height and slope of the canal banks it is unlikely that there will be any groundwater pumping required, however, if pumping out of groundwater is required there is potential for it to result in surface water emissions.

Site clearance also has the potential to result in temporary dust emissions from the works area. Dust deposition can potentially affect plant photosynthesis and habitat quality (*Holman et al*, 2014).

Piles for the abutment will then be constructed behind the sheet piles. A temporary weekend road closure to the Lower Park Road will be put in place to accommodate the works.

Reinforcement and formwork for the abutments and wingwalls will then be erected. The abutments and wingwalls will be cast in situ. Concrete will be delivered to site by truck. The concrete will be allowed to fully cure, and shutters removed. The abutments and wingwalls will then be backfilled with granular material.

Temporary decking will be erected spanning the abutments. Formwork and reinforcement for the decking will be constructed. The deck of the bridge will then be cast in situ, and steel parapets installed. Following the construction of the parapets the deck will be waterproofed. This will be spray applied and, as it binds to the deck on contact, there will be no run-off. The waterproofing will be within the confines of the parapet edge beams and no spraying is required outside of the deck over the canal. Following the waterproofing, the temporary decking will be removed. An earth embankment will be installed to tie in the new bridge and existing road.

Construction of the towpaths, walkways, and cycle paths

The sheet piles will be cut down to the towpath level, and the towpaths installed. Trenches will be excavated on the south canal bank and the precast concrete crib wall footings will be installed. Modular crib walls will be erected along the cycle paths and where the road will then be widened. The crib wall structures will then be backfilled along with the retained area. Along the southern canal bank the existing road will be widened.

The south lane of the existing carriageway (Shown in Figure 2.3). adjacent to the rail bridge will be excavated. Cantilever walkway foundations will be cast within the existing roadway and backfilled to the reinstated road level. Steel beams will be connected to the buried foundations and cantilever cycle path decking will be constructed adjacent to the north railway bridge. The embankment adjacent to the road to the northeast of the proposed bridge will be excavated. Precast concrete foundations will then be installed along with a modular crib retaining wall. The wall will be backfilled with 6N granular material. Flexible surfacing will be installed to all walkway paths and to the cycle paths. Cycleway barriers will also be installed along all cycle paths.

Reinstatement and finishing

The carriageway along the north bank, and the bridge deck will be surfaced, and new road markings painted. Additional speed restriction bumps will be added to existing roads, along with vehicle restraint barriers and road signage. The traffic lights at Park Bridge will be removed, and traffic bollards positioned in place. The exposed fasciae of the crib walls will be seeded. Pre-seeded erosion matting will be installed in areas where vegetation was removed during the works.

The works are expected to have a duration of approximately six months. It is proposed that they will commence in October 2021.

Operational Phase

The proposed works consist of alterations of use to the existing Park Bridge, and the addition of a new bridge spanning the Park Canal adjacent to the existing railway bridge. The existing Park Bridge will be pedestrian and cyclist only, while the new bridge will carry cars, cyclists and pedestrian over the canal. The design life of the works is 120 years and any further alterations to the bridges will be subject to environmental assessment.

2.4 Impact Prediction

Direct Impact

Vegetation clearance along the banks has the potential to result in direct impact to habitats within or in close proximity to the footprint of the works.

Dust

The Institute of Air Quality Management 'Guidance on the Assessment of dust from demolition and construction' (Holman et al., 2014) outlines the potential dust emission risk classes to ecological receptors. The guidelines specify that, for highly sensitive ecological receptors, sensitivity to dust is 'High' up to 20m from the source and reduces to 'Medium' over 50m from the source. The generation of dust from the proposed works is considered to be of a small scale, and, therefore, 50m is taken as a worst-case zone of impact for dust impacts from the works.

Noise and Vibration

The proposed project will result in a temporary increase in noise due to machinery operation. Piling in particular is identified as likely to result in noise emissions. Disturbance due to noise varies between species and is dependent on the volume and nature of the noise source.

BS 5228-1:2009+A1:2014 prescribes typical noise level data for various construction plant and activities within 10m of the various sources. The inverse square law can then be applied to determine likely noise levels at varying distances from the proposed intake works (Table 2.1).

Table 2.1: Typical noise level data for various construction plant and activities

Plant Item	100m Distance	200m Distance	300m Distance
Rock Breaking (excavator and crusher)	73 dB	65 dB	61 dB
Compactor rammer	57 dB	49 dB	45 dB
Tracked excavator	55 dB	47 dB	43 dB
Earthworks (Dozer)	63 dB	55 dB	51 dB
Dump truck (empty)	65 dB	57 dB	53 dB
Road planer	59 dB	51 dB	47 dB
Asphalt paver	54 dB	46 dB	42 dB
Spreading chipping/fill (dozer)	59 dB	51 dB	47 dB
Trenching	54 dB	46 dB	42 dB
Vibratory roller	61 dB	53 dB	49 dB
Hand held circular saw	64 dB	56 dB	52 dB
Sheet piling rig	65 dB	57 dB	53 dB
Pumping water	42 dB	34 dB	30 dB
All above	75 dB	68 dB	64 dB

Source: BS 5228-1:2009+A1:2014

Lighting

The area is currently lit by existing street lighting which is currently not cowled away from the river channel. The design of the improvement scheme will cowl light away from the river channel and will not result in any surplus lighting in the area. No impacts are anticipated as a result of lighting effects.

Surface Water Runoff

There is potential for run-off associated with the works. This may contain cement fines, hydrocarbon and sediment laden waters.

3 In-Combination Effects

Article 6(3) of the Habitats Directive requires that:

'Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives.'

It is therefore required that the potential impacts of the proposed development are considered in combination with any other relevant plans or projects. A search of the Limerick City and County Council planning database (<http://eplan.limerick.ie/searchtypes>), and the EIA portal (<https://www.housing.gov.ie/planning/environmental-assessment/environmental-impact-assessment-eia/eia-portal>) was undertaken to examine projects with potential for in combination effects. Applications which were made typically consisted of extensions and renovations to existing houses, and retention of existing developments. These are small scale developments which, due to their location do not have the potential to result in cumulative impacts in association with the proposed works. Other, larger planning applications are discussed hereunder:

Canal Bank Development

This development consists of a mixed-use development of build-to-rent apartments, student apartments, a café and 3 retail units, creche and management facilities building, and dwelling houses at Canal Bank, Pa Healy Road, Limerick city.

The application was refused permission by An Bord Pleanála (Case Ref: PL91.306541), the inspector's report outlined that significant effects to the Lower River Shannon SAC, and the River Shannon and River Fergus Estuaries SPA could not be ruled out, primarily due to a paucity of baseline information in relation to the qualifying interests associated with the sites.

This application may be re-submitted at a later stage. As part of this application the potential for effects to European sites will be re-examined.

Novelty ICAV Development (File no. 2025)

Novelty ICAV are seeking planning permission for the further development of an already partially constructed 7.96 hectares at a site at Singland which is located approximately 1.6km south-east of Park Bridge. The proposed development will include the construction of a mixed use residential, commercial and community development comprising of 245 residential units, 112 duplex units, 123 apartments and 1.12 hectares of public park and associated parking. A Natura Impact Statement (NIS) has been undertaken by Openfield Ecological Services for the proposed development and accompanies the planning application. Impacts identified from the NIS are in relation to sediment affecting the availability of Salmon spawning redds. Measures to prevent pollution during construction have been outlined in the NIS and include; following guidance from IFI, dedicated fuel storage areas and site staff training on pollution prevention measures. Considering the distance of the proposed residential development from Park Bridge and the proposed mitigation measures which will be implemented there is no potential for in-combination effects with the development under appraisal in this report.

4 Characteristics of the European Sites

As outlined in the Screening for Appropriate Assessment, the proposed works are located within the boundary of the Lower River Shannon SAC and have downstream hydrological connectivity to the River Fergus and River Shannon Estuaries SPA. No viable source pathway receptor links were identified to any other European sites.

4.1 Lower River Shannon SAC (002165)

The site synopsis for the Lower River Shannon SAC (002165) notes the following about the site:

“This very large site stretches along the Shannon valley from Killaloe in Co. Clare to Loop Head/ Kerry Head, a distance of some 120 km. The site thus encompasses the Shannon, Feale, Mulkear and Fergus estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick), the freshwater stretches of much of the Feale and Mulkear catchments and the marine area between Loop Head and Kerry Head. Rivers within the sub-catchment of the Feale include the Galey, Smearlagh, Oolagh, Allaughaun, Owveg, Clydagh, Caher, Breanagh and Glenacarneay. Rivers within the sub-catchment of the Mulkear include the Killeenagarrieff, Annagh, Newport, the Dead River, the Bilboa, Glashacloonaraveela, Gortnageragh and Cahernahallia.”

The qualifying interests for which the Lower River Shannon SAC is designated for are presented below in Table 4.1

Table 4.1: Qualifying Interests for Lower River Shannon SAC

Qualifying Interests (* Indicates priority habitats)	
Annex I Habitats	Annex II Species
Sandbanks which are slightly covered by sea water all the time [1110]	<i>Margaritifera margaritifera</i> (freshwater pearl mussel) [1029]
Estuaries [1130]	<i>Petromyzon marinus</i> (sea lamprey) [1095]
Mudflats and sandflats not covered by seawater at low tide [1140]	<i>Lampetra planeri</i> (brook lamprey) [1096]
Coastal lagoons [1150]	<i>Lampetra fluviatilis</i> (river lamprey) [1099]
Large shallow inlets and bays [1160]	<i>Salmo salar</i> (salmon) [1106]
Reefs [1170]	<i>Tursiops truncatus</i> (common bottlenose dolphin) [1349]
Perennial vegetation of stony banks [1220]	<i>Lutra lutra</i> (otter) [1355]
Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]	
Salicornia and other annuals colonising mud and sand [1310]	
Atlantic salt meadows (<i>Glauco-Puccinellietalia maritima</i>) [1330]	
Mediterranean salt meadows (<i>Juncetalia maritimi</i>) [1410]	
Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitricho-Batrachion</i> vegetation [3260]	
Molinia meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinion caeruleae</i>) [6410]	

Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]

4.2 River Fergus and River Shannon Estuaries SPA (004077)

The site synopsis for the River Fergus and River Shannon Estuaries SPA notes the following about the site:

“The estuaries of the River Shannon and River Fergus form the largest estuarine complex in Ireland. The site comprises the entire estuarine habitat from Limerick City westwards as far as Doonaha in Co. Clare and Dooneen Point in Co. Kerry. The site has vast expanses of intertidal flats which contain a diverse macroinvertebrate community, e.g. Macoma-Scrobicularia-Nereis, which provides a rich food resource for the wintering birds. Salt marsh vegetation frequently fringes the mudflats and this provides important high tide roost areas for the wintering birds. Elsewhere in the site the shoreline comprises stony or shingle beaches.”

