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CORK COUNTY BRIDGE REHABILITATION SERVICES: ARDCAHAN BRIDGE

Ecological Appraisal Report

Prepared for:
Cork County Council

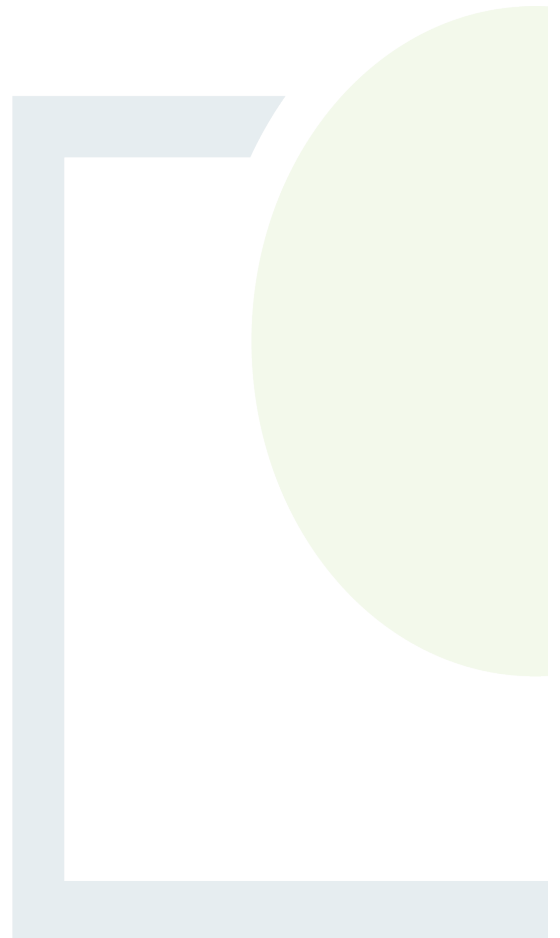


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Ecological Appraisal Report

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Abstract: This document comprises the Ecological Appraisal Report for Cork County Bridge Rehabilitation, Co. Cork for Ardcahan Bridge.

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1. INTRODUCTION

Fehily Timoney and Company (FT) were commissioned by Cork County Council to prepare an Ecological Appraisal Report, with regard to proposed works on Ardcahan bridge in the townlands of Ardcahan, Co. Cork (see Figure 2-1 for location).

The purpose of this evaluation was to:

- Undertake a desktop review of available ecological data for both the receiving environment and greater area, including a review of European sites within 15 km and/or potential zone of influence (ZoI) of the project (as part of a separate Appropriate Assessment Screening Report) and nationally designated sites within 10 km;
- Undertake ecological field surveys of the receiving environment;
- Identify flora and fauna and any invasive species present within the footprint of all elements of the project and;
- Appraise the potential impacts of the project on the ecology of the receiving environment.

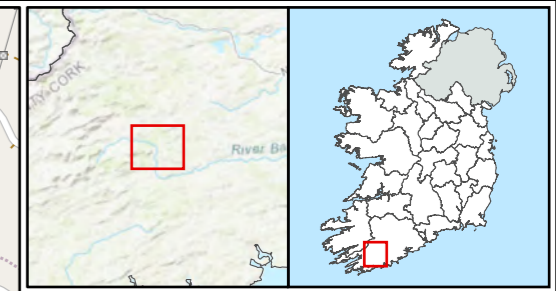
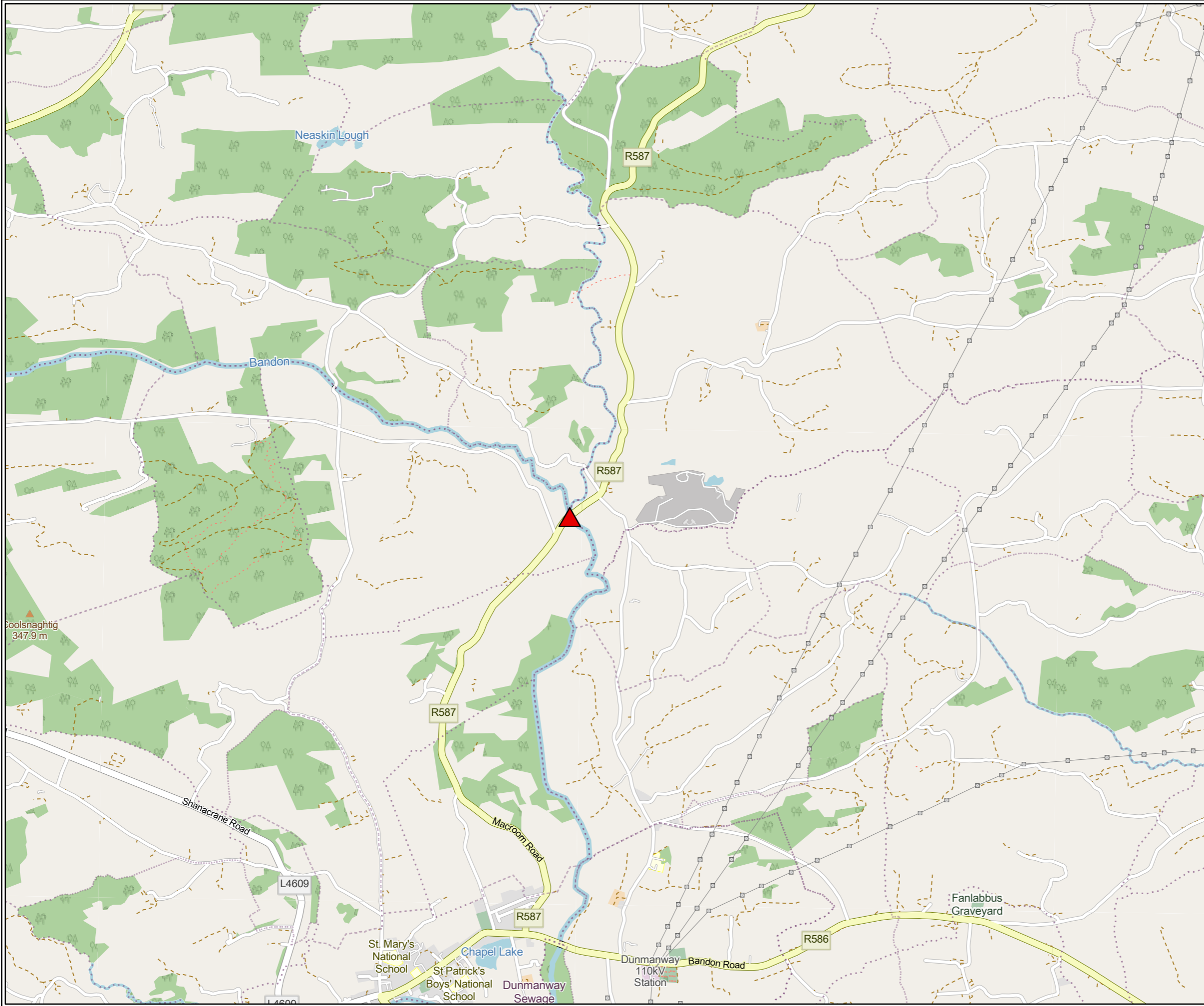



2. STUDY AREA

The landscape of the study area is rural in nature; the bridge is at an elevation of 73 m OD. The land use classification for the surrounding area as defined by the 2018 CORINE landcover dataset are: 231 Pastures, 243 Land principally occupied by agriculture with significant areas of natural vegetation and 133 Mines, dumps and construction sites.

The bedrock of the project area is Green-grey sandstone & purple siltstone. The soil types at and in the vicinity of the bridge are Alluvium and Sandstone till (Devonian).

The bridge spans the River Bandon (EPA Code 20B02), flowing north-south. The proposed development is located in the Bandon_SC_010 sub-catchment, which is part of the Bandon-Ilen catchment.



Legend
 Ardcahan Bridge

TITLE:	Site Location
PROJECT:	Ardcahan Bridge Rehabilitation
FIGURE NO:	2-1
CLIENT:	Cork County Council
SCALE:	1:24,000
REVISION:	0
DATE:	21/07/2023
PAGE SIZE:	A3





3. METHODOLOGY

3.1 Relevant Guidelines

The methodology for this appraisal has been devised in consideration of the following relevant guidance published by the Environmental Protection Agency (EPA) including 'Guidelines on the information to be contained in Environmental Impact Statements' (2022) and 'Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment' (DoECLG, 2013).

The appraisal also takes account of 'Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine', published by the Chartered Institute of Ecology and Environmental Management (CIEEM, 2018). The Heritage Council publication 'Best Practice Guidance for Habitat Survey & Mapping' (Smith *et al.*, 2011) is also referenced.

Relevant guidance published by the National Roads Authority (NRA) was also followed, including 'Guidelines for the Assessment of Ecological Impacts of National Road Schemes – Revision 2' (NRA 2009a), 'Ecological surveying techniques for protected flora and fauna during the planning of National Road Schemes – Version 2' (NRA 2009b), 'Environmental Impact Assessment of National Road Schemes – A practical guide' (NRA 2008a) and 'Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes' (NRA 2008b).

3.2 Consultation

The following bodies were consulted on the proposed project:

- National Parks & Wildlife Service (NPWS);
- Inland Fisheries Ireland (IFI).

Please note that previous proposals included removal of gravel above the waterline from Spans 1, 2 and 6 to improve conveyance. This was subsequently reduced to Span 1 and as such this is included in consultation summaries below.

More detailed site information obtained in 2023 confirmed that Span 1 could not be cleared without removing riparian tree roots and disturbing alluvial sediment and as such Span 1 could not be cleared without residual risks to freshwater pearl mussel (FPM). Therefore clearance of Span 1 was dropped and the current proposal is limited to repairs to the bridge structure.



For responses please see Table 3.1:

Table 3-1: Consultation responses

Consultee	Summary of Response
<p>NPWS (Site meeting on 8th July 2023)</p>	<p>More detailed surveys of riparian woodland in Span 1 clearance footprint required to investigate potential for links with Annex 1 habitat.</p> <p>More detailed hydrological modelling of flow alterations required to prove clearance of Span 1 won't affect FPM.</p> <p>Greater detail on water abstraction method (for gravel washing prior to reinstatement) required.</p> <p>Channel shading downstream would not be affected. Shading upstream would be reduced by removal of c. 3x multi-stemmed willow trees which border the channel.</p> <p>Willow tree root systems would need to be excavated on the upstream side in order to clear a channel through Span 1.</p> <p>Recommended placing geotextile under site compound aggregate to minimise disturbance when removing compound hard stranding.</p> <p>Chemical water testing should also be carried out due to potential for bridge repair activities and substances to cause pollution.</p>
<p>Inland Fisheries Ireland (IFI) (Consultation email received 24th May 2023)</p>	<p>All works are carried out in accordance with the IFI "Guidelines on protection of fisheries during construction works in and adjacent to waters".</p> <p>Instream works are limited to the period July to September inclusive.</p> <p>Only dry gravel or other riverbed material above the waterline at the line of the works should be removed.</p> <p>Instream tracking should be avoided where at all possible.</p> <p>Contaminated (suspended solids, hydrocarbon, cement products etc) construction runoff must be collected and disposed of in a manner so that pollution of surface waters cannot occur.</p> <p>On commencement and for the duration of construction a daily ongoing inspection programme of surface waters in the vicinity of the site should be undertaken, with any escape of contaminants notified immediately to IFI.</p> <p>All watercourse instream works should be carried out in the dry.</p> <p>IFI would ask to be notified prior to the commencement of works.</p> <p>Provision is made for the advance removal and relocation of fish stocks by means of electro-fishing as necessary when instream works occur.</p> <p>The free passage of fish should not be obstructed either during or a result of the works. In relation to the installation of rip rap on the river bed this must be undertaken in a manner that does not form an obstacle to fish passage post works.</p>



Consultee	Summary of Response
<p>NPWS, Cork. Co. Council (Video conference on 15th December 2020)</p>	<p>Access for bridge repairs requires scaffolding. Depending on the presence of FPM in the vicinity of the bridge, either suspended scaffolding or scaffolding resting on the riverbed may be used. Preconstruction survey required to determine presence and location of FPM.</p> <p>Arches to be dried out while excess gravel and sediment is removed. Sediment control measures to be implemented.</p> <p>Clearance of gravel and sediment from bridge arches to be carried out using vacuum truck.</p> <p>Willow trees upstream to be cut back to reduce flow impediments, roots to be preserved to keep sediment support system. Extent of tree cutting and potential for loss of shaded area suitable for FPM to be reviewed on site.</p> <p>Works will alter the flow speeds in the area. Further consideration to be given to this point. Works are planned to be carried out above mean water level, therefore normal flow profile will not be effected. Flow speed along the banks and downstream of the cleared areas may be increased locally. As the mussels downstream are concentrated in the centre of the channel, any changes in flow speed changes are unlikely to be detrimental.</p>
<p>NPWS, via DAU, Department of Arts, Heritage and the Gaeltacht (Consultation letter sent on 22nd May 2019)</p>	<p>Confirmation of receipt (DAU Ref. G Pre00150/2019) received 23rd May 2019. No other correspondence received.</p>
<p>Inland Fisheries Ireland (IFI) (Consultation letter sent on 22nd May 2019)</p>	<p>All watercourses should be considered to be fish bearing and passable to fish and treated accordingly unless proven otherwise.</p> <p>The construction of concrete bridge aprons should be avoided.</p> <p>Any proposed works should not cause a deterioration in this regard and instream works should be limited to the May-September period.</p> <p>Sediment and concrete based product control measures should be put in place as necessary.</p> <p>Should short terms diversions/ piping or over pumping be required all necessary measures which may include electro-fishing should be undertaken to ensure fish are not stranded in dried out areas.</p> <p>Please respond with details of the specific works proposed at each site for further consideration.</p>

3.3 Legislative Context

A diversity of flora and fauna, rare at a national level, are protected under the provisions of the Wildlife Act 1976, as amended, and the orders and regulations made thereunder, such as the Flora Protection Order (2022). The Habitats Directive 1992 has been transposed into Irish law by Part XAB of the Planning and Development Act 2000, as inserted. In addition, certain other obligations of the Habitats Directive have been transposed by the European Communities (Birds and Natural Habitats) Regulations 2011, as amended.