The Special Conservation interests for which the River Fergus and River Shannon Estuaries SPA is designated for are presented below in Table 4.2

Table 4.2: Special Conservation Interests of the River Fergus and River Shannon Estuaries SPA

Special Conservation Interests as Outlined in NPWS

Cormorant (<i>Phalacrocorax carbo</i>) [A017]
Whooper Swan (<i>Cygnus cygnus</i>) [A038]
Light-bellied Brent Goose (<i>Branta bernicla hrota</i>) [A046]
Shelduck (<i>Tadorna tadorna</i>) [A048]
Wigeon (<i>Anas penelope</i>) [A050]
Teal (<i>Anas crecca</i>) [A052]
Pintail (<i>Anas acuta</i>) [A054]
Shoveler (<i>Anas clypeata</i>) [A056]
Scaup (<i>Aythya marila</i>) [A062]
Ringed Plover (<i>Charadrius hiaticula</i>) [A137]
Golden Plover (<i>Pluvialis apricaria</i>) [A140]
Grey Plover (<i>Pluvialis squatarola</i>) [A141]
Lapwing (<i>Vanellus vanellus</i>) [A142]
Knot (<i>Calidris canutus</i>) [A143]
Dunlin (<i>Calidris alpina</i>) [A149]
Black-tailed Godwit (<i>Limosa limosa</i>) [A156]
Bar-tailed Godwit (<i>Limosa lapponica</i>) [A157]
Curlew (<i>Numenius arquata</i>) [A160]
Redshank (<i>Tringa totanus</i>) [A162]
Greenshank (<i>Tringa nebularia</i>) [A164]
Black-headed Gull (<i>Chroicocephalus ridibundus</i>) [A179]
Wetland and Waterbirds [A999]

5 Potential for Impact to European Sites

5.1 Lower River Shannon SAC (002165)

Having regard to the potential impacts as identified in section 2.4, the potential for effects to qualifying interests for which the Lower River Shannon SAC (002165) is designated in relation to physical changes, and to emissions are discussed below in Table 5.1.

Table 5.1: Potential for effects on Qualifying Interests

Feature of Interest	Potential for Effects	Likely Impacts
Sandbanks which are slightly covered by sea water all the time [1110]	<p>Sandbanks have been recorded and mapped as part of the conservation objectives. The habitat occurs only in the western extent of SAC in the mouth of the estuary. The nearest extent of this habitat to the proposed works is located approximately 76km (straight line) from park Bridge.</p> <p>Given the distance between the proposed works area and the protected habitat, there is no potential for impact.</p>	No likely impact identified
Estuaries [1130]	<p>Estuaries have been mapped as part of the conservation objectives. The closest extent of this habitat to Park Bridge is located approximately 700m from the works.</p> <p>The proposed works will not result in any direct impact to Estuarine habitat. There is potential for sediment laden surface run off associated with the works to enter into the habitat. The slow flowing waters within the canal will result in any sediment within the surface water run-off settling. Further, estuarine habitats are associated with a high degree of sediment as part of their natural processes. As such the addition of sediment to the habitat will not result in a significant impact to the habitat. There will therefore be no impact to Estuaries as a result of the proposed works.</p>	No likely impact identified
Mudflats and sandflats not covered by seawater at low tide [1140]	<p>Mudflats and sandflats have been mapped within the SAC as part of the conservation objectives. The closest extent of the habitat to the proposed works is located approximately 2km to the west of Park bridge.</p> <p>The proposed works will not result in any direct impact to mud flat and sand flat habitat. The</p>	No likely impact identified

	<p>slow flowing waters within the canal will result in any sediment within the surface water run-off settling. Given the distance between Park bridge and the habitat any sedimentation associated with the works will have dissipated prior to entering the habitat.</p> <p>There will therefore be no impact on Mudflats and Sandflats as a result of the proposed works.</p>	
Coastal lagoons [1150]	<p>Coastal lagoons have been mapped as part of the conservation objectives for the site. The closest extent of this habitat to park bridge is located 21km to the west of the works.</p> <p>Given the distance between Park Bridge and Coastal Lagoon habitat, there is no potential for impact on the habitat.</p>	No likely impact identified
Large shallow inlets and bays [1160]	<p>Large shallow inlets and bays have been mapped as part of the conservation objectives. The habitat occurs in the western extent of the SAC. The closest area of shallow inlets and bays to Park bridge is located approximately 60km west of the works.</p> <p>Given the distance between the habitat and Park bridge, there is no potential for impact on the habitat.</p>	No likely impact identified
Reefs [1170]	<p>Reef habitat has been mapped as part of the conservation objectives for the site. The habitat occurs throughout the coastal part of the SAC fringing the coastline. The closest area of reef is located approximately 11.5km to the west of Park bridge.</p> <p>Given the distance between the habitat and Park Bridge there is no potential for impact on the habitat.</p>	No likely impact identified
Perennial vegetation of stony banks [1220]	<p>Perennial vegetation of stony banks is a coastal habitat associated with stony beaches. The habitat has been mapped as part of the conservation objectives. The closest record for this habitat is located approximately 57km to the west of Park Bridge.</p> <p>Given the distance between the habitat and Park bridge there is no potential for impact on the habitat.</p>	No likely impact identified

<p>Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]</p>	<p>Vegetated sea cliffs have been mapped within the SAC as part of the conservation objectives. The habitat is associated with the western end of the SAC. The closest extent of this habitat to Park bridge is located approximately 52km from the works.</p>	<p>No likely impact identified</p>
<p>Salicornia and other annuals colonising mud and sand [1310]</p>	<p>Given the distance between the habitat and Park bridge there is no potential for impact on the habitat.</p> <p>Salicornia and other annuals colonising mud and sand were mapped as part of the Saltmarsh Monitoring Project (McCorry and Ryle, 2009).</p> <p>The closest extent of this habitat to Park bridge is located approximately 50km to the west of the works. On the basis of distance there is no potential for impact as a result of the works.</p>	<p>No likely impact identified</p>
<p>Atlantic salt meadows (<i>Glauco-Puccinellietalia maritima</i>) [1330]</p>	<p>Atlantic Salt Meadows were mapped as part of the Saltmarsh Monitoring Project (McCorry and Ryle, 2009).</p> <p>The closest extent of this habitat to Park bridge is located approximately 9km to the west of the works. On the basis of distance there is no potential for impact as a result of the works.</p>	<p>No likely impact identified</p>
<p>Mediterranean salt meadows (<i>Juncetalia maritimi</i>) [1410]</p>	<p>Mediterranean salt meadows were mapped as part of the Saltmarsh Monitoring Project (McCorry and Ryle, 2009).</p> <p>The closest extent of this habitat to Park bridge is located approximately 9km to the west of the works. On the basis of distance there is no potential for impact as a result of the works.</p>	<p>No likely impact identified</p>
<p>Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitricho-Batrachion</i> vegetation [3260]</p>	<p>Watercourses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitricho-Batrachion</i> vegetation has been mapped within the SAC as part of the conservation objectives supporting document. The mapping is based on a report by Reynolds <i>et al.</i> (2006) which recorded opposite leaved pondweed in eight locations along the entire length including at park bridge itself. There were no records at the location of the proposed new bridge.</p> <p>A follow up survey of the same location by Reynolds (2009) did</p>	<p>Potential for impact identified</p>

	<p>not record opposite leaved pondweed within the canal.</p> <p>The aquatic survey carried out by Triturus Environmental Ltd did not identify any floating river vegetation within the footprint, or immediately downstream of the proposed development. As such, there is no potential for direct impact to the habitat.</p> <p>There is potential, however for the habitat to occur downstream for the survey area. As such, having regard to the precautionary principal, the potential for significant effects is identified.</p>	
<p>Molinia meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinion caeruleae</i>) [6410]</p>	<p>The habitats at Park Canal do not constitute Molinia meadows. As such, there is no potential for direct impact to same.</p> <p>Molinia meadows were mapped as part of the Semi Natural Grassland Survey (O'Neill <i>et al.</i> 2013). The closest extent of this habitat to Park bridge is located approximately 9km to the north-east of the works.</p> <p>On the basis of distance there is no potential for impact as a result of the works.</p>	<p>No likely impact identified</p>
<p>Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i>, <i>Alnion incanae</i>, <i>Salicion albae</i>) [91E0]</p>	<p>Alluvial woodland was mapped as part of the National Survey of Native Woodlands (Perrin <i>et al.</i> 2008). The habitats at Park bridge do not constitute Alluvial woodland.</p> <p>The closest extent of this habitat to Park Bridge is located approximately 6km to the north east of the works. On the basis of distance there is no potential for impact to alluvial woodland as a result of the works.</p>	<p>No likely impact identified</p>
<p><i>Margaritifera margaritifera</i> (Freshwater Pearl Mussel) [1029]</p>	<p>Freshwater pearl mussel catchments have been mapped as part of the conservation objectives for the SAC.</p> <p>Park bridge is not located within any freshwater pearl mussel catchments. The nearest freshwater pearl mussel catchment to the park bridge is approximately 34km to the west. Given the location of the works in relation to the pearl mussel catchments, there is no potential for impact to freshwater pearl mussel as a result of the proposed works.</p>	<p>No likely impact identified</p>

<i>Petromyzon marinus</i> (sea lamprey) [1095]	The aquatic assessment of the site notes that the still water of the Park Canal near to park bridge is unlikely to support lamprey ammocoetes that favour flowing water.	Potential for impact identified
<i>Lampetra planeri</i> (brook lamprey) [1096]		Potential for impact identified
<i>Lampetra fluviatilis</i> (river lamprey) [1099]	The record of the single individual (species unidentified) during the survey indicates that migration of individuals through the canal can occur, at least on occasion. As such, there is potential for impact to lamprey species associated with the proposed development.	Potential for impact identified
<i>Salmo salar</i> (salmon) [1106]	No salmon, or suitable spawning habitat for salmon were recorded during the aquatic assessment. There is potential, however, for the species to occur within the canal at least on occasion. As such, having regard to the precautionary principal, the potential for impact to salmon is identified.	Potential for impact identified
<i>Tursiops truncatus</i> (common bottlenose dolphin) [1349]	Habitat suitable for Bottlenose Dolphin has been mapped as part of the conservation objectives for the SAC. Suitable habitat extends upstream as far as Coonagh nature park, Limerick. The closest extent of this habitat is located approximately 6.5km to the west of Park bridge. On the basis of distance there is no potential for impact on bottlenose dolphin as a result of the proposed works.	No likely impact identified
<i>Lutra lutra</i> (otter) [1355]	The national biodiversity data centre holds records of otter in the vicinity of park bridge. The ecological surveys found no evidence of otters within the works areas. However, given the historical records in the area it is likely that otters commute through the canal at least on occasion. As such, having regard to the precautionary principal, the potential for impact to otter is identified..	Potential for impact identified

5.2 River Fergus and River Shannon Estuaries SPA (004077)

Having regard to the potential impacts as identified in Section 2.4, the potential for effects to qualifying interests for which the River Fergus and River Shannon Estuary SPA is discussed hereunder.

Wetland birds have been documented to tolerate noise levels at or below 70dB(A) (Institute of Estuarine & Coastal Studies, University of Hull, 2009). BS 5228-1:2009+A1:2014 prescribes typical noise level data for various construction plant and activities within 10m of the various sources. The inverse square law can then be applied to determine likely noise levels at varying distances from the proposed works (As outlined previously in Table 2.1). This identifies that the noise levels fall below 70dB within 200m of the works. As such, the zone of impact for noise is taken as 200m from the red line boundary.