Section 171 of the Fisheries (Consolidation) Act 1959 creates the offence of throwing, emptying, permitting or causing to fall onto any waters deleterious matter. Deleterious matter is defined as not only as any substance that is liable to injure fish but is also liable to damage their spawning grounds or the food of any fish or to injure fish in their value as human food or to impair the usefulness of the bed and soil of any waters as spawning grounds or other capacity to produce the food of fish.

Under Section 3 of the Local Government (Water Pollution) Act, 1977 (as amended by Sections 3 and 24 of the 1990 Act) it is an offence to cause or permit any polluting matter to enter waters. Suspended solids would be a key parameter here. Likewise, any visual evidence of oil/fuel in the river would constitute an offence.

3.4 Desktop Study

In order to complete the Ecological Appraisal certain information on the existing environment is required. A desk study was carried out to collate available information on the site's natural environment. This comprised a review of the following publications, data and datasets:

- Cork County Development Plan 2022-2028
- Cork County Council Planning Enquiry System
- National Parks and Wildlife Service (NPWS) website and metadata available (www.npws.ie)
- OSI Aerial photography and 1:50,000 mapping
- National Biodiversity Data Centre (NBDC) (on-line map-viewer)
- BirdWatch Ireland website
- Teagasc soil area maps (NBDC website)
- Geological Survey Ireland (GSI) area maps
- Environmental Protection Agency (EPA) water quality data
- River Catchment & Sub-catchment WFD datasets

3.4.1 Designated Nature Conservation Sites

Natural Heritage Areas (NHAs) and proposed Natural Heritage Areas (pNHAs) within 10 km of the proposed site were identified as part of this ecological appraisal using the NPWS and EPA Map Viewers. European (Natura 2000) sites within 15 km and/or the potential zone of influence (Zoi) of this project, such as Special Areas of Conservation (SACs) and Special Protection Areas for birds (SPAs) were also identified as part of this ecological appraisal. A separate Appropriate Assessment Screening Report and Natura Impact Statement (NIS) were prepared to appraise the potential effects on European sites.

3.5 Field Study

Terrestrial ecological surveys were undertaken on 8th May 2019 and aquatic ecological surveys were undertaken on the 11th, 12th and 13th May 2019. Dedicated freshwater pearl mussel were carried out over the 11th and 12th July 2019. A further freshwater pearl mussel survey focusing on the immediate vicinity of the bridge was completed on 3rd July 2022. Further ecological information in light of advanced project design was gathered during the onsite consultation meeting on 8th July 2023, and previously recorded baseline conditions were also confirmed.



The objective of these visits was to gain an overview of the bridge location in regard to: the presence of invasive plant species; and habitats or species that are protected. Weather conditions were favourable for surveying. The area surveyed was the riparian corridor surrounding the bridge, here defined as up to 10m either side from the river banks and 150 m upstream and 150 m downstream of the bridge. The following were assessed during the walkover:

3.5.1 Habitats

The habitats within the riparian corridor of the proposed development were identified and classified, according to 'A Guide to Habitats in Ireland' (Fossitt, 2000). The plant species present in each habitat type were recorded, along with information on species abundance and relevant structural information. Invasive plant species were also identified with their location and area recorded using a handheld GPS.

Habitats were appraised and evaluated according to their occurrence as protected habitats under Annex I of the EU Habitats Directive (92/43/EEC) and for their capacity to support rare, threatened and endangered species. The methodology used in this report to assess the impact on habitats is based on NRA guidelines (2009).

The habitat mapping exercise had regard to the 'Best Practice Guidance for Habitat Survey and Mapping' (Smith *et al.*, 2011) published by the Heritage Council. Scientific and common names for plants follow Parnell *et al.* (2012), Rose *et al.* (2006) and Fitzpatrick *et al.* (2016), respectively. In addition to habitat identification, each habitat was assessed for its ecological significance, according to the guidance document Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009).

3.5.2 Mammals (excluding bats)

Mammal observations or signs were recorded during the survey, with a particular focus on otter *Lutra lutra* given the riparian habitats present in the vicinity of the bridge. The otter survey was carried out in accordance with NRA Guidelines (NRA, 2009).

3.5.3 Bats

During the surveys, the bridge structure itself as well as adjacent habitats and structures (such as trees, buildings etc.) were assessed for their potential suitability as bat roosts bats on the basis of the Billington and Norman (1997) and Collins (2016).

3.5.4 Avifauna

All bird species observed and heard within the study area were noted during the surveys, with a particular focus on kingfisher *Alcedo atthis* and dipper *Cinclus cinclus* given the riparian nature of the works. The conservation status of birds within Ireland and Europe is assessed using one or more of the following documents: Wildlife Acts (–as amended), The Status of EU Protected Habitats and Species in Ireland (NPWS, 2019) and Birds of Conservation Concern in Ireland (BoCCI) (Gilbert *et al.*, 2021).



3.5.5 Other (terrestrial) Taxa

During the course of the surveys, other species of fauna were noted. The conservation status of other taxa within Ireland and Europe is assessed using one or more of the following documents: Wildlife Acts (as amended) The Status of EU Protected Habitats and Species in Ireland (NPWS, 2019), Irish Red Data Book for Non-Marine Molluscs (Byrne *et al.*, 2009), Irish Red Data Book for Butterflies (Regan *et al.*, 2010), and Irish Red Data Book for Amphibians, Reptiles & Freshwater Fish (King *et al.*, 2011).

3.5.6 Aquatic Surveys

Walkover Surveys

Walkover surveys focused on both instream and riparian habitats were carried out. Surveys focused on 150 m both upstream and downstream of the bridge. Where safe and practical, in-stream surveys were undertaken. Baseline appraisals of habitat suitability for protected species of conservation interest which are known or suspected to occur within the study area (e.g. European eel, otter, kingfisher etc.) were conducted, as well as fisheries potential for various species groups, e.g. salmonids, lamprey, European eel.

Aquatic habitat assessment was conducted according to the methodology given in the Environment Agency's 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003' (EA, 2003) and the Irish Heritage Council's 'A Guide to Habitats in Ireland' (Fossitt, 2000).

The site was assessed in terms of:

- Stream width and depth and other physical characteristics
- Substrate type, listing substrate fractions in order of dominance, i.e. large rocks, cobble, gravel, sand, mud etc.
- Flow type, listing percentage of riffle, glide and pool in the sampling area
- In-stream vegetation, listing plant species occurring and their percentage coverage of the stream bottom at the sampling site (as applicable) and on the bankside

The existing environment was described in terms of the important aquatic habitats/species within the bridge works footprint. It also identified sensitive aquatic habitats and species occurring in the study area.

Fisheries habitat

Fisheries appraisals of the watercourses within the proposed bridge repair works footprints were undertaken to establish the importance of these areas as salmonid, lamprey, European eel and general fisheries habitat. The baseline assessment considered the quality of spawning, habitat and nursery habitat bordering, and with connectivity to, the proposed works areas.

More detailed methodologies for salmonids and lamprey are given in Appendix 2 (Aquatic Ecology Report).

Freshwater pearl mussel (Annex II)

An appraisal of freshwater pearl mussel habitat was undertaken based on physical channel attributes and overall habitat suitability. Furthermore, a desktop review of known distributions of pearl mussel also undertaken.

A sensitive species data request for freshwater pearl mussel for relevant grid squares on the rivers Bandon and Ardcahan was issued to the NPWS on Saturday 1st June 2019 and was received on Thursday 13th June 2019.



Following an initial appraisal, stage I and stage II freshwater pearl mussel surveys were undertaken to establish the presence/absence of the pearl mussel and also to conduct population estimates in light of proposed bridge repair works. These are used to help evaluate the density and distribution of pearl mussel populations relative to the proposed bridge works, thus informing the relative importance of a pearl mussel population in the context of potential impacts from instream works.

More detailed methodologies are given in Appendix 2 (Aquatic Ecology Reports).

White-clawed crayfish (Annex II)

As part of this baseline survey, an appraisal of white-clawed crayfish (*Austropotamobius pallipes*) habitat was undertaken based on physical channel attributes, water chemistry and incidental records in otter spraint. Furthermore, a desktop review of known distributions of crayfish was also undertaken.

Otter (Annex II)

Incidental signs of otter activity including holts, spraint, latrines and prints were recorded within 150 m upstream and 150 m downstream of the bridge site, where encountered. All otter sign locations were logged and mapped via a handheld Garmin GPS. The overall value of the habitats within and adjoining the proposed works area for breeding and foraging otter was also considered.

3.5.7 Survey Limitations

No targeted electro-fishing or netting methodologies were employed to further elucidate fish stocks of the study site during the baseline aquatic survey.

It is noted that fisheries surveys are not a key element of the assessment due to the absence of instream works.



4. PROPOSED WORKS

In summary, the rehabilitation at Ardcahan Bridge will require the following works according to the Construction Environmental Management Plan (CEMP). The works will take place over a 6 to 10 week period (July to September inclusive).

Temporary Site Compound:

During the construction phase, it will be necessary to provide temporary facilities for construction personnel. This project will have 1 no. temporary compound located near the entrance to the site which will include welfare facilities. The location of the temporary site compound is proposed to be set back c. 30m from the south west corner of the bridge, as shown in Figure 3 1. The temporary compound shall be constructed with crushed rock aggregate hard standings with low dust content. Temporary facilities will be removed, and the lands reinstated upon completion of the construction phase.

Facilities to be provided in the temporary site compound will include the following:

- Welfare facility
- Employee parking
- Contractor lock-up facility
- Bottled water for potable supply
- Water tanker to supply water used for other purposes
- Fuel storage
- Diesel generator
- Storage areas
- Waste management areas

The site compound is located in agricultural land within the Bandon River SAC (see Figure 4-1).



Figure 4-1: Site compound location south-west of Ardcahan Bridge

Corrosion Repairs & Minor Parapet Repairs:

1. To facilitate the installation of the scaffold, vegetation within a 2-meter width on either side of the bridge face will be cut back.
2. A scaffold shall be installed to allow access to the underside of the bridge arches.
3. Steel beams to be sandblasted to SA2.5 as per detail provided in Drawings P1959-ARDH-0004. Note that one operator will carry out the sandblasting using appropriate sandblasting equipment accessing the beams surface from the scaffold provided. Sandblasting equipment typically consists of a chamber in which sand and air are mixed. The mixture travels through a hand-held nozzle to direct the particles toward the surface of work.
4. Welding of additional steel plate at the bottom flange of existing steel beams as shown in Drawings P1959-ARDH-0004. One operative will carry out the welding using portable electric welding equipment accessing the beams surface from the scaffold provided.
5. A protective paint system to be applied to all exposed steel work, Hempel Hempadur Mastic 45880/1 or similar approved to be applied by brush in 2 coats of minimum 190 micron DFT (dry film thickness). One operative will paint the steel beams accessing them from the scaffold provided.
6. Steel Drip Strips will be positioned along the bottom edge of the bridge parapet on both sides of the bridge, the holes will be drilled along the bridge as per the spacing shown in drawing P1959-ARDH-0004 and bolted through with post-fixed mechanical anchors as shown in drawings P1959-ARDH-0004. The position of these elements is shown on drawings P1959-ARDH-0004.
7. Cracking at Deck Pier interface to be injected with Epoxy Resin. Prior the injection, the crack and surrounding surface will be cleaned to allow the paste-over to bond to sound concrete. The epoxy resin will be pressure pumped locally (directly into the cracks) to close the cracks at the Deck Pier interface. The deck/pier interface is above the waterline.
8. Vegetation on the internal side of the existing parapet and drainage outlets to be cleared from structure.



9. Minor repairs to missing sections of render shall be carried out along the parapet as shown in P1959-ARDH-0003. Repairs to be carried out by hand by an operator accessing the parapet surface from the deck/scaffolding level.
10. New Black PVC drain pipe to be positioned in the existing drainage outlets location and fixed in place with mortar from the deck level.
11. Scaffold to be removed

Deck Works:

1. Upon completion of the corrosion repairs it is proposed to repair the road surfacing on this bridge. A road closure and diversion will be required to facilitate these works.
2. The existing road surface shall be scarified, and the existing surface shall be removed and the concrete surface of the bridge deck exposed.
3. Any defects encountered when deck is exposed to be repaired using an appropriate concrete repair mortar. This will only include small localised repairs with concrete repair mortar, limited to the top side of the deck.
4. A trial hole and rebar scan shall be completed to confirm deck reinforcement and strength. The trial hole will be superficial and will not penetrate the entire thickness of the deck. If this investigation is unsatisfactory, Cork County Council may introduce a weight limit to the bridge.
5. A spray applied bridge deck waterproofing system shall be installed.
6. Kerb drain (feeding to new Black PVC drainage outlet) and concrete rubbing strip to be installed by an operator accessing the area from the deck level.
7. The pavement surface shall be laid, sand asphalt followed by HRA, high friction colour contract surfacing shall be applied.



5. EXISTING ENVIRONMENT

5.1 Designated Sites

The proposed project is located within the Bandon River SAC (site code 002171). One other European site is located within 15 km of the bridge. Both sites are discussed in full in the accompanying Appropriate Assessment screening and Natura Impact Statement reports.

One site of national importance (one proposed Natural Heritage Area) is located within 10 km of the bridge. This pNHA overlaps with a European site whose designation supersedes that of the national sites (Bandon Valley South of Dunmanway pNHA 001035 overlaps with the Bandon River SAC).

5.2 Habitats Within and Immediately Adjacent to the Proposed Development

There are ten habitat types at and around the bridge (Figure 2):

- Depositing/lowland rivers (FW2)
- Buildings and artificial surfaces (BL3)
- Dense Bracken (HD1)
- Wet grassland/Dry calcareous and neutral grassland Mosaic (GS4/GS1)
- Improved agricultural grassland (GA1)
- Hedgerows (WL1)
- Treelines (WL2)
- Dry meadows and grassy verges (GS2)
- Scrub (WS1)
- Riparian woodland (WN5)

Buildings and artificial surfaces (BL3) is represented by the bridge structure itself, while depositing/lowland rivers (FW2) is represented by the Bandon River. Dry meadows and grassy verges (GS2) is present along road verges leading up to the bridge.

Narrow strips of riparian woodland (WN5) dominated by grey willow (*Salix cinerea*) are present up and down-stream of the bridge along the riverbanks. This habitat has potential for links with the Annex I habitat 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*' [91E0].

A mosaic of wet grassland / dry calcareous and neutral grassland (GS4/GS2) habitat is present in the field south-west of the bridge where the proposed site compound is located. Species indicative of wet conditions include Yorkshire fog (*Holcus lanatus*), ragged robin (*Silene flos-cuculi*) and rushes (*Juncus Spp.*), while the presence of selfheal (*Prunella vulgaris*), cat's ear (*Hypochaeris radicata*) and crested dog's tail (*Cynosurus cristatus*) are indicative of calcareous/neutral conditions. This is likely to be due to the presence of alluvial soils closer to the river which would differ in their makeup from the more acidic soils which would be characteristic of the surrounding upland areas. This habitat does not have links with any Annex 1 habitat type.

The other habitats are present in riparian areas up and down-stream, and in the surrounding landscape.



Exuberant instream water crowfoot (*Ranunculus penicillatus*) was present. This floating river vegetation shares strong links with EU Habitats Directive Annex I habitat type 'Watercourses of plain to montaine levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation (3260)'.

Detailed habitat descriptions are included in Appendix 1 and detailed aquatic habitat descriptions are included in Appendix 2.

5.3 Invasive species

The following invasive plant species were found in the vicinity of the bridge during the field survey (Figure 5-1):

1. Low impact - winter heliotrope (*Petasites fragrans*)

This species was recorded in the road verge adjacent to the north-western corner of the bridge. This species is not within the footprint or zone of influence of the proposed repair works.

The following were identified in the desktop review of the 2 km grid square (W25M) where the bridge is located: Canadian waterweed *Elodea canadensis* (Schedule III, High Impact invasive species; recorded in 2006). Canadian waterweed was not recorded during surveys at or near Ardcahan Bridge.

5.4 Mammals (excluding bats)

Otter signs (spraints) were recorded under or in the vicinity of the bridge. The channel is suitable for foraging/commuting otter. No holts or slides were recorded.

No signs of other mammal species were recorded. The following were identified in the desktop review of the 2 km grid square (W25M) where the bridge is located: badger *Meles meles* (Wildlife Acts; recorded 2013), red squirrel *Sciurus vulgaris* (Wildlife Acts; recorded 2012), otter *Lutra lutra* (Wildlife Acts and Annex II; recorded 2016), pine marten *Martes martes* (Wildlife Acts; recorded 2012) and hedgehog *Erinaceus europaeus* (Wildlife Acts; recorded 2016).

5.5 Bats

The underside of the bridge has moderate potential for bats, with a few crevices that could act as roosting habitat. Treelines near to the bridge are suitable for commuting bats. The River Bandon is suitable for foraging Daubenton's bat.

Brown long-eared bat (*Plecotus auritus*; Wildlife Acts; Annex IV; recorded 2012) were identified in the desktop review of the 2 km grid square (W25M) where the bridge is located.

5.6 Avifauna

No evidence of nesting dipper was observed, although birds were observed feeding and diving under the bridge. No evidence of kingfisher was observed. Banks were evaluated as unsuitable for nesting kingfisher; the river is of high suitability for foraging kingfisher. No other riparian birds were recorded using the local area.

No birds of conservation concern were identified in the desktop review of the 2 km grid square (W25M) where the bridge is located.



5.7 Aquatic Surveys

Some excellent salmonid spawning habitat was present in the close vicinity of the bridge (both upstream and downstream) in well sorted coarse and medium gravel beds adjoining pool tailings. Both adult and juvenile brown trout were observed and a high abundance of Atlantic salmon parr was also noted, particularly downstream of the bridge. Good salmonid nursery habitat was located in the fast-flowing water flowing over the cobbled bed of bridge abutments. Ardcahan Bridge featured good fish passage with no evident obstructions.

Lamprey spawning habitat was situated at the same locations, with notably good nursery habitat immediately downstream of bridge in deep pool below the bridge apron (right hand bank) and upstream at the mouth of the Caha River.

No white-clawed crayfish records are known from the Bandon catchment, being a sandstone geology river, and none were recorded during the survey.

Good European eel habitat was present locally in association with deeper pool areas and large macrophyte stands, especially upstream of the bridge structure in deeper glide habitat.

Results from the initial surveys showed that algal growth was also visible on both live and dead freshwater pearl mussel shells upstream (and downstream) of the bridge, typically in pool areas adjoining glide and riffle where stable cobble was present amongst gravels. Pearl mussels (both live and dead) were also present upstream of the bridge with small numbers present in gravels at mouth of the adjoining Caha River. Limited pearl mussel habitat was present under the bridge structure.

Results from the stage I and II freshwater pearl mussel surveys showed that pearl mussels were well distributed throughout the Ardcahan survey sections with the highest densities recorded in the immediate downstream vicinity (≤ 5 m) of the bridge structure. At this location, unbedded cobble and gravel substrata provided stable footing opportunities for mussels in deep glide areas downstream of the bridge. However, filamentous algal cover (indicating enrichment) and siltation were evidently causing stress to some mussels (approx. 20% of individuals) in this area at the time of survey. Other areas such as survey section B (50- ≤ 125 m downstream of bridge), which comprised stable cobble in deeper glide, also supported moderate quality pearl mussel habitat (87 live mussels recorded), albeit siltation pressures were still evident. Indeed, siltation and eutrophication pressures have already been identified as significant in the Bandon catchment and are seriously impacting pearl mussel habitat. Recent significant native woodland removal and instream works approx. 6.5 km upstream at Keenrath (Triturus Environmental Ltd. pers. obs.) during 2018 and 2019 has resulted in further destruction of pearl mussel habitat and evident deterioration of water quality. Continued pressure from land use activities is continuing the long-term trend of habitat deterioration in the catchment and has to be reversed in order to restore habitat quality for pearl mussel if the river population is to be prevented from extinction.

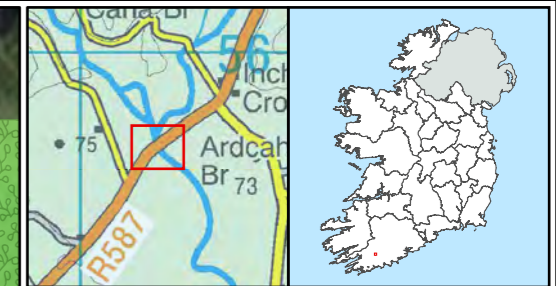
The most recent surveys carried out on July 3rd 2022 recorded n=14 mussel in the bridge apron. These are summarised in Table 1 below. Given the limitations of correct GPS signal accuracy under the bridge structure the occurrence of mussel is recorded relative to each of the bridge arches in Table 5-1 below. Span 1 is on the east side of Ardcahan Bridge with span 6 on the west side.

Detailed results and descriptions are included in Appendix 2 (Aquatic Ecology Report).



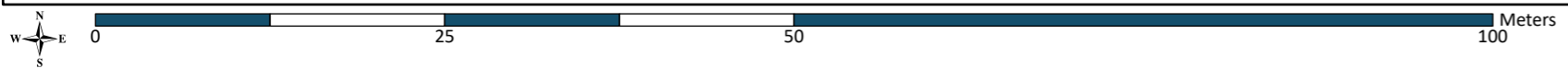
Table 5-1: Location of freshwater pearl mussel relative to bridge arches

Span No.	Number of Mussels	Location of mussel under arch facing upstream	Notes on habitat
Span 1	None	None	Dry arch with large pile of gravels, localised ponding water near pier
Span 2	4 + 2	3 on downstream side of span right hand side (c. 3m) and 2 mussels c. 2.5m downstream centre	Situated in cobble and gravels downstream of apron
Span 3	4	3 at upstream side of span on left hand side near pier and 1 no. mussel centre on downstream side	Situated in void between historical cobble apron
Span 4	3	2 at upstream side of span on left hand side near pier and 1 no. mussel centre on downstream side	Situated in void between historical cobble apron
Span 5	1	Single mussel at centre of arch downstream side	Situated in void between historical cobble apron
Span 6	None present	None present	Dry arch during summer surveys with large gravel bank
Total mussels	14	n/a	n/a



- Legend**
- Ardcahan Bridge
 - Winter Heliotrope
- Habitat Polygon Code, Description**
- BL3, Buildings and Artificial Surfaces
 - FW2, Depositing / Lowland Rivers
 - GA1, Improved Agricultural Grassland
 - GS4/GS2, Wet Grassland/Dry Meadows and Grassy Verges Mosaic
 - HD1, Dense Bracken
 - WN5, Riparian Woodland
 - WS1, Scrub
- Habitat Line Code, Description**
- WL1, Hedgerows
 - WL2, Treelines

TITLE:	
Habitat Map and Invasive Species	
PROJECT:	
Ardcahan Bridge Rehabilitation	
FIGURE NO: 5-1	
CLIENT: Cork County Council	
SCALE: 1:500	REVISION: 0
DATE: 21/07/2023	PAGE SIZE: A3





6. POTENTIAL IMPACTS AND MITIGATION

6.1 Designated Sites

A separate Appropriate Assessment Screening Report has been undertaken to identify likely significant effects to European sites (SACs and SPAs) resulting from the proposed development either alone or in-combination with other plans or projects. This concluded that likely significant effects to the Bandon River SAC could not be ruled out prior to mitigation. As such, a Natura Impact Statement (NIS) was prepared. This Natura Impact Statement has considered the potential for the proposed project to give rise to adverse effects on the integrity of the Bandon River SAC (002171) alone and in combination with other plans and projects. Where adverse effects were identified, mitigation measures were been recommended to prevent these effects.

Following a comprehensive evaluation of the effects on the qualifying interests and conservation objectives for the SAC and the implementation of the proposed mitigation measures, it has been concluded that there will be no residual effects. Therefore, the proposed bridge remediation works will not have an adverse effect on the integrity of the Bandon River SAC (002171).

In this section on designated sites, impacts to proposed Natural Heritage Areas (pNHAs) and Natural Heritage Areas (NHAs) that are outside SPAs and SACs have been identified for assessment. The proposed development is within the boundary of the Bandon River SAC, which flows into and overlaps with Bandon Valley South of Dunmanway pNHA (site code 001035). Consequently, any recommendations for the pNHA are the same as those made for the SAC.

6.1.1 Mitigation

Mitigation measures for designated sites:

- Described in accompanying Natura Impact Statement and CEMP.

6.2 Habitats Within and Immediately Adjacent to Proposed Development

Floating river vegetation that shares strong links with EU Habitats Directive Annex I habitat type 'Watercourses of plain to montaine levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260)' is present immediately up and down-stream of the bridge. Riparian woodland (WN5) is present up and down-stream of the bridge. Wet grassland/dry calcareous and neutral grassland mosaic (GS4/GS2) is present in the area of the proposed site compound.

Trimming of tree branches within 2m of the bridge will be required for access and repairs. Floating river vegetation will not be directly impacted by works as it does not occur immediately at bridge structure. This habitat could potentially be subject to indirect effects arising from siltation or pollutant inputs. Wet grassland /dry calcareous and neutral grassland will be affected by construction of the proposed site compound and concrete washout area (overall footprint c. 30m²). The vegetation in the footprint of the site compound will be covered for the duration of the project (6-10 weeks), and vegetation along the access route will be disturbed.



6.2.1 Mitigation

- A geotextile will be placed under the aggregate hard standing of the site compound to minimise soil disturbance and ensure the seed bank is retained to aid in natural recolonisation after the hardstanding is removed.
- Prevent ingress of dust, sediment or pollutants during steel beam and deck repairs. This will be achieved through the use of impermeable membranes on work platforms and blocking of drainage eyelets in the bridge parapets during deck works.
- Trimming of trees will be limited to tree branches; no main stems will be cut. An ECoW will supervise tree trimming to minimise the area affected.