The River Fergus and River Shannon Estuary SPA is located 2km downstream of the works area. The Conservation Objectives Supporting document (NPWS 2012) notes that different waterbird species may utilise wetland habitats in different ways. The Special Conservation Interests for the site and their principal supporting habitat are presented in Table 5.25.

The potential for effects to the Wetland and Waterbirds attribute is dealt with below, separately to the bird species.

Roosting locations have been mapped as part of the Waterbird Survey Programme. The closest such location is approximately 1km from the works area and is buffered from the works area by urban development and playing pitches. As such, no key roosting areas are located within the footprint of the works, or within the zone of impact for noise or vibration disturbance.

Table 5.2: Principal Supporting Habitats for Special Conservation Interests

Special Conservation Interests	Winter Distribution	Principal Supporting Habitat	Ability to Utilise Other/Alternative Habitats
Cormorant (<i>Phalacrocorax carbo</i>) [A017]	Widespread	Sheltered & shallow subtidal over sand and mud flats	Wide-ranging species with requirement to utilise the site as and when required
Whooper Swan (<i>Cygnus cygnus</i>) [A038]	Widespread	Lagoon and associated habitats, Intertidal mudflats and shallow subtidal	Reliant on site but highly likely to utilise alternative habitats at certain times (e.g. High tide)
Light-bellied Brent Goose (<i>Branta bernicla hrota</i>) [A046]	Localised	Intertidal mud and sand flats	Reliant on site but highly likely to utilise alternative habitats at certain times (e.g. High tide)
Shelduck (<i>Tadorna tadorna</i>) [A048]	Localised	Intertidal mudflats and shallow subtidal	Considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited habitat requirements.
Wigeon (<i>Anas penelope</i>) [A050]	Widespread	Intertidal mud and sand flats and sheltered and shallow subtidal	Reliant on site but highly likely to utilise alternative habitats at certain times (e.g. High tide)
Teal (<i>Anas crecca</i>) [A052]	Widespread	Intertidal mud and sand flats and sheltered and shallow subtidal	Considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited habitat requirements.
Pintail (<i>Anas acuta</i>) [A054]	Localised	Intertidal mud and sand flats and sheltered and shallow subtidal	Reliant on site but highly likely to utilise alternative habitats at certain times (e.g. High tide)
Shoveler (<i>Anas clypeata</i>) [A056]	Intermediate	Lagoon, brackish and freshwater lakes plus intertidal mud and sand flats	Considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited habitat requirements.
Scaup (<i>Aythya marila</i>) [A062]	Highly restricted	Subtidal	Wide-ranging species with requirement to utilise the site as and when required
Ringed Plover (<i>Charadrius hiaticula</i>) [A137]	Localised	Intertidal mud and sand flats	Considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited habitat requirements.
Golden Plover (<i>Pluvialis apricaria</i>) [A140]	Intermediate	Intertidal mud and sand flats	Reliant on site but highly likely to utilise alternative habitats at certain times (e.g. High tide)
Grey Plover (<i>Pluvialis squatarola</i>) [A141]	Localised	Intertidal mud and sand flats	Considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited habitat requirements.
Lapwing (<i>Vanellus vanellus</i>) [A142]	Widespread	Intertidal mud and sand flats	Reliant on site but highly likely to utilise alternative habitats at certain times (e.g. High tide)

Special Conservation Interests	Winter Distribution	Principal Supporting Habitat	Ability to Utilise Other/Alternative Habitats
Knot (<i>Calidris canutus</i>) [A143]	Localised	Intertidal mud and sand flats	Considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited habitat requirements.
Dunlin (<i>Calidris alpina</i>) [A149]	Intermediate	Intertidal mud and sand flats	Considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited habitat requirements.
Black-tailed Godwit (<i>Limosa limosa</i>) [A156]	Localised	Intertidal mud and sand flats	Reliant on site but highly likely to utilise alternative habitats at certain times (e.g. High tide)
Bar-tailed Godwit (<i>Limosa lapponica</i>) [A157]	Localised	Intertidal mud and sand flats	Reliant on site but highly likely to utilise alternative habitats at certain times (e.g. High tide)
Curlew (<i>Numenius arquata</i>) [A160]	Widespread	Intertidal mud and sand flats	Reliant on site but highly likely to utilise alternative habitats at certain times (e.g. High tide)
Redshank (<i>Tringa totanus</i>) [A162]	Intermediate	Intertidal mud and sand flats	Reliant on site but highly likely to utilise alternative habitats at certain times (e.g. High tide)
Greenshank (<i>Tringa nebularia</i>) [A164]	Intermediate	Intertidal mud and sand flats	Considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited habitat requirements.
Black-headed Gull (<i>Chroicocephalus ridibundus</i>) [A179]	n/c	Intertidal flats & sheltered & shallow subtidal	Reliant on site but highly likely to utilise alternative habitats at certain times (e.g. High tide)

Source: NPWS 2012

The majority of the Special Conservation Interests for the River Fergus and River Shannon Estuary SPA are associated with intertidal mudflats and sand flats. The habitats within the works area do not correspond to tidal mudflats and sandflats and there will, therefore, be no direct impact to habitat associated with these Special Conservation Interests. As previously noted, the closest extent of mudflat and sand flat to the works area is approximately 2km from the works area.

Special Conservation Interests who do not have intertidal mudflats and sand flats listed as their principal supporting habitat are:

- Whooper swan; principal supporting habitat also includes “*lagoon and associated habitats*”,
- Shoveler; principal supporting habitat also includes “*lagoon, brackish and freshwater lakes*”
- Scaup; principal supporting habitat is listed as “*Subtidal*”
- Black-headed Gull; principal supporting habitat includes “*shallow subtidal*”

The canal is highly modified, with steep banks and walkways on both sides. The general area is highly trafficked and surrounded to the north and the south by existing development. As such, the area is unlikely to provide key supporting habitat to these species. However, there is potential for these species to occur within the canal at least on occasion. Therefore, having regard to the precautionary principal whooper swan, shoveler, scaup and black-headed gull will be examined further in terms of the assessment of significant effects.

The wetland habitats upon which the Special Conservation Interests of the SPA are reliant are located a significant distance downstream of the proposed development. As outlined in section 5.1, on the basis of the location of the proposed development in relation to these wetland habitats, and given the nature of the potential surface water emissions (sediment laden run-off) there is no potential for significant effects to the wetland habitat associated with the SPA.

Summary

Potential for significant effects to the following Qualifying Interests associated with the Lower River Shannon SAC were identified:

- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]
- *Petromyzon marinus* (sea lamprey) [1095]
- *Lampetra planeri* (brook lamprey) [1096]
- *Lampetra fluviatilis* (river lamprey) [1099]
- *Salmo salar* (salmon) [1106]
- *Lutra lutra* (otter) [1355]

Potential for significant effects to the following Qualifying Interests associated with the River Fergus and River Shannon SPA were identified

- Whooper Swan (*Cygnus cygnus*)
- Shoveler (*Anas clypeata*)
- Scaup (*Aythya marila*)

6 Potential for Adverse Effects on Site Integrity

6.1 Conservation Objectives

European and national legislation places a collective obligation on Ireland and its citizens to maintain or restore habitats and species in the Natura 2000 Network to favourable conservation condition. Ireland has determined conservation objectives for European Sites which define favourable conservation condition for habitats and species protected under the Habitats Directive and Birds Directive.

Conservation objectives for European sites relate to the site and the Qualifying Interests/Special Conservation interests for which they are designated. An assessment of the potential impacts to Qualifying Interests/Special Conservation Interests identified in section 5 to adversely affect the integrity of the European sites was undertaken in relation to the attributes, measures and targets relevant to each site.

Potential for Adverse Effects on Lower River Shannon SAC

It has been determined through desk-based assessment and ecological field surveys that the proposed development may impact on the following qualifying interests of the Lower River Shannon SAC due to impacts associated with the construction phase of the proposed development:

- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation [3260]
- *Petromyzon marinus* (sea lamprey) [1095]
- *Lampetra planeri* (brook lamprey) [1096]
- *Lampetra fluviatilis* (river lamprey) [1099]
- *Salmo salar* (salmon) [1106]
- *Lutra lutra* (otter) [1355]

Site Specific Conservation Objectives have been developed for Lower River Shannon SAC. An assessment of the potential for adverse effects on the integrity of the SAC is presented hereunder

Table 6.1 Assessment of Potential for Adverse Effects on the Site Integrity of the Lower River Shannon SAC Site Code 002165 - Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Habitat area	Kilometres	Area stable or increasing, subject to natural processes	<p>There is no potential for direct impact on the habitat area as there is no floating river vegetation present within the footprint of the works or within 200m upstream or downstream of the proposed works. However, NPWS mapping does pinpoint the canal as an area where opposite leaved pondweed has been present historically, and as such it might be present further downstream.</p> <p>Release of surface water run-off has the potential to cause impacts to the water quality. This may result in an associated deterioration in the area of habitat suitable for colonisation by floating river vegetation within the canal.</p> <p>Therefore, there is potential for indirect impact on the habitat area.</p>	Impacts on the habitat area would constitute a negative effect on site's integrity.
Habitat distribution	Occurrence	No decline, subject to natural processes	<p>While the area has been historically known to contain opposite leaved pondweed, a survey carried out in June 2020 did not find any evidence of it within the footprint of the work.</p> <p>While it was not present within the survey there is potential that it may occur downstream of the works.</p>	Impacts on the habitat distribution would constitute a negative effect on site's integrity.

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
			Release of surface water run-off has the potential to cause impacts to the water quality. This may result in an associated deterioration in the area of habitat suitable for colonisation by floating river vegetation within the canal. This may, in turn, result in a decline in the occurrence of the habitat and the distribution within Park Canal.	
Hydrological regime: river flow	Metres per second	Maintain appropriate hydrological regimes	There will not be a change in the hydrological regime upstream or downstream of the works.	No potential for adverse effects on site integrity.
Hydrological regime: tidal influence	Daily water level fluctuations - metres	Maintain natural tidal regime	The tidal regime of the Shannon estuary will not be affected by the works. There will be no effect on daily water level fluctuations.	No potential for adverse effects on site integrity.
Hydrological regime: freshwater seepages	Metres per second	Maintain appropriate freshwater seepage regimes	There are no freshwater seepages in the Park Canal therefore they will not be affected by the proposed development. There will be no change in hydrological regime to the Park Canal.	No potential for adverse effects on site integrity.
Substratum composition: particle size range	Millimetres	The substratum should be dominated by the particle size ranges, appropriate to the habitat sub - type (frequently sands, gravels and cobbles)	The Park Canal is a transitional water body which is heavily silted and modified. There is potential for surface water run-off in the Park Canal due to surface water run-off from the proposed works. This may cause changes to the particle size ranges.	Impacts on the substratum composition would constitute a negative effect on site's integrity.

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Water quality: nutrients	Milligrams per litre	The concentration of nutrients in the water column should be sufficiently low to prevent changes in species composition or habitat condition	<p>There is potential for surface water run-off to enter the Park Canal due to surface water emissions from the proposed works. This will not, however, result in an increase in nutrients to the canal.</p> <p>No potential for increase in nutrients has been identified.</p>	No potential for adverse effects on site integrity.
Vegetation composition: typical species	Occurrence	Typical species of the relevant habitat sub - type should be present and in good condition	Degradation in the substrate of the canal associated with release of sediment and hydrocarbon laden water laden surface water run-off has the potential to result in a change in vegetation composition should the habitat occur downstream of the proposed works.	Impacts on the substratum affecting vegetation composition would constitute a negative effect on site's integrity.
Floodplain connectivity	Area	The area of active floodplain at and upstream of the habitat should be maintained	There will be no impact arising from the proposed development on floodplain connectivity.	No potential for adverse effects on site integrity.
Riparian habitat	Area	The area of riparian woodland at and upstream of the bryophyte - rich sub - type should be maintained	There is no record of riparian woodland downstream of the proposed works. There is no record of the bryophyte – rich subtype within or downstream of the proposed works area.	No potential for adverse effects on site integrity.

Table 6.2 Assessment of Potential for Adverse Effects on the Site Integrity of the Lower River Shannon SAC Site Code 002165 - *Petromyzon marinus* (sea lamprey) [1095]

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Distribution: extent of anadromy	% of river accessible	Greater than 75% of main stem length of rivers accessible from estuary	The sheet piles for the works will be placed at the toe of the canal banks, and the bridge will span the entire width. There will be no reduction in the extent of river that is accessible from the estuary.	No potential for adverse effects on site integrity.
Population structure of juveniles	Number of age/size group	At least three age/size groups present	<p>No suitable spawning fines were recorded within during the aquatic survey which included 200m upstream and downstream of the works areas.</p> <p>The aquatic survey notes that the confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations.</p> <p>As such, there is potential for indirect impact to juvenile lamprey caused by surface water run-off associated with the proposed development should they occur downstream of the proposed development. Any impact to the juvenile lamprey has the potential to result in changes to the population structure of juvenile lamprey.</p>	Impacts on the population structure of juveniles would constitute a negative effect on site's integrity .
Juvenile density in fine sediment	Juveniles/m ²	Juvenile density at least 1/m ² J	No suitable spawning fines were recorded within during the aquatic survey which included	Impacts on the density of juveniles in fine sediment would

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Extent and distribution of spawning habitat	m ² and occurrence	No decline in extent and distribution of spawning beds	<p>200m upstream and downstream of the works areas.</p> <p>The aquatic survey notes that the confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations.</p> <p>As such, there is potential for indirect impact to juvenile lamprey caused by surface water run-off associated with the proposed development should they occur downstream of the proposed development. Any impact to the juvenile lamprey has the potential to result in changes to the juvenile density in fine sediment.</p>	constitute a negative effect on site's integrity.
Extent and distribution of spawning habitat	m ² and occurrence	No decline in extent and distribution of spawning beds	<p>No suitable spawning fines were recorded within during the aquatic survey which included 200m upstream and downstream of the works areas.</p> <p>The aquatic survey notes that the confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations.</p> <p>As such, there is potential for indirect impact to spawning habitat caused by surface water run-off associated with the</p>	Impacts on the extent and distribution of spawning habitat would constitute a negative effect on site's integrity.

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Availability of juvenile habitat	Number of positive sites in 3rd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive	<p>proposed development should they occur downstream of the proposed development. Any impact to the spawning habitat has the potential to result in changes to the extent and distribution of same.</p> <p>No suitable spawning fines were recorded within during the aquatic survey which included 200m upstream and downstream of the works areas.</p> <p>The aquatic survey notes that the confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations.</p> <p>As such, there is potential for indirect impact to spawning habitat caused by surface water run-off associated with the proposed development should they occur downstream of the proposed development. Any impact to the spawning habitat has the potential to result in changes to the availability of same.</p>	<p>Impacts on the availability of spawning habitat would constitute a negative effect on site's integrity.</p>

Table 6.3 Assessment of Potential for Adverse Effects on the Site Integrity of the Lower River Shannon SAC Site Code 002165 - *Lampetra fluviatilis* (river lamprey) [1099] and *Lampetra planeri* (brook lamprey) [1096]

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Distribution	% of river accessible	Access to all water courses down to first order streams	The sheet piles for the works will be placed at the toe of the canal banks, and the bridge will span the entire width. There will be no reduction in the extent of river that is accessible from the estuary.	No potential for adverse effects on site integrity.
Population structure of juveniles	Number of age/size group	At least three age/size groups of river/brook lamprey present	<p>No suitable spawning fines were recorded within during the aquatic survey which included 200m upstream and downstream of the works areas.</p> <p>The aquatic survey notes that the confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations.</p> <p>As such, there is potential for indirect impact to juvenile lamprey caused by surface water run-off associated with the proposed development should they occur downstream of the proposed development. Any impact to the juvenile lamprey has the potential to result in changes to the population structure of juvenile lamprey.</p>	Impacts on the population structure of juveniles would constitute a negative effect on site's integrity .
Juvenile density in fine sediment	Juveniles/m ²	Mean catchment juvenile density of river/brook	No suitable spawning fines were recorded within during the aquatic survey which included	Impacts on the density of juveniles in fine sediment would

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Extent and distribution of spawning habitat	m ² and occurrence	No decline in extent and distribution of spawning beds	<p>200m upstream and downstream of the works areas.</p> <p>The aquatic survey notes that the confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations.</p> <p>As such, there is potential for indirect impact to juvenile lamprey caused by surface water run-off associated with the proposed development should they occur downstream of the proposed development. Any impact to the juvenile lamprey has the potential to result in changes to the juvenile density in fine sediment.</p>	constitute a negative effect on site's integrity.
			<p>No suitable spawning fines were recorded within during the aquatic survey which included 200m upstream and downstream of the works areas.</p> <p>The aquatic survey notes that the confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations.</p> <p>As such, there is potential for indirect impact to spawning habitat caused by surface water run-off associated with the</p>	Impacts on the extent and distribution of spawning habitat would constitute a negative effect on site's integrity.

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Availability of juvenile habitat	Number of positive sites in 2nd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive	<p>proposed development should they occur downstream of the proposed development. Any impact to the spawning habitat has the potential to result in changes to the extent and distribution of same.</p> <p>No suitable spawning fines were recorded within during the aquatic survey which included 200m upstream and downstream of the works areas. The aquatic survey notes that the confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations. As such, there is potential for indirect impact to spawning habitat caused by surface water run-off associated with the proposed development should they occur downstream of the proposed development. Any impact to the spawning habitat has the potential to result in changes to the availability of same.</p>	<p>Impacts on the availability of spawning habitat would constitute a negative effect on site's integrity.</p>

Table 6.4 Assessment of Potential for Adverse Effects on the Site Integrity of the Lower River Shannon SAC Site Code 002165 - *Petromyzon marinus* (sea lamprey) [1095]

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Distribution: extent of anadromy	% of river accessible	Greater than 75% of main stem length of rivers accessible from estuary	The sheet piles for the works will be placed at the toe of the canal banks, and the bridge will span the entire width. There will be no reduction in the extent of river that is accessible from the estuary.	No potential for adverse effects on site integrity.
Population structure of juveniles	Number of age/size group	At least three age/size groups present	<p>No suitable spawning fines were recorded within during the aquatic survey which included 200m upstream and downstream of the works areas.</p> <p>The aquatic survey notes that the confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations.</p> <p>As such, there is potential for indirect impact to juvenile lamprey caused by surface water run-off associated with the proposed development should they occur downstream of the proposed development. Any impact to the juvenile lamprey has the potential to result in changes to the population structure of juvenile lamprey.</p>	Impacts on the population structure of juveniles would constitute a negative effect on site's integrity .
Juvenile density in fine sediment	Juveniles/m ²	Juvenile density at least 1/m ² J	No suitable spawning fines were recorded within during the aquatic survey which included	Impacts on the density of juveniles in fine sediment would

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Extent and distribution of spawning habitat	m ² and occurrence	No decline in extent and distribution of spawning beds	<p>200m upstream and downstream of the works areas.</p> <p>The aquatic survey notes that the confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations.</p> <p>As such, there is potential for indirect impact to juvenile lamprey caused by surface water run-off associated with the proposed development should they occur downstream of the proposed development. Any impact to the juvenile lamprey has the potential to result in changes to the juvenile density in fine sediment.</p>	constitute a negative effect on site's integrity.
Extent and distribution of spawning habitat	m ² and occurrence	No decline in extent and distribution of spawning beds	<p>No suitable spawning fines were recorded within during the aquatic survey which included 200m upstream and downstream of the works areas.</p> <p>The aquatic survey notes that the confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations.</p> <p>As such, there is potential for indirect impact to spawning habitat caused by surface water run-off associated with the</p>	Impacts on the extent and distribution of spawning habitat would constitute a negative effect on site's integrity.

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Availability of juvenile habitat	Number of positive sites in 3rd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive	<p>proposed development should they occur downstream of the proposed development. Any impact to the spawning habitat has the potential to result in changes to the extent and distribution of same.</p> <p>No suitable spawning fines were recorded within during the aquatic survey which included 200m upstream and downstream of the works areas.</p> <p>The aquatic survey notes that the confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations.</p> <p>As such, there is potential for indirect impact to spawning habitat caused by surface water run-off associated with the proposed development should they occur downstream of the proposed development. Any impact to the spawning habitat has the potential to result in changes to the availability of same.</p>	<p>Impacts on the availability of spawning habitat would constitute a negative effect on site's integrity.</p>

Table 6.5 Assessment of Potential for Adverse Effects on the Site Integrity of the Lower River Shannon SAC Site Code 002165 – *Salmo salar* (salmon) [1106]

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Distribution: extent of anadromy	% of river accessible	100% of river channels down to second order accessible from estuary	The sheet piles for the works will be placed at the toe of the canal banks, and the bridge will span the entire width. There will be no reduction in the extent of river that is accessible from the estuary.	No potential for adverse effects on site integrity.
Adult spawning fish	Number	Conservation Limit (CL) for each system consistently exceeded	No suitable spawning habitat was identified within Park Canal. There is, however, potential for impact to adult fish which pass through the canal due to surface water run-off associated with the works.	Impacts on adult spawning would constitute a negative effect on site's integrity .
Salmon fry abundance	Number of fry/5 minutes electrofishing	Maintain or exceed 0+ fry mean catchment - wide abundance threshold value. Currently set at 17 salmon fry/5 min sampling	The aquatic survey carried out did not identify any fry. Further, the water within the canal is generally very slow moving and would be considered unsuitable for salmon fry which are typically associated with fast flowing streams. As such, no impact to salmon fry abundance is anticipated.	No potential for adverse effects on site integrity.
Out - migrating smolt abundance	Number	No significant decline	Out migrating smolt may, at least on occasion utilise the canal as part of their out-migration. As such, there is potential for surface water run-off to impact on these individuals.	Impacts on out migrating smolt abundance would constitute a negative effect on site's integrity .