6.3 Invasive Species

The invasive plant species, winter heliotrope is present along the road verge at the north-western corner of the bridge. This species is not within the footprint or zone of influence of proposed repair works, so the risk of accidental spreading is very low.

6.3.1 Mitigation

- Prior to works an invasive species survey will be undertaken in the area to reconfirm the findings of the Ecological Appraisal.
- If any invasive species have become established in areas potentially affected by works, management measures will be prepared and agreed with NPWS and the contractor prior to construction.
- Demarcation fencing and signage will be installed to implement an exclusion area around invasive species in which no works or access will be permitted.
- All workers on site will be informed of the location of the exclusion zone in advance of the works.
- Good work hygiene practises will be adhered to throughout.

6.4 Mammals (excluding bats)

Otters may undergo some temporary disturbance during the repair works (duration of works will be no more than 10 weeks). No otter holts or couches were present within 150m up and down-stream of the bridge during surveys. None of the other species identified in the desktop review are likely to be affected by the proposed works.

6.4.1 Mitigation

- There is the potential for holts to be discovered during vegetation clearance works. Care will need to be taken during this early stage of the development and a competent ecologist will be required on-site for these works. If a holt is discovered, all works within 150m of the holt shall cease including vegetation clearance. NPWS shall be contacted, and a derogation licence shall be sought. An activity survey shall be carried out to assess the potential for the holt to be used by otters.



- All efforts to minimise pollution and siltation escapement to the river will be made and an Ecological Clerk of Works (EcoW) will be present to supervise the construction activities as informed by their knowledge of the site's ecological sensitivities.
- Working hours will be constrained to daylight.

6.5 Bats

There is moderate bat roosting potential within the bridge structure.

6.5.1 Further Surveys

Surveys are currently ongoing. As part of this application, further surveys as detailed below will be completed during the 2023 survey season:

- An endoscope survey (licensed) and emergence surveys (2 separate emergence survey rounds) will be carried out to confirm the presence/absence of bats using the bridge structure, locations of any entry/exit holes and obtain information on internal suitability of any spaces with roosting potential.

6.5.2 Derogation

- If bats are found to be present, the derogation process will be completed (a derogation licence will be sought from NPWS to allow works to proceed in a manner which minimises disturbance and ensures no bats are harmed).
- An Annex IV assessment and report shall be completed in the event that bats are present in the bridge.
- A bat specialist will carry out any exclusion procedures required under the conditions set out in the derogation licence prior to any works.

6.5.3 Mitigation

- Carry out preconstruction endoscope and emergence surveys (2 separate emergence survey rounds) to re-confirm baseline conditions.
- If bats are found to be present, the ECoW will supervise works (accompanied by a bat specialist if required) to ensure they are carried out in a manner which minimises disturbance and ensures no bats are harmed.

6.5.4 Enhancement

- Bat boxes will be installed under the bridge to enhance roosting potential and increase roosting options and capacity. It is noted that the bridge is located in an area which presents opportunities for foraging bats, but roosting opportunities in the bridge may be limited.



6.6 Avifauna

The absence of kingfisher presence and suitable breeding habitats precludes any impacts to breeding kingfisher. Dipper were present feeding but not breeding under the bridge. None of the other species identified in the desktop review are likely to be affected by the proposed works.

6.6.1 Mitigation

- Works should be carried out outside of the bird breeding season (March – August inclusive) and if not possible, checks should be made to reconfirm the surveys completed to date and ensure no dipper nests are present prior to works.
- If any dipper are found nesting prior to works, works shall not begin until young are confirmed to have fledged
- In the event of other bird species nesting within affected areas, suitable mitigation will be put in place and trimming will only proceed upon agreement with NPWS and receipt of a wildlife licence.
- Kingfisher and dipper: Implement water quality mitigation measures detailed in CEMP to minimise and prevent the identified indirect impacts to water quality.

6.6.2 Enhancement

- Install dipper nest boxes under bridge to enhance suitability of area for breeding dipper.

6.7 Aquatic fauna

Freshwater pearl mussel are present under and in the vicinity of the bridge, and salmonids are also present in the area. Lamprey spawning habitat and European eel habitat are also present. These aquatic ecological receptors could be adversely affected by scaffolding installation and release of silt and pollutants.

6.7.1 Mitigation

- Given the location of the Ardcahan Bridge site within the River Bandon SAC, and the widespread decline of pearl mussel numbers within the catchment (NS2, 2010), it is critically important to prevent any silt or pollution escapement during bridge repair works through strict adherence to the water quality mitigation measures defined in the Construction Environmental Management Plan (CEMP).
- It is also important to monitor water quality throughout the construction period to prevent any spikes in siltation or pollution. Chemical and physico-chemical water testing will be undertaken to help ensure any pollution arising from steel beam repair and bridge deck works is prevented.
- A suspended scaffold attached to the bridge deck will be used in order to avoid instream works/access and prevent injury or mortality of pearl mussels during scaffold installation.
- Aggregate with low content of fines will be used for construction of the temporary compound hard standing in order to minimise sediment washout.
- All concrete washout shall be carried out in a dedicated area of the temporary compound.
- Biosecurity/invasive species measures detailed in the CEMP will be adhered to.



7. RESIDUAL IMPACTS

With the implementation of the mitigation measures detailed in this Ecological Appraisal, the CEMP and the NIS, there will be no significant residual impacts from the bridge rehabilitation works on biodiversity.



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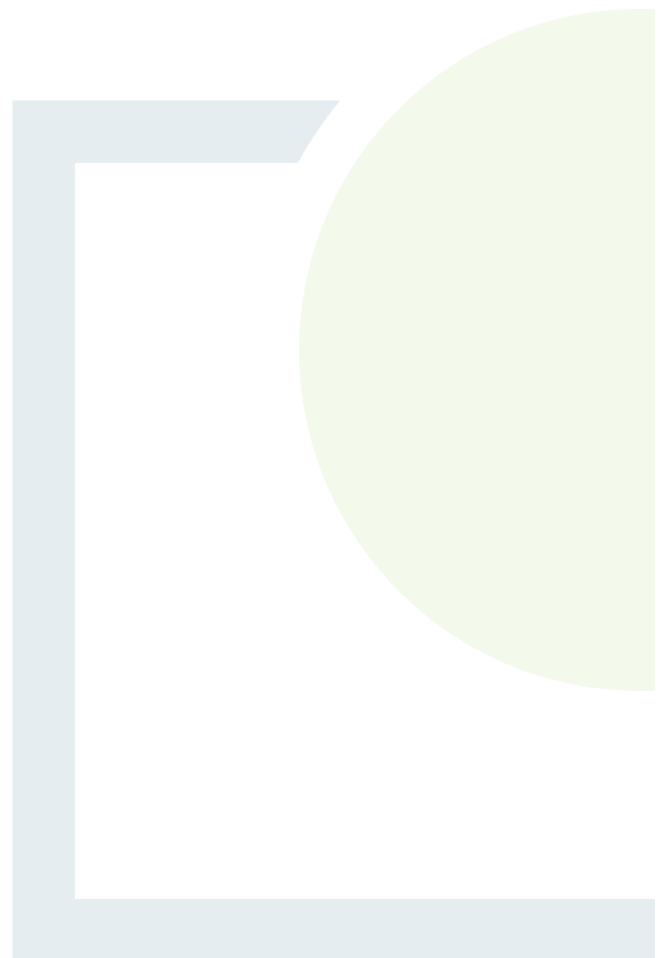
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APPENDIX 1

Habitats



Depositing/Lowland Rivers (FW2), Buildings and Artificial Surfaces (BL3), Treelines (WL2)

Depositing/lowland rivers habitat type is found in the river that the Ardcahan bridge spans. Note the instream vegetation. Buildings and artificial surfaces is represented by the bridge itself. Also visible in the photo are treelines.



Figure 1: Depositing/Lowland Rivers (FW2), Buildings and Artificial Surfaces (BL3), Treelines (WL2)

Depositing/Lowland Rivers (FW2) and Riparian Woodland (WN5)

Depositing/lowland rivers makes up the River Bandon that Ardcahan bridge spans. Also present are patches of riparian woodland (edges of which seen here).



Figure 2: Depositing/Lowland Rivers (FW2) and Riparian Woodland (WN5)

Dry Meadows and Grassy Verges (GS2), Hedgerows (WL1) and Buildings and Artificial Surfaces (BL3)

Buildings and artificial surfaces include the road that crosses the bridge. Hedgerows can also be seen along the edge of the road. Dry meadows and grassy verges are present alongside the road. Note also the presence of winter heliotrope in this picture.



Figure 3: Dry Meadows and Grassy Verges (GS2), Hedgerows (WL1) and Buildings and Artificial Surfaces (BL3)

Wet grassland (GS4)/ Dry calcareous and neutral grassland Mosaic (GS4/GS2)

A mosaic of wet grassland / dry calcareous and neutral grassland (GS4/GS2) habitat is present in the field south-west of the bridge where the proposed site compound is located. Species indicative of wet conditions include Yorkshire fog (*Holcus lanatus*), ragged robin (*Silene flos-cuculi*) and rushes (*Juncus Spp.*), while the presence of selfheal (*Prunella vulgaris*), cat's ear (*Hypochaeris radicata*) and crested dog's tail (*Cynosurus cristatus*) are indicative of calcareous/neutral conditions. This is likely to be due to the presence of alluvial soils closer to the river which would differ in their makeup from the more acidic soils which would be characteristic of the surrounding upland areas. This habitat does not have links with any Annex 1 habitat type.

This habitat does not have links with any Annex 1 habitat type.



Figure 4: Wet grassland/ Dry calcareous and neutral grassland Mosaic (GS4/GS2)

Riparian Woodland (WN5)

Narrow strips of riparian woodland (WN5) dominated by grey willow (*Salix cinerea*) forming gallery woodland are present up and down-stream of the bridge along the riverbanks. These wooded areas occur on mixed mud and gravel deposits closer to the river and extend into drier ground further back from the water, resulting in species associated with wet conditions occurring in proximity to drier/more generalist plant species.

Individual specimens of Ash (*Fraxinus excelsior*), blackthorn (*Prunus spinosa*) and sycamore (*Acer pseudoplatanus*) were also recorded. Other plant species present include hedge woundwort (*Stachys sylvatica*), nettle (*Urtica dioica*), broadleaved plantain (*Plantago major*), hemlock water dropwort (*Oenanthe crocata*), marsh marigold (*Caltha palustris*), fool's watercress (*Apium nodiflorum*), valerian (*Valeriana officinalis*), ivy (*Hedera helix*) remote sedge (*Carex remota*), wood avens (*Geum urbanum*), meadowsweet (*Filipendula ulmaria*), Galium Sp., bramble (*Rubus fruticosus*), Rumex Sp., false brome (*Brachypodium sylvaticum*), scaly male fern (*Dryopteris affinis*) and marsh ragwort (*Jacobaea aquatica*).

This habitat has potential links with the Annex I habitat 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*' [91E0].



Figure 5: Riparian Woodland (WN5)

Scrub (WS1)

A scrubby transitional zone is present at the south-west corner of the bridge.



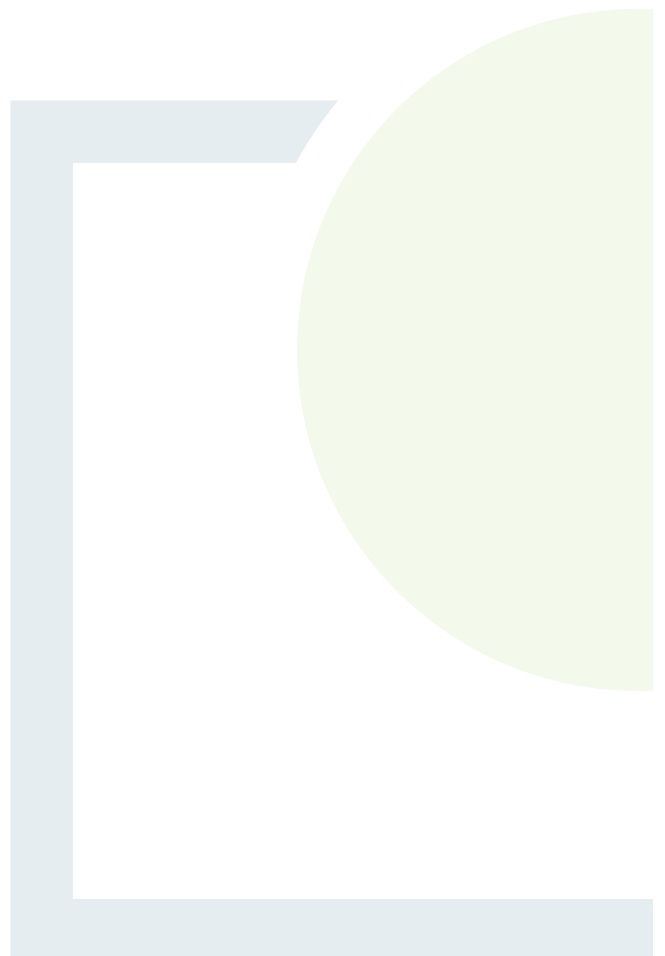
Figure 6: Scrub (WS1)



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APPENDIX 2

Aquatic Survey Reports



Aquatic baseline survey of selected bridge sites, Co. Cork [Edited for Ardcahan Bridge or site 3]



Prepared by Triturus Environmental Ltd.
for Fehily Timoney & Company

May 2019

Please cite as:

Triturus (2019) Aquatic baseline survey of selected bridge sites, Co. Cork. Unpublished report prepared by Ross Macklin & Bill Brazier for Fehily Timoney & Company.