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Number and distribution of redds	Number and occurrence	No decline in number and distribution of spawning redds due to anthropogenic causes	<p>This may, in turn cause a reduction in the abundance of same.</p> <p>No suitable spawning habitat was identified within the works area or 200m upstream or downstream of same.</p> <p>The water within the canal is slow moving and turbid. Given this, and the history of dredging within the canal it is unlikely that redds should occur within the canal.</p> <p>No potential for impacts to the number and distribution of redds is identified.</p>	No potential for adverse effects on site integrity.
Water quality	EPA Q value	At least Q4 at all sites sampled by EPA	<p>There is potential for a short-term degradation in water quality associated with the construction phase of the proposed development.</p> <p>This release of sediment laden water into park canal is unlikely to have a significant impact on the Q Value of the canal.</p>	No potential for adverse effects on site integrity.

Table 6.6: Assessment of Potential for Adverse Effects on the site Integrity of Lower River Shannon SAC Site Code 002165 – Otter (*Lutra lutra*)

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Distribution	Percentage positive survey sites	No significant decline	<p>No signs of otter were recorded during the aquatic survey. However, there is potential for otter holts or couches to become established prior to construction of the proposed development. There is also potential for otters to forage and commute through the works areas, at least on occasion.</p> <p>As such, there is potential for the works to cause disturbance resulting in the avoidance of the works area by otter. As such this may, in a worst-case scenario, result in a reduction in the percentage of positive survey sites for otters associated the SAC.</p>	Impacts on the distribution of positive survey sites would constitute a negative effect on the site's integrity .
Extent of terrestrial habitat	Hectares	No significant decline. Area mapped and calculated as 596.8ha above high water mark (HWM); 958.9ha along river banks/ around ponds	<p>No signs of otter were recorded during the aquatic survey. However, give the historical records in the area it is likely that they occur within the area at least on occasion.</p> <p>The banks of the Park Canal are steep and highly modified. The proposed development will not result in a significant decline in the extent of terrestrial habitat available to otters.</p>	No potential for Adverse Effects on Site Integrity have been identified.
Extent of marine habitat	Hectares	No significant decline. Area mapped and calculated as 4,461.6ha	The proposed development is not located within the marine environment. There will be no loss of marine habitat associated with the proposed development.	No potential for Adverse Effects on Site Integrity have been identified.
Extent of freshwater (river) habitat	Kilometres	No significant decline. Area mapped and calculated as 125.6ha	The sheet piles will be placed at the toe of the river embankments. There will be no restriction in the width of the canal. There will be no significant decline in the extent of freshwater (river) habitat.	No potential for Adverse Effects on Site Integrity have been identified.
Extent of freshwater (lake) habitat	Hectares	No significant decline. Area mapped and calculated as 25.06ha	The proposed development is not located within a lake habitat. There will be no loss of marine habitat associated with the proposed development.	No potential for Adverse Effects on Site Integrity have been identified.

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Couching sites and holts	Number	No significant decline	No otter holts or couches were recorded during the aquatic survey. There is potential, however, given the nature of the site, for holts and couches to become established prior to construction of the proposed development. As such there is potential for the works to result in a decline in the number of couching sites and holts for otter associated with the SAC.	Impacts on the number of couching sites and holts would constitute a negative effect on the site's integrity .
Fish biomass available	Kilograms	No significant decline	There is potential for the release of surface water run-off to cause an impact to fish species within the canal.	Impacts on the fish biomass available to otter would constitute a negative effect on the site's integrity .
Barriers to connectivity	Number	No significant increase	The proposed development will not result in any barriers to connectivity to otter associated with the SAC.	No potential for Adverse Effects on Site Integrity have been identified.

Potential for Adverse Effects on the River Fergus and River Shannon Estuaries SPA (004077)

It has been determined through desk-based assessment and ecological field surveys that the proposed development is likely to impact on the following Special Conservation Interests associated with the River Fergus and River Shannon Estuaries SPA.

- Whooper Swan (*Cygnus cygnus*)
- Shoveler (*Anas clypeata*)
- Scaup (*Aythya marila*)

Site Specific Conservation Objectives have been developed for River Fergus and River Shannon Estuaries SPA. An assessment of the potential for adverse effects on the integrity of the SPA is presented hereunder

Table 6.7: Assessment of Potential for Adverse Effects on the site Integrity of the River Fergus and River Shannon Estuaries SPA Whooper Swan (*Cygnus cygnus*)

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Population trend	Percentage change	Long term population trend stable or increasing	<p>The proposed works have the potential to result in a short-term disturbance effect within approximately 200m of the proposed development. While whooper swan may occur within the works area at least on occasion, given the level of anthropogenic disturbance in the vicinity this area likely does not constitute a key foraging area for the species, and has not been identified as a roosting area for the species.</p> <p>While the construction of the proposed development is anticipated to take place over 6 months, the most impactful works from a noise and disturbance perspective will be completed within two weeks. Following the completion of these works the zone of impact for noise will be further reduced.</p> <p>As such, the disturbance of whooper swan from the zone of impact associated with noise disturbance does not constitute a significant effect. Given the suitable habitat for the species within the SPA the effect will not result in a decrease in the long-term population trend for the species.</p>	No potential for Adverse Effects on Site Integrity have been identified.
Distribution	Range, timing and intensity of use of areas	There should be no significant decrease in the range, timing or intensity of use of areas by scaup other than that occurring from natural patterns of variation	<p>The proposed works have the potential to result in a short-term disturbance effect within approximately 200m of the proposed development. While whooper swan may occur within the works area at least on occasion, given the level of anthropogenic disturbance in the vicinity this area likely does not constitute a key foraging area for the species, and has not been identified as a roosting area for the species.</p> <p>While the construction of the proposed development is anticipated to take place over 6 months, the most impactful works from a noise</p>	No potential for Adverse Effects on Site Integrity have been identified.

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
			<p>and disturbance perspective will be completed within two weeks. Following the completion of these works the zone of impact for noise will be further reduced.</p> <p>As such, the disturbance of whooper swan from the zone of impact associated with noise disturbance does not constitute a significant reduction in the range, timing or intensity of use of the area.</p>	

Table 6.8: Assessment of Potential for Adverse Effects on the site Integrity of the River Fergus and River Shannon Estuaries SPA Shoveler (*Anas clypeata*)

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Population trend	Percentage change	Long term population trend stable or increasing	<p>The proposed works have the potential to result in a short-term disturbance effect within approximately 200m of the proposed development. While shoveler may occur within the works area at least on occasion, given the level of anthropogenic disturbance in the vicinity this area likely does not constitute a key foraging area for the species, and has not been identified as a roosting area for the species.</p> <p>While the construction of the proposed development is anticipated to take place over 6 months, the most impactful works from a noise and disturbance perspective will be completed within two weeks. Following the completion of these works the zone of impact for noise will be further reduced.</p> <p>As such, the disturbance of shoveler from the zone of impact associated with noise disturbance does not constitute a significant effect. Given the suitable habitat for the species within the SPA the effect will not result in a decrease in the long-term population trend for the species.</p>	No potential for Adverse Effects on Site Integrity have been identified.
Distribution	Range, timing and intensity of use of areas	There should be no significant decrease in the range, timing or intensity of use of areas by shoveler other than that occurring from natural patterns of variation	<p>The proposed works have the potential to result in a short-term disturbance effect within approximately 200m of the proposed development. While shoveler may occur within the works area at least on occasion, given the level of anthropogenic disturbance in the vicinity this area likely does not constitute a key foraging area for the species, and has not been identified as a roosting area for the species.</p> <p>While the construction of the proposed development is anticipated to take place over 6 months, the most impactful works from a noise and disturbance perspective will be completed within two weeks. Following the completion of</p>	No potential for Adverse Effects on Site Integrity have been identified.

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
			<p>these works the zone of impact for noise will be further reduced.</p> <p>As such, the disturbance of shoveler from the zone of impact associated with noise disturbance does not constitute a significant reduction in the range, timing or intensity of use of the area.</p>	

Table 6.9: Assessment of Potential for Adverse Effects on the site Integrity of the River Fergus and River Shannon Estuaries SPA Scaup (*Aythya marila*)

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
Population trend	Percentage change	Long term population trend stable or increasing	<p>The proposed works have the potential to result in a short-term disturbance effect within approximately 200m of the proposed development. While scaup may occur within the works area at least on occasion, given the level of anthropogenic disturbance in the vicinity this area likely does not constitute a key foraging area for the species, and has not been identified as a roosting area for the species.</p> <p>While the construction of the proposed development is anticipated to take place over 6 months, the most impactful works from a noise and disturbance perspective will be completed within two weeks. Following the completion of these works the zone of impact for noise will be further reduced.</p> <p>As such, the disturbance of scaup from the zone of impact associated with noise disturbance does not constitute a significant effect. Given the suitable habitat for the species within the SPA the effect will not result in a decrease in the long term population trend for the species.</p>	No potential for Adverse Effects on Site Integrity have been identified.
Distribution	Range, timing and intensity of use of areas	There should be no significant decrease in the range, timing or intensity of use of areas by scaup other than that occurring from natural patterns of variation	<p>The proposed works have the potential to result in a short-term disturbance effect within approximately 200m of the proposed development. While scaup may occur within the works area at least on occasion, given the level of anthropogenic disturbance in the vicinity this area likely does not constitute a key foraging area for the species, and has not been identified as a roosting area for the species.</p> <p>While the construction of the proposed development is anticipated to take place over 6 months, the most impactful works from a noise and disturbance perspective will be completed within two weeks. Following the completion of</p>	No potential for Adverse Effects on Site Integrity have been identified.

Attribute	Measures	Targets	Potential Impact	Potential for Adverse Effects on Site Integrity
			<p>these works the zone of impact for noise will be further reduced.</p> <p>As such, the disturbance of scaup from the zone of impact associated with noise disturbance does not constitute a significant reduction in the range, timing or intensity of use of the area.</p>	

7 Mitigation

Mitigation is prescribed in accordance with the EPA draft guidance on EIAR (EPA, 2017) which requires mitigation by avoidance as a first approach. Where this is not feasible, measures to prevent impacts from giving rise to adverse effects should be adopted (e.g. design of bunded storage for chemicals). Where impacts cannot be avoided e.g. generation of noise, mitigation by reduction of impact is required to limit the exposure of the receptor to an acceptable level (often achieved by interrupting the pathway between the source and receptor).

Potential project-related impacts likely to negatively affect the site integrity of the following European sites are summarised below as follows:

- Impacts to:
 - Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation
 - *Petromyzon marinus* (sea lamprey)
 - *Lampetra fluviatilis* (river lamprey)
 - *Lampetra planeri* (brook lamprey)
 - *Salmo salar* (salmon)
 - Otter (*Lutra lutra*)

all caused by surface water run-off associated with the proposed development.

- Potential for loss of Otter (*Lutra lutra*) couches and holts associated with the construction proposed development.