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1. Introduction

1.1 Project background

Triturus Environmental Ltd. were appointed by Fehily Timoney & Company (FTCO) to undertake baseline aquatic surveys along $n=9$ riverine sites in the footprint of proposed bridge repair and infrastructural works across County Cork.

Several bridge sites have downstream connectivity with a protected Natura 2000 site. The Bawnknockane Stream, Ballydehob Bridge discharges to Roaringwater Bay and Islands SAC (site code: 000101). Tobin's Bridge on the Fealge River, Clonakilty has direct downstream connectivity with Clonakilty Bay SAC (000091) whilst the River Bandon (Ardcahan Bridge) is located within the River Bandon SAC (002171). These sites are designated for a range of both marine and freshwater aquatic habitats and species including otter (*Lutra lutra*), 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' and freshwater pearl mussel (*Margaritifera margaritifera*), among others (NPWS, 2011; 2014; 2018).

The main purpose of the bridge site surveys, including both desktop and walkover assessments, was to describe the existing environment in terms of important aquatic species and habitats occurring along site borders, inclusive of connecting and adjoining habitats. This would help identify and evaluate species and habitats of ecological value utilising the broader site and thus further inform the mitigation for the proposed bridge repair works across Cork county.

Specifically, the baseline aquatic surveys aimed to evaluate the fisheries potential (including salmonid and lamprey species), macrophytes, aquatic invasive species and Annex II aquatic species (notably freshwater pearl mussel and white-clawed crayfish) which may use the site and its surrounds.

1.2 Proposed works

The baseline surveys were conducted in the context of the proposed bridge repair works along $n=9$ bridge sites across Cork county, namely Lisheenleigh, Derryduff, Ardcahan, Argideen, Tobin's, Ardogrena, Roury, Ballydehob and Toormore Bridges. The proposed works for each site are outlined below with locations for the bridge sites provided in Figure 1.2.

Site 3 – Ardcahan Bridge, River Bandon

In summary, the rehabilitation at Ardcahan Bridge will require the following works according to the Construction Environmental Management Plan (CEMP). The works will take place over a 6 to 10 week period (July to September inclusive).

Temporary Site Compound:

During the construction phase, it will be necessary to provide temporary facilities for construction personnel. This project will have 1 no. temporary compound located near the entrance to the site which will include welfare facilities. The location of the temporary site compound is proposed to be set back c. 30m from the south west corner of the bridge, as shown in Figure 3 1. The temporary compound shall be constructed with crushed rock aggregate hard standings with low dust content. Temporary facilities will be removed, and the lands reinstated upon completion of the construction phase.

Facilities to be provided in the temporary site compound will include the following:

- Welfare facility
- Employee parking
- Contractor lock-up facility
- Bottled water for potable supply
- Water tanker to supply water used for other purposes
- Fuel storage
- Diesel generator
- Storage areas
- Waste management areas

The site compound is located in agricultural land within the Bandon River SAC (see Figure 1.1).



Figure 1.1: Site compound location south-west of Ardcahan Bridge

Corrosion Repairs:

1. To facilitate the installation of the scaffold, vegetation within a 2-meter width on either side of the bridge face will be cut back. Trimming will be limited to tree branches; no main stems will be cut.
2. A scaffold shall be installed to allow access to the underside of the bridge arches.
3. Steel beams to be sandblasted to SA2.5 as per detail provided in Drawings P1959-ARDH-0004. Note that one operator will carry out the sandblasting using appropriate sandblasting equipment accessing the beams surface from the scaffold provided. Sandblasting equipment typically consists of a chamber in which sand and air are mixed. The mixture travels through a hand-held nozzle to direct the particles toward the surface of work.
4. Welding of additional steel plate at the bottom flange of existing steel beams as shown in Drawings P1959-ARDH-0004. One operative will carry out the welding using portable electric welding equipment accessing the beams surface from the scaffold provided.
5. A protective paint system to be applied to all exposed steel work, Hempel Hempadur Mastic 45880/1 or similar approved to be applied by brush in 2 coats of minimum 190 micron DFT (dry film thickness). One operative will paint the steel beams accessing them from the scaffold provided.

6. Steel Drip Strips will be positioned along the bottom edge of the bridge parapet on both sides of the bridge, the holes will be drilled along the bridge as per the spacing shown in drawing P1959-ARDH-0004 and bolted through with post-fixed mechanical anchors as shown in drawings P1959-ARDH-0004. The position of these elements is shown on drawings P1959-ARDH-0004.
7. Cracking at Deck Pier interface to be injected with Epoxy Resin. Prior the injection, the crack and surrounding surface will be cleaned to allow the paste-over to bond to sound concrete. The epoxy resin will be pressure pumped locally (directly into the cracks) to close the cracks at the Deck Pier interface. The deck/pier interface is above the waterline.
8. Scaffold to be removed

Deck Works:

1. Upon completion of the corrosion repairs it is proposed to repair the road surfacing on this bridge. A road closure and diversion will be required to facilitate these works.
2. The existing road surface shall be scarified, and the existing surface shall be removed and the concrete surface of the bridge deck exposed.
3. Any defects encountered when deck is exposed to be repaired using an appropriate concrete repair mortar. This will only include small localised repairs with concrete repair mortar, limited to the top side of the deck.
4. A trial hole and rebar scan shall be completed to confirm deck reinforcement and strength. The trial hole will be superficial and will not penetrate the entire thickness of the deck. If this investigation is unsatisfactory, Cork County Council may introduce a weight limit to the bridge.
5. A spray applied bridge deck waterproofing system shall be installed.
6. The pavement surface shall be laid, sand asphalt followed by HRA, high friction colour contract surfacing shall be applied.

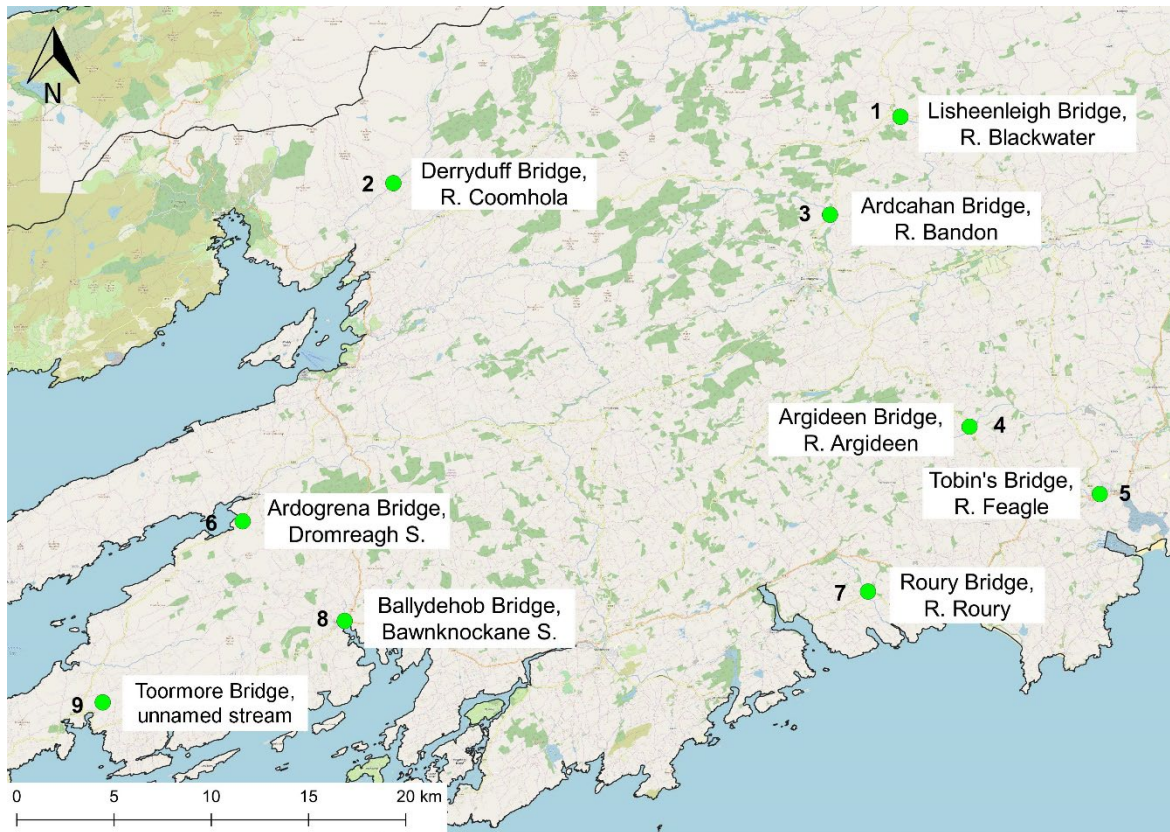


Figure 1.2 Overview of the proposed bridge repair site locations across Co. Cork

2. Methodology

2.1 Desktop review

A desktop survey of published and unpublished reports (see references) for the watercourses in the vicinity of the proposed bridge repair works was undertaken in respect of fisheries and general flora and fauna.

Data on protected and sensitive aquatic 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 Walkover surveys

Walkover surveys of the $n=9$ bridge sites were conducted on Sunday 12th and Monday 13th May 2019, with survey effort focused on both instream and riparian habitats at each site. Surveys focused on 150m both upstream and downstream of the bridge sites on the River (Bandon) Blackwater, River Coomhola, River Bandon, Argideen River, Fealge River, Dromreagh Stream, Roury River, Bawnknockane Stream and an unnamed stream at Toormore (see Figure 1.2).

Where safe and practical, in-stream surveys were facilitated by the use of chest or thigh waders and appropriate PPE (i.e. life jacket, wading staff, polarising eyewear). Deeper sites (>1.2m) were surveyed from the riverbank only.

Baseline appraisals of habitat suitability for protected species of conservation interest which are known or suspected to occur within the study area (e.g. European eel, otter, kingfisher etc.) were conducted, as well as fisheries potential for various species groups, e.g. salmonids, lamprey, European eel.

Aquatic habitat assessment was conducted according to the methodology given in the Environment Agency's '*River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003*' (EA, 2003) and the Irish Heritage Council's '*A Guide to Habitats in Ireland*' (Fossitt, 2000).

All sites were assessed in terms of:

- Stream width and depth and other physical characteristics
- Substrate type, listing substrate fractions in order of dominance, i.e. large rocks, cobble, gravel, sand, mud etc.
- Flow type, listing percentage of riffle, glide and pool in the sampling area
- In-stream vegetation, listing plant species occurring and their percentage coverage of the stream bottom at the sampling site (as applicable) and on the bankside

The existing environment was described in terms of the important aquatic habitats/species within the bridge works footprint. It also identified sensitive aquatic habitats and species occurring at each site.

Table 2.1 Bridge site locations surveyed across Co. Cork in May 2019 in light of proposed bridge repair works (please refer to Figure 1.2 above)

Site no.	Bridge	Watercourse	ITM (x)	ITM (y)
3	Ardcahan	River Bandon	0524202	0555783

2.3 Fisheries habitat

Fisheries appraisals of the watercourses within the proposed bridge repair works footprints were undertaken to establish the importance of these areas as salmonid, lamprey, European eel and general fisheries habitat. The baseline assessment considered the quality of spawning, habitat and nursery habitat bordering, and with connectivity to, the proposed works areas.

No targeted electro-fishing or netting methodologies were employed to further elucidate fish stocks of the study sites during this baseline aquatic survey.

Salmonids

Fisheries habitat for salmonids was assessed using the Life Cycle Unit method (Kennedy, 1984; O’Connor & Kennedy, 2002) to map $n=9$ riverine sites as nursery, spawning and holding water, by assigning quality scores to each type of habitat. Overall scores are calculated as the sum of individual habitat scores. Those habitats with poor quality substrata, shallow depth and a poorly defined river profile receive a higher score. Higher scores in the Life Cycle Unit method of fisheries quantification are representative of poorer value, with lower scores being more optimal despite this appearing counter-intuitive. Life Cycle Unit scores are not typically calculated for brackish or saline habitats and were thus applied tentatively for selected sites during this baseline survey.

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

Habitat quality	Habitat score	Overall score
Poor	4	12
Moderate	3	9-11
Good	2	6-8
Excellent	1	3-5

Lamprey species

An evaluation of the lamprey importance of $n=9$ bridge sites surveyed followed the novel Lamprey Habitat Quality Index (LHQI) scoring system as devised by the authors of this report (Macklin & Brazier, manuscript in preparation).

The LHQI loosely follows the same rationale as the Life Cycle Unit score for salmonids outlined above (Kennedy, 1984; O’Connor & Kennedy, 2002). Those habitats with a lack of soft, largely organic sediment areas for ammocoete burrowing, shallow sediment depth (<10cm) or compacted sediment nature receive a higher score. Overall scores are calculated as the sum of individual habitat scores. Higher scores are thus of poorer value (in a similar fashion to the salmonid Life Cycle Unit Index), with lower scores being more optimal. Larval lamprey habitat quality as well as the suitability of adult spawning habitat is assessed based on the information provided in Maitland (2003) and other relevant literature (e.g. Gardiner, 2003). Unlike the salmonid Life Cycle Unit index, holding habitat for adult lamprey is not assessed owing to their different migratory and life history strategies, and that surveys such as this one routinely only sample larval lamprey.