Mitigation is prescribed hereunder to address the impacts such that adverse effects on site integrity of the European site does not occur.

Mitigation measures are set out in accordance with the European Commission guidance on the 'Assessment of plans and projects significantly affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC, (2001). Mitigation is described with respect to:

- how the measures will avoid / prevent / reduce the adverse impacts on the site to an acceptable level;
- the degree of confidence in their likely success;
- the timescale, relative to the project, when they will be implemented;
- how and when the measures will be monitored.

All mitigation prescribed in this NIS must be implemented by the appointed Contractor for the works to ensure that there are no adverse effects on the integrity of the European Site. The proposed mitigation measures will be incorporated into the CEMP for the contractor in advance of the works commencing.

Mitigation Against Water Quality Impacts to Surface Water

The principle likely pollution sources from construction activities are from contaminated site runoff. Mitigation measures to avoid / prevent contaminated runoff and pollution from site are prescribed in below.

Table 7.1 Mitigation Against Degradation in Water Quality

Measure	How the measures will avoid / prevent / reduce impacts	Confidence in the likely success of the measure	Timescale for Implementation	Monitoring requirements
<p>General</p> <p>At a minimum, all pollution control measures will be designed, installed, and maintained in accordance with CIRIA guidance for '<i>Environmental Good Practice on Site</i>' (C741), '<i>Guidelines on Protection of Fisheries During Construction Works In and Adjacent to Waters</i>' (IFI 2016), '<i>Control of water pollution from linear construction projects. Technical guidance</i>' (C648), and under the supervision of an Environmental Clerk of Works (EnCoW) who shall be appointed by the Contractor.</p> <p>The works area shall be clearly marked out on site. No works will be permitted to take place outside of this area.</p> <p>Works will be scheduled for dry conditions to reduce the risk of run off. In the event of adverse weather events work will be halted; and Construction works will not be undertaken during or immediately after significant rainfall events.</p>	<p>Measure will reduce environmental impact beyond the footprint of the proposed works.</p>	<p>Measure prescribed is a best practice measure as prescribed by the Construction Industry Research and Information Association.</p>	<p>Pollution prevention will be in place from the commencement of the works to the end of the construction phase.</p>	<p>The EnCoW shall monitor and ensure that works are progressing in line with these guidelines, and that the works do not take place outside of the agreed areas.</p>

Measure	How the measures will avoid / prevent / reduce impacts	Confidence in the likely success of the measure	Timescale for Implementation	Monitoring requirements
<p><u>Stockpiling Material</u></p> <p>The stockpiling of material at park bridge has the potential to cause runoff into Park Canal. Stockpiling may be required for excavation, and for material introduced to the site for landscaping. Any excavated material from Park Bridge will be stored away from drains and watercourses within. Such material will be from a source confirmed to be free of invasive species.</p> <p>All stockpiled material will be profiled to reduce run-off where possible and covered in order to prevent surface water run-off.</p>	<p>Measure will prevent the uncontrolled runoff of sediment into surface water.</p>	<p>Measure prescribed is a best practice measure as prescribed by the Construction Industry Research and Information Association.</p>	<p>Pollution prevention will be in place from the commencement of the works to the end of the construction phase.</p>	<p>The EnCoW shall monitor and ensure that all and any potential sources of surface water runoff are being mitigated against appropriately.</p>
<p><u>Dewatering Excavations</u></p> <p>The proposed works will require excavation. These areas may be subject to water ingress which will be required to be removed in order to facilitate construction.</p> <p>Where it is required to dewater an area, the water will be treated prior to discharge in line with <i>Guidelines on Protection of Fisheries During Construction Works In and Adjacent to Waters</i> (IFI 2016) requirements.</p>	<p>Measure will prevent the uncontrolled runoff of sediment into surface water.</p>	<p>Measure prescribed is a best practice measure as prescribed by the Construction Industry Research and Information Association.</p>	<p>Dewatering will take place as required throughout the works.</p>	<p>Dewatering will be monitored by a suitably qualified freshwater ecologist.</p>
<p><u>Concrete and Other Pollutants</u></p> <p>Any concrete used for the works will be brought to site by a concrete truck. On-site concrete batching and mixing activities will not be permitted at the Works Site.</p> <p>Any pumping of groundwater at the site of the concrete pour will cease for the pour and only be resumed once the pH of the groundwater has been confirmed to be between 6.0 and 9.0 units.</p> <p>The EnCOW will monitor the pH levels of the canal during concrete works such that a change measuring +/- 0.5pH units will be detected and measures should be</p>	<p>Measure will prevent the uncontrolled runoff of concrete, hydrocarbons and fuels into surface water.</p>	<p>Measures prescribed are best practice measures as prescribed by the Construction Industry Research and Information Association.</p>	<p>A suitable washout area will be agreed with the appointed EnCOW and included in the planning documents and the CEMP. Prior to the commencement of the works the washout area will be bunded and isolated.</p>	<p>The appointed EnCOW will monitor pollution control measures daily.</p>

Measure	How the measures will avoid / prevent / reduce impacts	Confidence in the likely success of the measure	Timescale for Implementation	Monitoring requirements
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immediately taken to cease concrete works, identify the entry point to the canal and implement appropriate measures to prevent further escape to the environment. NPWS and IFI will be notified immediately of any concrete spills into the canal.

Concrete mix trucks, pumps and equipment must be washed down within a designated bunded area site or at a suitably designed and operated depot washdown facility which will be identified by the EnCOW. Such areas will be located a minimum of 50m from any watercourse /drain. Wash water will be disposed of in accordance with waste legislation. Any concrete works will be scheduled during dry weather conditions to reduce the risk of runoff.

Where it is required to sling concrete into the form work situated behind the sheet piles, an experienced banksman and machine operator will be required. Such works will be supervised by the EnCOW. The concrete will be slung in using a leak proof skip and will not be swung over the canal.

Where mobile equipment is required e.g. generators, these will be housed in a suitably sized bund such that any leaks / spills are intercepted. Bund specification will conform to the current best practice for oil storage such as 'Best Practice Guide BPGCS005 Oil Storage Guidelines,' Enterprise Ireland. All waste fuels / oils, and other hazardous wastes will be disposed of in accordance with the requirements of the Waste Management Acts 1996, as amended. Spill-kits and hydrocarbon absorbent packs will be stored in the cabin of each vehicle and operators will be fully trained in the use of this equipment.

<p><u>Temporary Decking and Sheeting</u> Temporary decking and sheeting will be placed over the canal between the lock walls under Park Bridge. Any gaps in the sheeting will be filled with expanding foam. Steel replacement beams will be erected to Park Bridge. The</p>	<p>Measure will prevent the uncontrolled runoff of sand, rust and paint into surface water.</p>	<p>Method prescribed is a proven method.</p>	<p>Temporary decking will be installed as required during the construction phase of the new deck.</p>	<p>The appointed EnCOW will monitor pollution control measures daily and ensure that any temporary sheeting which is installed is effective.</p>
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------	----------------------------------------------	-------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------

Measure	How the measures will avoid / prevent / reduce impacts	Confidence in the likely success of the measure	Timescale for Implementation	Monitoring requirements
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<p>existing beams will be shot-blasted and repainted. The temporary decking will then be removed.</p>				
<p>Water Level Monitoring Due to the location of the works it will be necessary to monitor water levels daily to ensure the works area is not inundated. During flood level water levels no concrete pours at or near water level will occur. Pre-cast elements will not be installed during high tide levels to prevent the runoff of any blinding which is required.</p>	<p>Measure will prevent the installation of blinding behind the sheet piles in periods of potential flooding.</p>	<p>Method prescribed is a proven method.</p>	<p>Water level monitoring will be carried out from commencement of the proposed works.</p>	<p>The appointed EnCOW will monitor tide levels and coastal flooding warnings daily.</p>

Mitigation Against Impacts to Otter

Potential for Impacts to unidentified couches and holts are prescribed below.

Table 7.2: Mitigation Against Disturbance to Otter

Measure	How the measures will avoid / prevent / reduce impacts	Confidence in the likely success of the measure	Timescale for Implementation	Monitoring requirements
<p><u>Pre Works Survey</u></p> <p>Otter surveys will be carried by a suitably qualified ecologist ahead of the works commencing to determine the placement, and type, of any otter holts or couches within 150m of the works area.</p> <p>The survey shall be carried out in accordance with the NRA <i>Guidelines for the Treatment of Otter Prior to the Construction of National Road Schemes</i>.</p>	<p>The measures will identify all areas with otter breeding and resting places in the works area and within 150m thereof.</p> <p>Measure to take place in advance of the works each year as relevant.</p> <p>The measures will be carried out by a suitably qualified ecologist to ensure they are undertaken correctly</p>	<p>Measures prescribed as best practice and are proven technologies / methods</p>	<p>Measure to take place in advance of the works commencing.</p>	<p>The measure will be carried out by a suitably qualified ecologist to ensure they are undertaken correctly</p>
<p><u>Avoidance</u></p> <p>Where the presence of a holts is confirmed, no works take place within a 150m circumference of a breeding holt and 30m of a non-breeding holt or couch. Where works in proximity to a holt or couch cannot be avoided, a licence to disturb otter will be necessary from NPWS.</p> <p>The Contractor will be required to comply with any specific mitigation measures as stipulated under the license.</p>	<p>The measures will identify any areas with otter breeding and resting places within the zone of impact.</p>	<p>Measures prescribed as best practice and are proven technologies / methods</p>	<p>Measure to take place in advance of the works commencing.</p>	<p>The measure will be carried out by a suitably qualified and licensed ecologist to ensure they are undertaken correctly</p>

7.1 Outcomes

The mitigation measures detailed in Section 7 of this NIS have been carefully considered to ensure no adverse effects on the integrity of any European sites in light of the site's conservation objectives and status.

Based on the assessment of the proposed development alone and in combination with other projects and plans, including the implementation of mitigation measures, it can be concluded that no adverse effects on the site's integrity will arise, in view of the site's conservation objectives.

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A. Aquatic Assessment of the Park Canal, Limerick

Aquatic assessment of the Park Canal, Limerick



Prepared by Triturus Environmental Ltd.

for Mott McDonald Ltd.

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1. Introduction

1.1 Project background

This report comprises an aquatic ecological assessment of the Park Canal in Limerick City to inform the preparation of an ecological impact assessment as part of a proposed road bridge development. Refer to Figure 1.1 below for the site location.

It is proposed to construct a new bridge approximately 140m to the east of Park Bridge, adjacent to the existing railway bridge. The south end of the Lower Park Road on the north canal bank, where it passes under the rail bridge, will be connected by the new bridge to the junction at the east end of the south canal road. The north canal road will be maintained as a pedestrian and cycleway with local access for residents. The south junction will be widened to accommodate traffic travelling from the south canal road towards Rhebogue Road. The new bridge will consist of reinforced concrete abutments supported on piles on each canal bank. The bridge will have a skew span of 17.6m which will maintain the existing navigable canal width and provide a towpaths on both banks of the canal. The deck width will be 13m which is enough to accommodate one lane of highway traffic and combined pedestrian/cycleway raised verges to the east and west side of the deck. The approaches will be a combination of unreinforced and reinforced earth embankments.