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

2.4 Freshwater pearl mussel (Annex II)

An appraisal of freshwater pearl mussel habitat was undertaken across all $n=9$ bridge sites based on physical channel attributes and overall habitat suitability. Furthermore, a desktop review of known distributions of pearl mussel within the relevant watercourses was also undertaken.

A sensitive species data request for freshwater pearl mussel for relevant grid squares on the rivers (Bandon) Blackwater, Bandon, Coomhola, Roury and Argideen was issued to the NPWS on Saturday 1st June 2019 and was received on Thursday 13th June.

2.5 White-clawed crayfish (Annex II)

As part of this baseline survey, an appraisal of white-clawed crayfish (*Austropotamobius pallipes*) habitat was undertaken across the $n=9$ bridge sites based on physical channel attributes, water chemistry and incidental records in otter spraint. Furthermore, a desktop review of known distributions of crayfish within the relevant watercourses was also undertaken.

2.6 Otter (Annex II)

Incidental signs of otter activity including holts, spraint, latrines and prints were recorded within 150m upstream and 150m downstream of the bridge site locations, where encountered. All otter sign locations were logged and mapped via a handheld Garmin GPS. The overall value of the habitats within and adjoining the proposed works area for breeding and foraging otter was also considered.

2.7 Macrophytes and Annex I floating river vegetation

Macrophyte surveys were conducted alongside fisheries appraisals and, if present, floating river vegetation and other rare or notable species were documented.

2.8 Biosecurity

All equipment and PPE used during the survey was disinfected with Virkon[®] disinfectant prior to and post-survey completion, and best practice precautions were employed to prevent the potential spread of invasive species and water-borne pathogens, according to best practice biosecurity protocols.

3. Results

3.1 Site descriptions & habitats

For greater clarification of fisheries potential and habitats, the following site descriptions describe each bridge site in terms of 150m upstream and downstream of the bridge and under the bridge itself (bridge apron). Please refer to Figure 1.2 when consulting the following site descriptions.

Habitat codes are listed according to Fossit (2000). Species names are provided in parenthesis at first mention only. A summary of the presence/absence of protected aquatic species and habitats and potential for each at each bridge site is provided in Table 3.1.

Physical site characteristics for each bridge site are summarised in Appendix I.

Site 3 – Ardcahan Bridge, River Bandon

150m upstream and downstream of bridge

In the vicinity of Ardcahan Bridge, the River Bandon featured a good semi-natural profile with good channel sinuosity and limited channel alterations. The river was bordered by improved agricultural grassland (GA1) but buffered by good, often dense fringes of wet willow vegetation supporting a diverse herbaceous layer. Bankful height was 0.5m to 1.0m with a channel width of approx. 20m at its widest point. The average depth ranged from 0.4m to 1.2m with unbedded cobbles and coarse gravels dominating. However, silt plumes underfoot indicated light siltation. Enrichment of the river was evident due to filamentous algae (mainly *Cladophora* spp.) and exuberant stream water crowfoot (*Ranunculus penicillatus*) growth (the latter having strong links with floating river vegetation habitat). Algal growth was also visible on both live and dead freshwater pearl mussel shells upstream (and downstream) of the bridge, typically in pool areas adjoining glide and riffle where stable cobble was present amongst gravels. Pearl mussels (both live and dead) were also present upstream of the bridge with small numbers present in gravels at mouth of the adjoining Caha River.

Some excellent salmonid spawning habitat was present in the close vicinity of the bridge (both upstream and downstream) in well sorted coarse and medium gravel beds adjoining pool tailings. Both adult and juvenile brown trout were observed and a high abundance of Atlantic salmon parr was also noted, particularly downstream of the bridge. Lamprey spawning habitat was situated at same locations, with notably good nursery habitat immediately downstream of bridge in deep pool below the bridge apron (right hand bank) and upstream at the mouth of Caha River. No white-clawed crayfish records are known from the Bandon catchment, being a sandstone geology river, and none were recorded during the survey. Good European eel habitat was present locally

in association with deeper pool areas and large macrophyte stands, especially upstream of the bridge structure in deeper glide habitat.

Under the bridge

The bridge apron at Ardcahan was comprised mainly of a historical cobbled base with good moss and liverwort growth (*Fontanalis* and *Porella* spp.). Four of the seven arches contained flowing water while three had dry arches at the time of survey. Good salmonid nursery habitat was located in the fast-flowing water flowing over the cobbled bed of bridge abutments but limited pearl mussel habitat was present under the bridge structure. Ardcahan Bridge featured good fish passage with no evident obstructions. Several otter signs (i.e. spraints) were recorded under or in the vicinity of the bridge (see Table 3.4).



Plate 3.3 Representative image of site 3 at Ardcahan Bridge on the River Bandon near Dunmanway, Co. Cork

Fisheries habitat

Salmonid habitat

The overall salmonid habitat quality of the surveyed Cork bridge sites was generally good, with all but two sites achieving 'good' scores or higher (Table 3.1). Generally, sites provided good nursery conditions for salmonids but often lacked deeper pooling areas for adult holding habitat. Site 3 on the Coomhola River at Derryduff Bridge offered to best overall salmonid habitat, featuring excellent grade spawning, nursery and holding habitat, respectively. Site 1 on the River

Blackwater at Lisheenleigh Bridge offered moderate value habitat given the lack of optimal spawning, nursery and holding habitat. Site 9 on a small unnamed stream at Toormore Bridge presented the poorest quality salmonid habitat of any site surveyed ('poor' score) given its lack of unsilted spawning substrata, poor nursery habitat and lack of deeper holding areas.

Table 3.1 Summary of the salmonid Life Cycle Unit scores for $n=9$ bridge sites surveyed across Co. Cork (after Kennedy, 1984; O Connor & Kennedy, 2002)

Site	Salmonid habitat value	Spawning	Nursery	Pool (holding)	Total Score	Salmonids observed
3	Excellent	1	1	2	4	Yes

Lamprey habitat

The lamprey habitat of the sites surveyed within the footprint of bridge repair works ranged from poor to moderate, with no site offering 'excellent' quality habitat (Table 3.2). Four sites offered poor habitat in terms of spawning and nursery, two provided moderate habitat and three represented good quality habitats. Sites 3 (Ardcahan) and 7 (Roury) provided the best overall lamprey habitat, with good quality fine gravel substrata available for spawning (brook lamprey) alongside good quality soft sediment (sand/silt) for ammocoetes. Site 4 (Argideen) also offered good overall habitat.

In contrast, sites 2 (Derryduff), 6 (Ardogrena) and 9 (Toormore) represented poor quality habitat for lamprey, generally owing to their higher energy nature and lack of finer substrata for spawning and larval settlement. Site 8 (Ballydehob) was estuarine environment and not suitable for lamprey spawning or settlement.

Table 3.2 Lamprey Habitat Quality Index (LHQI) scoring system for lamprey habitat value at for $n=9$ bridge sites surveyed across Co. Cork (as devised by Ross Macklin & Bill Brazier, adapted from Kennedy (1984))

Site	Lamprey habitat value	Spawning	Nursery	Total Score	Habitat type present*
3	Good	2	2	4	Type 1, Type 2

*Habitat type is assessed according to Applegate (1950) and Slade et al. (2003) – see methodology section

European eel habitat

European eel habitat was varied across all $n=9$ survey sites, although all offered at least some value to the species. Sites such as 1 (Lisheenleigh), 3 (Ardcahan), Tobin’s (5) and Roury (7) offered some good suitability locally in the vicinity of the bridge sites, where frequent large woody debris and or boulder/cobble refugia were present in lower flow areas of channel. Although site 9 (Toormore) offered poor eel habitat near the bridge, the stream did provide a potentially valuable migratory pathway for the species between Toormore Bay and local freshwater habitats. Site 8 (Ballydehob) provided excellent estuarine habitat for the species, in terms of both a migratory pathway and foraging/nursery habitat.

3.2 Freshwater pearl mussel records

A desktop review indicated freshwater pearl mussel populations in the rivers (Bandon) Blackwater, Bandon, Coomhola, Argideen and Roury. To identify exact locations, a sensitive species data request for relevant grid squares along these watercourses was applied for and subsequently furnished by the NPWS (received Thursday 13th June). The known locations in context of proposed bridge repair sites are provided in Figure 3.1 below. A summary of the nearest downstream and upstream locations (where applicable) to the proposed bridge repair sites are provided in Table 3.3.

Additionally, field surveys (utilising a bathyscope and wet suits) at the bridge sites revealed freshwater pearl mussels both immediately upstream and downstream of Ardcahan Bridge on the River Bandon (site 3). No pearl mussels were identified within 150m of any of the other bridge sites, despite known records for the Coomhola River both upstream and downstream of Derryduff Bridge (Table 3.3).

Table 3.3 Nearest known locations of freshwater pearl mussel (*Margaritifera margaritifera*) in context of the proposed bridge repair sites across Co. Cork (**bold** indicates known records)

Site	Bridge	Watercourse	FPM records for river	Nearest known location (approx.)
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3 Ardcahan Bandon Yes At Ardcahan Bridge

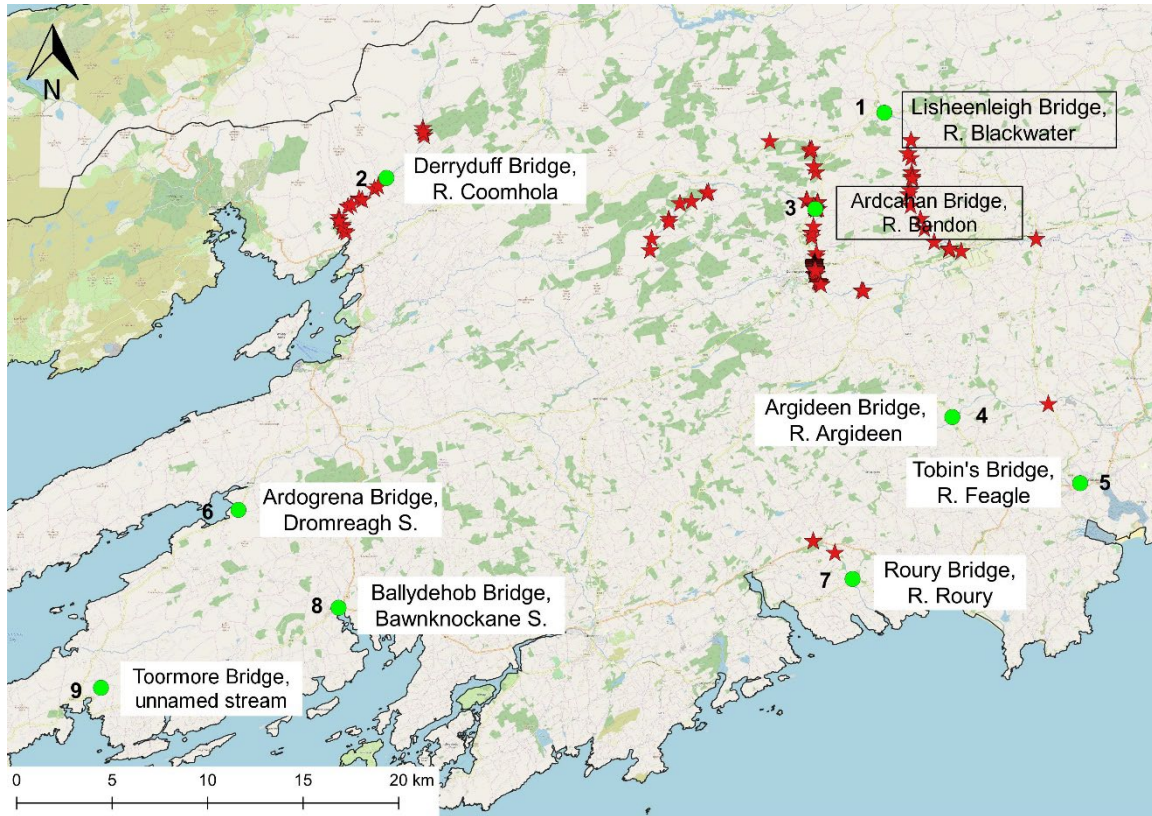


Figure 3.1 Known distribution of freshwater pearl mussel (*Margaritifera margaritifera*) in context of the proposed bridge repair sites across Co. Cork (NPWS sensitive species data request). Mussels are known from the Blackwater (downstream site 1), Coomhola (upstream & downstream site 2) Bandon (upstream & downstream site 3), Argideen (downstream site 4) and Roury (upstream site 7) rivers

3.3 White-clawed crayfish

No white-clawed crayfish were observed or recorded during site surveys of the $n=9$ bridge sites. Although some physical habitat suitability existed at certain sites (e.g. Lisheenleigh, Ardcahan, Roury bridges), no known records exist for the species within the study area (NBDC data) and physio-chemical parameters (i.e. alkalinity) are generally accepted as being sub-optimal.

3.4 Otter

Otter signs were recorded from six of the nine bridge sites during site surveys, with spraint noted at Lisheenleigh, Ardcahan, Argideen, Tobin's, Ballydehob and Toormore bridges (see Figure 3.2). Typically, these spraints were associated with the apron/ledges of the bridge structure although 150m upstream and downstream of each bridge was searched. There were no otter signs

recorded at Derryduff, Roury or Ardogrena bridges. No holts were recorded within 150m of any bridge sites.

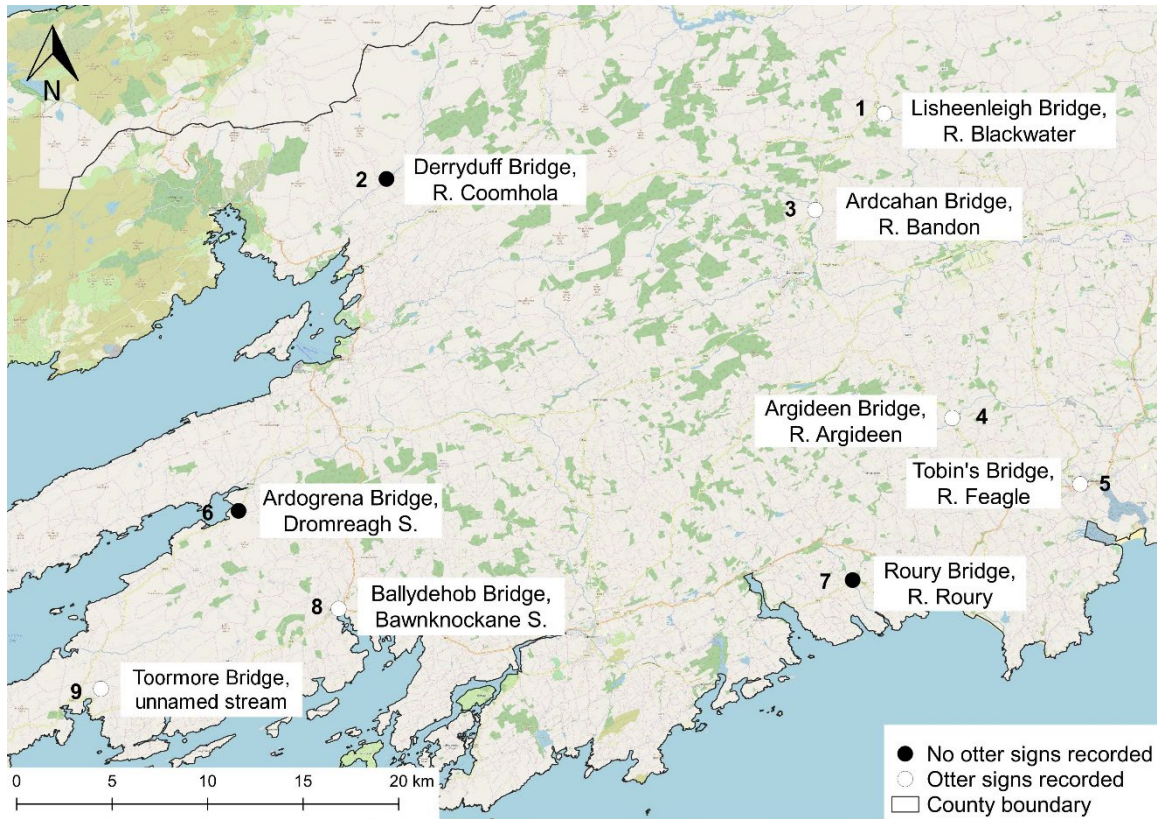


Figure 3.2 Otter sign records (positive or negative) from the $n=9$ bridge sites surveyed across Cork county in May 2019



Table 3.4 Summary of the potential for protected species groups in the (150m upstream and downstream) vicinity of each bridge site surveyed. (FPM = Freshwater pearl mussel, FRV = Floating river vegetation)

Site	Bridge site	Salmonids	Lamprey	Eel	Crayfish	FPM	Otter	FRV
3	Ardcahan	Excellent salmonid habitat present. Salmonids observed during site visit	Some good spawning & larval habitat present	Good habitat present	Not recorded during site visit. No known records	Recorded upstream & downstream of bridge (<150m) during site visit.	Recorded during site visit within 150m of bridge (spraint only)	Present within 150m of bridge

4. Discussion

The following sections briefly discuss and elaborate the survey findings from the $n=9$ bridge sites in terms of protected species and habitats pertinent to the sites; namely salmonids, lamprey species, European eel, white-clawed crayfish, freshwater pearl mussel, otter and floating river vegetation. Management recommendations and mitigation measures in light of proposed works (see Introduction, section 1.2 for details) are also provided.

4.1 Fisheries habitat – best and least quality areas

Salmonids

With the exception of the unnamed stream near Toormore (site 9; very low all-round salmonid potential), all bridge sites offered moderate to good salmonid potential. On the larger watercourses surveyed, particularly good spawning opportunities (i.e. clean, unbedded gravels and cobbles) were present in close proximity to Ardcahan, Derryduff and Roury Bridges, especially on the downstream end of pools associated with the bridge structures. Whilst these rivers are known to support Atlantic salmon, the other smaller watercourses were more suited to brown trout, e.g. River Blackwater at Lisheenleigh, Dromreagh Stream at Ardogrena etc. The Bawnaknockane Stream in its tidal reaches at Ballydehob Bridge (site 6) provided excellent holding water for adult salmonids (Atlantic salmon and sea trout) immediately upstream of the bridge.

Lamprey species

Most bridge sites had at least some potential for lamprey species, at least in terms of brook lamprey (*Lampetra planerii*). Particularly good examples of larval lamprey (ammocoete) habitat by way of soft, organic-rich sediment, were noted particularly in association with the downstream side of bridge abutments at Ardcahan (site 3) and Roury (7) bridges. Here, both marginal and mid-channel accumulations of soft sediment (sand/silt) were present. Such suitable areas were also recorded immediately downstream of site 4 on the River Argideen at Argideen Bridge and immediately upstream of Lisheenleigh Bridge (site 1). Soft sediment deposits suitable (but not optimal) for larval lamprey also existed approx. 50m upstream of Tobin's Bridge (site 5).

Lampetra spp. not only require good fractions of clean, fine gravels for spawning but also soft sediment in which to burrow, be it mud, sand, silt, clay or a matrix of all types, which is ≥ 5 cm in depth (Maitland, 2003). Invariably such areas are composed of organic-rich fines with a high level of non-humic detritus. The remaining bridge sites (i.e. 2, 6 & 9) were invariably unsuitable for lamprey spawning or larval settlement given their higher energy nature and lack of finer substrata and soft sediment. Site 8 (Ballydehob Bridge) was estuarine and thus unsuitable for lamprey species spawning or settlement.

European eel

European eel habitat varied from poor to good across the $n=9$ survey sites, although all offered at least some value to the species. Sites such as Lisheenleigh (site 1), Ardcahan (3), Tobin's (5) and Roury (7) offered some good suitability locally in the vicinity of the bridge sites, where frequent large woody debris and or boulder/cobble refugia were present in lower flow areas of channel. Such areas are vital to eel and act as daytime refugia (Laffaille et al., 2003). Likewise, instream macrophyte beds, such as the *Ranunculus* beds at Argideen and Ardcahan Bridges, also provide important eel refugia and foraging habitat.

The critically endangered European eel (Jacoby & Gollock, 2014) are considered to be the most threatened fish species in Ireland in a recent red listed publication on Irish Fish (King et al., 2011). The European eel has protected status under the European Eel Regulation EC No. 1100/2007 to facilitate the recovery of the eel stocks since the large decline in the 1980's and is listed under Annex II of the EU Habitats Directive (92/43/EEC). As such, even sub-optimal foraging/nursery sites, such as Toormore Bridge, may act as valuable migratory pathways for the species up and down the wider catchment and anywhere that is capable of facilitating Annex II European eel passage can be considered of conservation importance.

4.2 Freshwater pearl mussel

A sensitive species data request (NPWS) revealed freshwater pearl mussels have been recorded in close proximity to Lisheenleigh (2.45km downstream), Derryduff (0.65km downstream) and Ardcahan (0km downstream) bridges. Furthermore, populations are also known near Roury Bridge (1.9km upstream) and approx. 5.9km downstream of Argideen Bridge (Figure 3.1).

Preliminary surveys of mussel habitat using a bathyscope at the $n=9$ bridges failed to reveal any additional records to the existing NPWS data, although some good suitability was present in close proximity to Derryduff Bridge (no mussels observed). However, to fully elucidate any additional records of extant mussel populations in light of proposed bridge repair works, Phase 1 (and possibly Phase 2) pearl mussel surveys should be carried out under licence at both Lisheenleigh and Ardcahan Bridges given their connectivity to the River Bandon SAC (2171) (see Recommendations below).

4.3 White-clawed crayfish

No white-clawed crayfish were observed or recorded during site surveys of the $n=9$ bridge sites through either casual observations, hand-searching (under boulders etc) or through visual analysis of otter spraints. Although some physical habitat suitability in terms of boulder/macrophyte refugia existed at certain sites (e.g. Lisheenleigh, Ardcahan, Argideen, Roury bridges), no known records exist for the species within the study area and physio-chemical

parameters are generally accepted as being unsuitable. Crayfish typically require calcareous substrates (Holdich, 2003; Gallagher et al., 2006) and, consequentially, the species' distribution follows many of Ireland's carboniferous limestone belts and occurs throughout the limestone-rich midlands.

4.4 Otter

Otter signs were recorded from the majority of the bridge sites, with spraint noted at Lisheenleigh, Ardcahan, Argideen, Tobin's, Ardogrena, Roury and Ballydehob bridges (see Figure 3.2). Typically, these spraints were associated with the apron/ledges of the bridge structure. Whilst no otter signs were recorded from Derryduff Bridge, the species is known in the Coomhola River catchment (NBDC, 2019) and there is good suitability for otter at the site given the good quality salmonid (and to a lesser extent European eel) habitat present. Toormore Bridge (site 9) offered very poor fisheries habitat (shallow depth, silted gravels) and did not appear to support regular otter utilisation. However, the small unnamed stream at Toormore may act as a migratory/feeding corridor for otter, especially in light of the close proximity to Roaringwater Bay.

Despite a concentrated search, no holts were recorded in the close vicinity of the $n=9$ bridge sites, although a regular couch site was recorded approx. 50m upstream of Ballydehob Bridge (site 8), an area of channel which was highly used by otter. Given as this couch was within 150m of the bridge structure at Ballydehob, a derogation under Section 54 of S.I. No. 477 of 2001 (Birds & Natural Habitats Regulations) may be required to facilitate works due to indirect disturbance to otter.

5. Recommendations & constraints

The schedule of mitigation prepared in the NIS for Ardcahan Bridge will be applied in full under the supervision of an Ecological Clerk of Works (ECoW). Full details of the construction proposals have been prepared in the accompanying CEMP which also specifies mitigation to minimise impacts to non-qualifying interest species. The contractor will ensure that their working programme facilitates the full application of these measures under the stewardship of the ECoW.

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Appendix I

Physical site characteristics

Table 1.1 Physical site characteristics for the surveyed watercourses in the footprint of the proposed bridge repair works across Co. Cork, May 2019 (please refer to Figure 1.2 in the main report for site locations)

Characteristic	Site 3
Channel type (Fossitt, 2000)	FW2
Channel width (m)	20
Bankful height (m)	0.5-1.2
Flow type	Riffle-glide-pool
Channel depth (m)	0.4-1.2
Channel profile	Natural U-shaped
Riffle %	20
Glide %	50
Pool %	30
Bedrock %	0
Boulder %	5
Cobble %	20
Gravel Coarse %	30
Gravel Medium %	30
Gravel Fine %	10

Characteristic	Site 3
Sand %	2
Silt %	3
Beddedness %	20
Shading %	30
Macrophytes (most frequent) with percentage cover	Stream water crowfoot 30%; Branched bur-reed 1%; Hemlock water dropwort 5%; Fool's watercress 2%; Water plantain 1%; broad leaved pondweed 2%; blue water speedwell 1%
Invasive species	None
Riparian zone (most frequent species only)	Grey willow, hemlock water dropwort, marsh marigold
Bordering land uses (after Fossitt, 2000)	GA1, WS1, WL2



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Stage I and II Freshwater Pearl Mussel surveys at Lisheenleigh & Ardcahan Bridges, River Bandon & River Blackwater, Co. Cork [Edited for Ardcahan only]



Prepared by Triturus Environmental Ltd. for Fehily Timoney & Company

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1. Introduction

1.1 Project background

Triturus Environmental Ltd. were commissioned by Fehily Timoney & Company to conduct Stage I and II freshwater pearl mussel (*Margaritifera margaritifera*) surveys at Ardcahan Bridge and Lisheenleigh Bridge, Co. Cork.

Ardcahan Bridge is situated on the upper River Bandon within the River Bandon SAC (site code: 002171), approximately 3km north of Dunmanway (see Figure 1.1 below).

The surveys were required to establish the presence/absence of freshwater pearl mussel (hereafter pearl mussel) and also to conduct population estimates in light of proposed bridge repair works at each site. Population estimates would help evaluate the density and distribution of pearl mussel populations relative to the proposed bridge works, thus informing the relative importance of a pearl mussel population in the context of potential impacts from instream works.