1.2 Park Canal site background

The Park Canal (also known as Limerick Canal) was built in 1757-58 to provision access between the River Shannon and Limerick Docks (Reynolds, 2013). According to the author the canal was lowered for a few years prior to 2010, with the canal cleared with later restoration of the water levels. Of note the canal was known to support opposite leaved pondweed (*Groenlandia densa*), a species protected under the Flora (Protection) Order, 2015 (S.I. No. 356/2015). According to Reynolds (2006) the species was known from “near the River Shannon at its north-east end to the lock gates at its southwest end”. This distribution is also referenced in the conservation objectives supporting document, ‘Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation [3260] for the Lower River Shannon SAC’ (NPWS, 2012). The most recent known record for the species was recorded at the confluence of the Park Canal with the Abbey River (Ecofact, 2011). As the species favours areas where tidal and freshwater meet on fine mud, such a location would seem optimal for the species (Triturus pers. obs.). For example, the tidal channels of the River Maigne and Ballyclough River support frequent pockets of the species in such habitats (Triturus pers. obs.).

According to Reynolds (2013), the Park Canal was known to support a diversity of other aquatic plants including *Myriophyllum verticillatum*, *Nuphar lutea*, *Potamogeton crispus*, *Potamogeton lucens*, *Potamogeton natans*, *Potamogeton pectinatus*, *Elodea canadensis*, *Groenlandia densa* and Chara species. Following drainage works in the canal prior to 2010, *Ceratophyllum demersum*, *Ranunculus circinatus* and *Elodea nuttalli* were noted. Outside of the protected *Groenlandia densa*, *Ranunculus circinatus* can also be considered an uncommon macrophyte species in Ireland and worthy of note.



Figure 1.1 Location of the study area within the Park Canal, Limerick City.

2. Methodology

2.1 Desktop review

A desktop survey of published and unpublished reports was carried out in respect of the proposed development site to elucidate any potential impacts pertaining to conservation objective species and or habitats present at or near the site. Data on protected species and habitats, as well as invasive species listed under the Part 1 of the Third Schedule of S.I No. 477 of 2011, European Communities (Birds and Natural Habitats) Regulations 2011), held by the National Parks & Wildlife Service (NPWS) and National Biodiversity Data Centre (NBDC) were reviewed.

2.2 Site Snorkelling Survey

A baseline aquatic survey of the Park Canal was undertaken on the 27th May 2020. The aquatic and immediate riparian habitats of three sections of canal were recorded (see Figure 2.1 below). The three survey sections included as follows;

- Section A - Canal bank area (from railway bridge, 200m upstream)
- Section B; Park Bridge to Railway Bridge (approximately 200m section between bridges)
- Section C; Park Bridge to Abbey Rovers AFC (covering 200m downstream of canal lock)

The site assessment was undertaken by a snorkelling survey of each section of canal to help visually establish the cover of macrophyte plants and also better describe other physical habitat attributes. Hand searching and sweep netting was also undertaken to survey for crayfish species. The macrophyte community and fisheries value was collated based on visual assessments and also desktop review. The riparian habitats were noted according to Fossitt (2000).

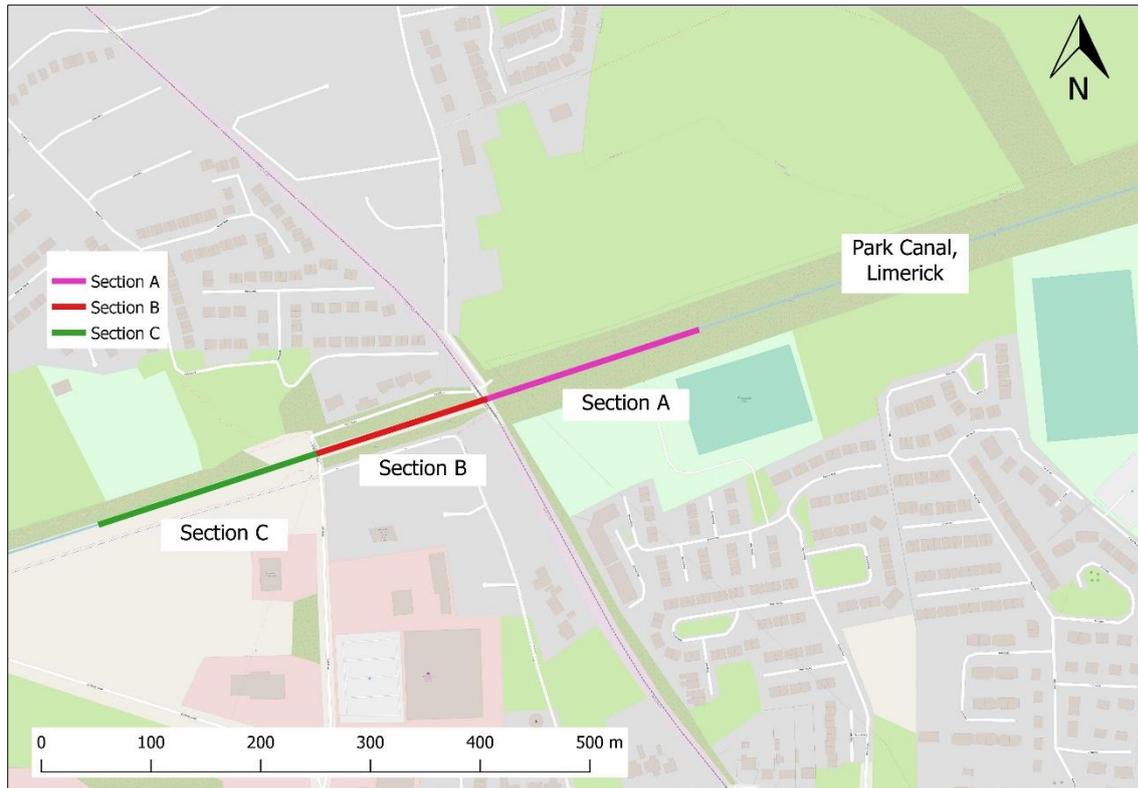


Figure 2.1 Park Canal survey sections, June 2020.

2.3 Macro-invertebrates

Macro-invertebrate samples were collected from the three canal survey sections (A, B & C) as shown on Figure 2.1 above. All canal samples were taken with a pond sampling hand net (250mm width, 500mm deep, 500µm mesh size) which was used to sweep macrophytes to capture macroinvertebrates. The net was also moved along the canal bottom 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 meso-habitats present (i.e. macrophytes & benthos) at each site to get a representative sample for sub-habitats. Samples were 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), mayflies (Kelly-Quinn & Regan, 2012) and other relevant taxa (i.e. Byrne et al., 2009; Nelson et al., 2011).

3. Results

3.1 Desktop review

A comprehensive desktop review of protected species within the 10km grid square R55 revealed a number of historical records for aquatic species of conservation value in addition to invasive plant species.

Protected species

Numerous historical and contemporary records exist for *Groenlandia densa* and triangular club rush (*Scirpus triqueter*) within the lower River Shannon and selected tributaries. A single historical record for the nationally rare and pennyroyal (*Mentha pulegium*), a short-lived perennial mint species which favours winter-inundated and marshy ground, was also available for the grid square. A single record was also available for meadow barley (*Hordeum secalinum*), a terrestrial species of dry alluvial grassland. All four species are listed as 'endangered' on the Irish Red-list (Curtis & McGough, 1988) and are protected under the Flora (Protection) Order, 2015 (S.I. No. 356/2015). None of these plants are known to occur in the study area with the exception of *Groenlandia densa*.

Groenlandia densa is known from the northern bank of the River Shannon at the Shannon (New) Bridge, Dock Road Area (drainage channels) and from King's Island. The species is also known from the Park Canal. According to Reynolds et al. (2006), the species is known "near the River Shannon at its north-east end to the lock gates at its southwest end". This distribution is also reflected on the most recent records are documented by Ecofact (2011) from the confluence of the Park Canal with the Abbey River (i.e. western extent). The species is likely to be more widespread in the tidal stretches of the Shannon and other rivers, as well as in marginal ditches and drainage channels.

The growth and distribution of opposite-leaved pondweed in the lower River Shannon has been strongly associated with horned pondweed (*Zannichellia palustris*), water starworts (*Callitriche* spp.), water pepper (*Persicaria hydropiper*) and triangular club rush (*Schoenoplectus triqueter*) (Reynolds et al., 2006). In the Limerick Canal, *Groenlandia densa* is known to be associated with whorled water milfoil (*Myriophyllum verticillatum*) and *Callitriche* spp., in addition to arrowhead (*Sagittaria sagittifolia*), stonewort species (*Chara* spp.), yellow water lily (*Nuphar lutea*), curled pondweed (*Potamogeton crispus*), broad-leaved pondweed (*Potamogeton natans*) and various fine leaved *Potamogeton* species (Reynolds et al., 2006). However, despite dedicated snorkel surveys the species was not identified within the study area (see section 3.2 below) but is likely to occur at the confluence of the Park Canal with the River Shannon where most recent records for the species have been detected (Ecofact, 2011).

Records are also available for otter (*Lutra lutra*) (including on the River Shannon, downstream of the Park Canal confluence), smooth newt (*Lissotriton vulgaris*) and common frog (*Rana temporaria*) within the grid square (although none specifically along the Park Canal).

Invasive species

According to data held by the National Biodiversity Data Centre, numerous invasive plant species are widespread within grid square R55, namely Japanese knotweed (*Fallopia japonica*), winter heliotrope (*Petasites fragrans*), Himalayan balsam (*Impatiens glandulifera*), giant hogweed (*Heracleum mantegazzianum*), water fern (*Azolla filiculoides*), Nuttall's pondweed (*Elodea nuttallii*) and least duckweed (*Lemna minuta*). All of these species have also been recorded in the vicinity, within and or along the Park Canal. A record for the non-native but established species Canadian pondweed (*Elodea canadensis*) is also available for the grid square.

In terms of invasive fauna, the Australian flatworm (*Australoplana sanguinea*) has also been recorded within the 10km grid square R55 (in 2019). The non-native cyprinid fish dace (*Leuciscus leuciscus*) is known in the Park Canal and is widespread in the lower River Shannon catchment. Zebra mussel (*Dreissena polymorpha*) are known from the tidal reaches of the River Shannon and Bunlicky Lake. The species may also occur locally in the Park Canal.

White-clawed crayfish (*Austropotamobius pallipes*)

There are no records for white clawed crayfish in the Park Canal from the National Biodiversity Data Centre webpage (accessed 17th June 2020). The species was, however, known historically at low densities from the canal according to Ecofact (2014). It is unknown whether crayfish plague (*Aphanomyces astacii*) outbreaks in parts of the Shannon system upstream (e.g. Al River in Athlone and in the Lorrha River (Lough Derg tributary)) may have resulted in local population extinction further downstream e.g. in the Park Canal. Further outbreaks in downstream connecting river catchments (e.g. Maigne and Limerick Deel) indicate the water mould disease is highly active in the wider Shannon catchment and may have extirpated many of the formerly present populations.

Fish populations

The Park canal is a heavily weeded and generally turbid canal basin that would be considered primarily a coarse fish habitat. Coarse fish species known from the lower River Shannon include roach (*Rutilus rutilus*), perch (*Perca fluviatilis*), pike (*Esox Lucius*), minnow (*Phoxinus phoxinus*), tench (*Tinca tinca*), bream (*Abramis brama*) and invasive dace. While bream (*Abramis brama*) and rudd (*Scardinius erythrophthalmus*) were once a prolific species in the lower River Shannon their numbers have been significantly reduced since the late 1990s. The canal may also support some migratory fish movement being connected to the River Shannon and Abbey River, albeit this would mostly be European eel (*Anguilla anguilla*), which would grow and mature in the habitat. Eel were recorded in high numbers during canal dredging works historically and are likely to still be present.

3.2 Physical habitat descriptions

The following section summarises the results of the site surveys for the three survey sections on the Park Canal (sections A, B and C as shown on Figure 2.1).

Survey section A – Park Canal

The Park Canal at Richmond had steep V-shaped 10-12m embankments adjoining a U-shaped channel. The channel width was approximately 8-10m wide and between 2m and 3m deep. The water was very slow moving and turbid at the time of survey. The substrata were dominated by silt. The riparian composition comprised of semi mature and mature alder (*Alnus glutinosa*), grey willow (*Salix cinerea*) and hawthorn (*Crataegus monoygna*) with bramble (*Rubus fruticosus* agg.) and reed canary grass (*Phalaris arundinacea*) in the understories with frequent bulrush (*Typha latifolia*), great willowherb (*Epilobium hirsutum*), lesser pond sedge (*Carex acutiformis*), tufted vetch (*Vicia cracca*) and marsh horsetail (*Equisetum palustre*).

The macrophyte growth of the Park Canal in the Lower Park area/ Rebogue area was dense, with pondweeds (*Potamogeton* species) and arrowhead (*Sagittaria sagittifolia*) being well represented. The macrophyte composition included frequent broad-leaved pondweed (*Potamogeton natans*) with the large pondweed shining pondweed (*Potamogeton lucens*) being locally frequent. The invasive pondweed *Elodea nuttalli* was recorded as occasional. Other species recorded included arrowhead *Sagittaria sagittifolia* that was abundant and most represented by the heterophyllous submerged strap-like form. Yellow water lily (*Nuphar lutea*) was also frequent with a proliferation of large submerged leaves given the higher turbidity of the canal. Blue water speedwell (*Veronica anagallis-aquatica*) was recorded locally in the margins. The duckweed species, ivy-leaved duckweed (*Lemna trisulca*) was abundant in submerged beds under pondweeds and arrowhead with the invasive duckweed (*Lemna minuta*) being more frequent floating in the margins of the canal. The margins of the canal supported locally emergent bulrush (*Typha latifolia*) with small patches of branched bur reed (*Sparganium erectum*).

Despite a dedicated transect search by snorkelling, *Groenlandia densa* was not recorded in survey section A.

No fish were observed during the snorkelling survey apart from very small numbers of roach and a single adult sea lamprey (*Petromyzon marinus*) that was evidently returning back from spawning grounds on the River Shannon or Mulkear tributary (heavily marked head from spawning activity). While this was an unusual encounter it, nonetheless, illustrates that the Park Canal may be used by migratory fish species such as sea lamprey, albeit fish passage is poor given the presence of lock gates.



Plate 3.1 Survey area A on the Park Canal.

Survey section B – Park Canal

The Park Canal between Park Bridge to Railway Bridge (i.e. Section B) had steep V-shaped 10-12m embankments adjoining a U-shaped channel. The channel width was approximately 10-12m wide and between 2m and 3m deep. The water was very slow moving and turbid at the time of survey and the substrata were dominated by silt. The riparian composition comprised of alder, white-willow (*Salix alba*), grey willow and osier (*Salix viminalis*) with bramble and reed canary grass in the understories. The macrophyte composition of the Park Canal in survey section B area had lush macrophyte growth as with other survey sections within the canal basin. The macrophyte composition was most well represented by floating broad-leaved pondweed that was recorded as frequent with *Potamogeton lucens* being recorded as locally frequent. The milfoil species whorl-leaf milfoil (*Myriophyllum verticillatum*) was recorded as rare. Other species recorded included arrowhead which was recorded locally (occasional). Yellow water lily was also occasional. Blue water speedwell was recorded locally in the margins. Ivy-leaved duckweed was locally frequent in submerged beds along the canal littoral.

Despite a dedicated transect search by snorkelling, *Groenlandia densa* was not recorded in survey section B.

No fish species or crayfish were observed in section B during snorkelling. It is likely that the habitat would support coarse fish such as pike, perch and roach, albeit fish density was considered low overall.



Plate 3.2 Survey section B on the Park Canal.

Survey section C – Park Canal

The Park Canal at Abbey Lock had gently sloping V-shaped 10-12m embankments adjoining a U-shaped canal channel. The channel width was approximately 8-10m wide with depths between 1.5m and 2.5m. The substrata comprised of sand, silt and fine gravels. The water was very slow moving and turbid (as with upstream) but evidently had a lower macrophyte diversity than upstream. This may have been because of historical drainage works. The riparian composition comprised of grey willow, crack willow (*Salix fragilis*), alder and other willow species with meadow sweet (*Filipendula ulmaria*), horsetail, bramble, nettle (*Urtica dioica*) and reed canary grass in the understories. Hemlock water dropwort (*Oenanthe crocata*) was present in the canal margins alongside reed sweet grass (*Glyceria maxima*). The macrophyte composition of the canal had frequent arrowhead dominated by the submerged form and occasional unbranched bur-reed (*Sparganium emersum*). Yellow water lily was also recorded as occasional. Blue water speedwell was recorded locally in the margins. Ivy-leaved duckweed was locally frequent in submerged beds along the canal littoral.

Despite a dedicated transect search by snorkelling, *Groenlandia densa* was not recorded in survey section C.

No fish species or crayfish were observed in section C during snorkelling. It is likely that the habitat would support coarse fish such as pike, perch and roach albeit fish density was considered low overall.



Plate 3.3 Survey section C on the Park Canal.

3.3 Macro-invertebrates

A summary of the taxonomic composition for the three invertebrate samples collected from 3-minute sweep samples in the Park Canal is summarised on Table 3.1 below. The samples had a good diversity of species including mayflies, beetles, dipterans and cased caddis. Section B had the highest diversity of the three sites with 18 species recorded with lower diversity recorded in sections A and B ($n=15$ & $n=10$ species respectively). The species recorded are indicative of more enriched, macrophyte-rich and silty conditions. For example, the mayfly species *Caenis horaria* and *Cloeon dipterum* are associated with slow-moving habitats and are considered tolerant of organic pollution and siltation (Kelly-Quinn & Regan, 2012). Snail species such as the grazer and filter-feeding *Bithynia tentaculata* and *Valvata piscinalis* are also indicative of more enriched conditions, and their capacity to filter feed allows them to be opportunistic of such environments. Furthermore, Coenagrionidae damselflies were well represented in the sample and these odonata are typically known to be widespread and tolerant of enrichment. The cased caddis species *Limnephilus marmoratus*, *Athripsodes aterrimus*, *Triaenodes bicolor* favour slow-moving habitats including canals in areas with plant growth. All are widespread species in Ireland.

No red listed invertebrate species were recorded from the survey area when compared with national red lists (Foster et al., 2009), mayflies (Kelly-Quinn & Regan, 2012) and other relevant taxa (i.e. Byrne et al., 2009; Nelson et al., 2011).

Table 3.1. Invertebrate taxonomic composition recorded in each survey section of the Park Canal.

Group	Family	Species	Section A	Section B	Section C
Mayfly	Caenidae	<i>Caenis horaria</i>		4	
Mayfly	Baetidae	<i>Cloeon dipterum</i>	2	8	
Mayfly	Ephemereillidae	<i>Seratella ignita</i>		5	
Shrimp	Gammaridae	<i>Gammarus duebeni</i>	14	2	
Beetle	Haliplidae	<i>Haliplus ruficollis</i> (group)	2	2	1
Dipteran	Chironomidae	Not speciated	10	11	9
Dipteran	Simuliidae	<i>Simulium</i> sp.		90	
Corixid	Corixidae	Corixid young instar	3	1	
Corixid	Corixidae	<i>Siagra dorsalis</i>			1
Hoglouse	Asellidae	<i>Asellus aquaticus</i>	30	7	5
Snail	Lymnaeidae	<i>Lymnaea stagnalis</i>	10	23	
Snail	Bithyniidae	<i>Bithynia tentaculata</i>	7	7	12
Snail	Planorbidae	<i>Planorbis planorbis</i>	3	1	
Snail	Valvatidae	<i>Valvata piscinalis</i>		57	
Lake limpet	Acroloxidae	<i>Acroloxus lacustris</i>	1	2	
Pea Mussel	Sphaeriidae	<i>Pisidium</i> sp.	3	6	4
Damselfly	Coenagrionidae	<i>Coenagrion pulchellum</i>	5	2	
Damselfly	Coenagrionidae	<i>Ischnura elegans</i>		1	1
Damselfly	Coenagrionidae	<i>Coenagrion pulchellum</i>		2	

Group	Family	Species	Section A	Section B	Section C
Cased caddis	Limnephilidae	<i>Limnephilus marmoratus</i>	8		
Cased caddis	Leptoceridae	<i>Athripsodes aterrimus</i>	1		
Cased caddis	Leptoceridae	<i>Triaenodes bicolor</i>	4	3	2
Alderfly	Sialidae	<i>larvae</i>			1
Water mite	Hydrachniidae	Not speciated			1
Taxon richness (n)			15	18	10

4. Discussion

The Park Canal can be considered an important area for aquatic biodiversity supporting a range of macrophyte, invertebrate and fish species. Both protected white-clawed crayfish and opposite leaved pondweed were known from the Park Canal historically but were not detected during the current survey. Historical dewatering and dredging works have resulted in changes in the macrophyte community overtime (Reynolds, 2013) and may have resulted in changes to the distribution of *Goelandia densa* overtime. *Groenlandia densa* may occur downstream of the survey area near the confluence with the Abbey River where the most suitable habitat conditions exist for its presence (i.e. near the mixing of the tidal water of the Abbey River where more open muddy habitat exists).

It is highly probable that the presence of crayfish plague in the River Shannon catchment may have resulted in the disappearance of crayfish from the Park Canal area (which is connected to hydrologically to the River Shannon). The canal evidently supported coarse fish species at low densities including invasive dace and roach. The watercourse is also known to support European eel and can be considered a good nursery for the species. High numbers of eel were detected during historical dewatering works and likely still use the habitat as a nursery area. A single adult sea lamprey was observed migrating back from spawning areas in the River Shannon during the snorkelling survey. The confluences of the canal extents with the River Shannon and Abbey River may support lamprey ammocoetes given the mixing of flowing water and soft sediment at these locations. The Stillwater of the Park Canal near Park Bridge are unlikely to support lamprey ammocoetes that favour flowing water.

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