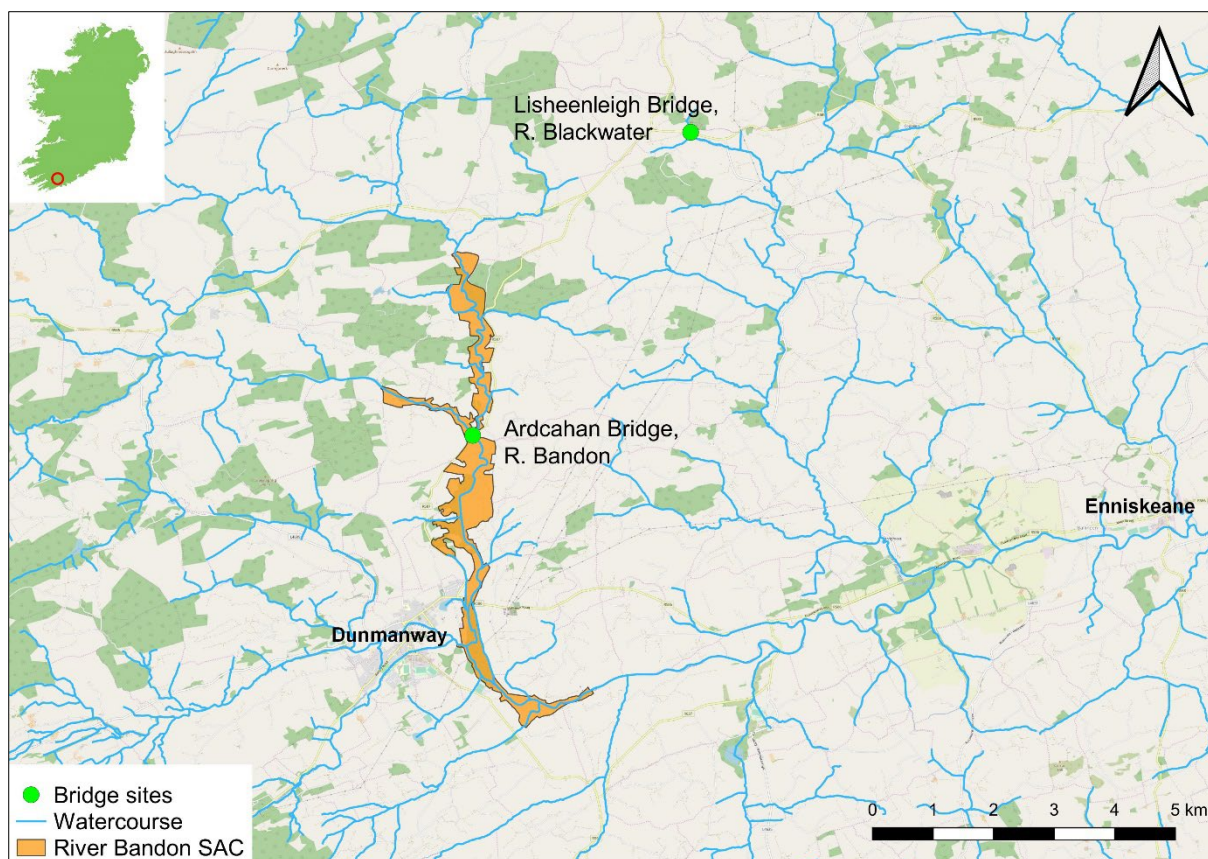


Figure 1.1 Location of the two bridge sites in context of the River Bandon SAC (Site Code 002171)

1.2 Conservation status of freshwater pearl mussel

The freshwater pearl mussel (*Margaritifera margaritifera*) is listed on the IUCN Invertebrate Red Data List as an ‘endangered species’ (Moorkens et al., 2018) according to the most recent status classification. It is also protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). Pearl mussel are protected by law in Ireland under the 1976 Wildlife Act (S.I. 112, 1990) and the species is listed on Annex II and Annex V of the EU Habitats Directive (92/43/EEC). Pearl mussel are also a Qualifying Interest of the River Bandon SAC (site code 002171).

Three Article 17 reports have been prepared for pearl mussel (to report on national status as part of the requirements of the Habitats Directive) with the overall conservation status being considered as ‘Bad’ on three occasions (NPWS, 2008, 2013, 2019).

During 2009, The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations S.I. No. 296/2009 were created to establish environmental quality objectives for SAC pearl mussel populations, including the preparation of sub-basin management plans. These regulations set out conservation targets for pearl mussel as shown in Table 1.1 below.

Within the River Bandon SAC sub-basin management plan, the pearl mussel population was recorded to have 0% of the mussels under the 30mm and 65mm size class categories indicating low or absent recruitment (NS2, 2010). The same report stated that the Bandon population was in unfavourable conservation status and catchment wide measures were required to reduce significant levels siltation and eutrophication that were seriously impacting pearl mussel habitat. One of the largest populations within the Bandon is known to exist downstream of Dunmanway, with a count of 14,322 mussels according to Ross (2017). However, serious declines across monitoring Sections in place since 2000 by -33.9% have indicated a fast trajectory towards extinction for the Bandon population, particularly in light of the absence of juvenile mussels (Ross, 2018).

Table 1.1 Targets for sustainable pearl mussel population structure under the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009

Criterion	Target to pass	Notes
Numbers of live adults	No recent decline	Based on comparative results from the most recent surveys
Numbers of dead shells	<1% of population and scattered distribution	1% considered to be indicative of natural losses
Mussels shell length ≤65mm	At least 20% of populations ≤65mm in length	Field survey of 0.5 x 0.5 m quadrats must be carried out in suitable habitat areas for juveniles
Mussels shell length ≤30mm	At least 5% of populations ≤30mm in length	Field survey of 0.5 x 0.5m quadrats must be carried out in suitable habitat areas for juveniles

2. Methodology

2.1 Desktop review

A desktop survey of published and unpublished reports (see references) for the River Bandon & River Blackwater tributary for pearl mussel populations was undertaken. This included a National Parks & Wildlife Service (NPWS) sensitive species data request for the respective rivers in vicinity of Ardcahan and Lisheenleigh Bridges (issued Saturday 1st June 2019, received Thursday 13th June). This helped to establish the presence of the nearest downstream mussel populations from the bridge works areas (section 3.1 below).

2.2 Site surveys

The pearl mussel surveys were carried out on Thursday 11th and Friday 12th July 2019 in bright weather, with good underwater visibility and under base flow conditions. This helps to maximise visibility of pearl mussel against dark substrata and also helps increase chances of detection when mussels are filtering in brighter conditions. The pearl mussel survey was carried out under Licence Number C165/2019, issued by the National Parks and Wildlife Service (NPWS) on the 24th June 2019. The survey methodology used was in accordance with the Stage I & II guidelines given in Irish Wildlife Manual No. 12, NPWS (Anon., 2004).

The riverbeds at the Ardcahan and Lisheenleigh Bridge survey areas were examined visually, with a bathyscope, and by snorkelling in the case of deeper water downstream of Ardcahan Bridge. The survey areas at each bridge site were broadly considered 'upstream of bridge', 'underneath the bridge structure' and 'downstream of bridge', covering approx. 50-100m upstream and ≥ 250 m downstream of each bridge structure. Further sub-divisions were applied in the vicinity of the bridge structure. This more detailed approach facilitated a clearer interpretation of results in respect of the proposed bridge repair works. The survey sections and a map of pearl mussel numbers by river section are illustrated in Figures 3.2 and 3.3 of the results.

Surveys began downstream and worked upstream to avoid silt and debris blocking the view of pearl mussels and to avoid damage to pearl mussels by trampling (i.e. because of better visibility). Notes were also taken on the aquatic habitat conditions and suitability for freshwater pearl mussels at each site, based on the criteria of Hastie et al. (2000) and Skinner et al. (2003).

2.3 Biosecurity

All equipment and PPE used during the survey was disinfected with Virkon[®] disinfectant prior to and post-survey completion. As standard the check-clean-dry approach was also applied following best practice. This would help prevent the potential spread of invasive species and water-borne pathogens. Surveyors were certified by the University of Leeds for Aquatic biosecurity protocols.

3. Results

Pearl mussel surveys were completed at the bridge sites on Thursday 11th and Friday 12th July 2019. The results of the surveys are presented below in terms of the number of mussels recorded (live or dead), number of shells and overall pearl mussel suitability as well as general observations on the ecology of each site. Each site is summarised in distinct sections. Scientific names are provided at first mention only.

The results of the pearl mussel surveys in terms of numbers of mussels recorded along with basic habitat observations are provided in Table 3.1 and 3.2 at the end of this section. Appendix A provides further details of pearl mussel records during the survey.

3.1 Desktop review

A desktop review indicated known freshwater pearl mussel population in the River Bandon at Ardcahan Bridge (NPWS sensitive species data request). The known locations of pearl mussel from the NPWS sensitive data request in the context of proposed bridge repair sites are provided in Figure 3.1 below.

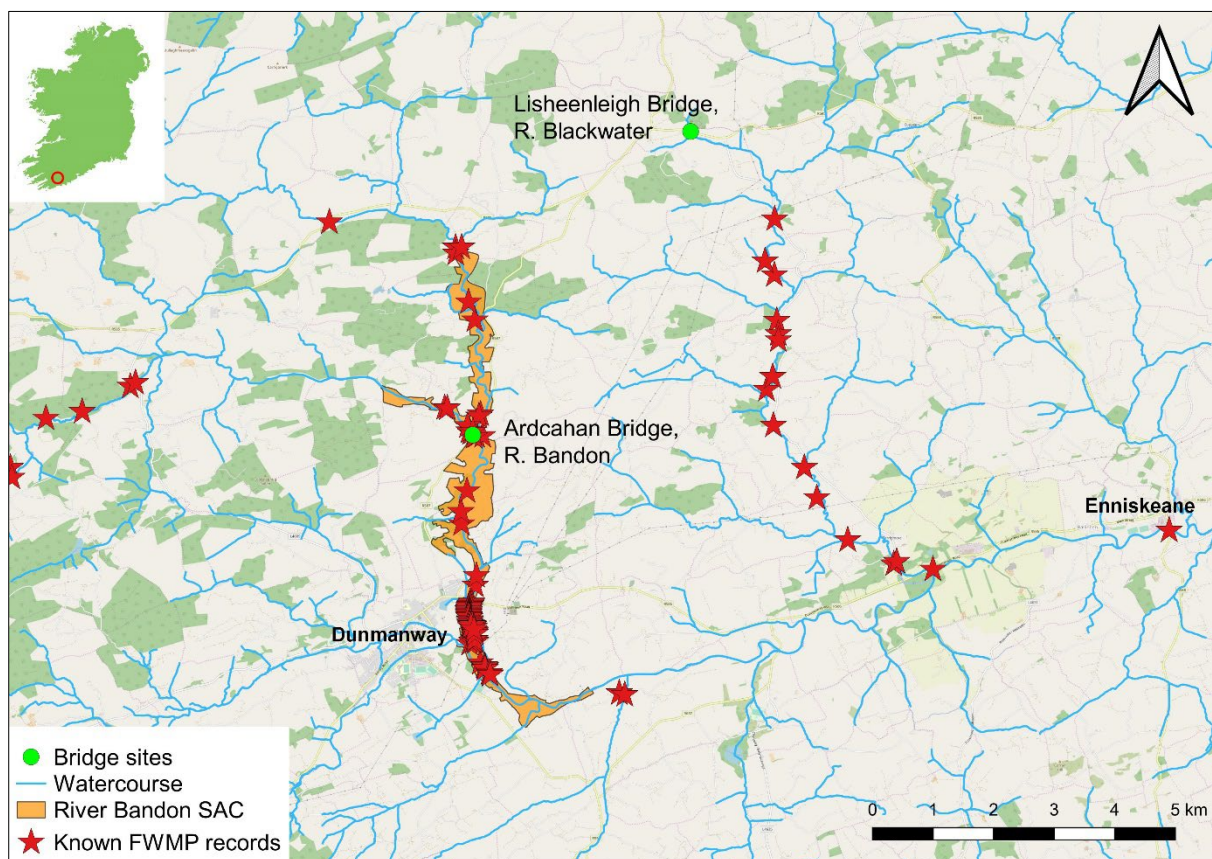


Figure 3.1 Overview of known freshwater pearl mussel locations on the River Bandon and River Blackwater in context of bridge repair works (data courtesy of NPWS sensitive species data request)

3.2 Site descriptions & pearl mussel habitat

Ardcahan Bridge, River Bandon

The survey results summarised below start with survey section A (furthest downstream) moving in an upstream direction (survey sections A through G).

Section A – ≥ 125 -200m downstream of the bridge

Section A (Figure 3.2 for location) covered the river 125-200m downstream of Ardcahan Bridge. The river here was composed primarily of deeper glide habitat up to 1.5m which became deeper on average towards the downstream extent of the survey area. Pools to ≥ 2 m were localised throughout, particularly at the beginning of the section (i.e. downstream extent) where a large pool of approximately 2.0m was present. The substrata were dominated by frequent, partially-bedded cobble with smaller boulder and coarse gravel in interstitial spaces. The river was bordered by agricultural grassland (GA1) with mature ash (*Fraxinus excelsior*), willow (*Salix* sp.) & hazel (*Corylus avellana*) treelines. Small pockets of stream water crowfoot (*Ranunculus penicillatus*; 10% cover) with low amounts of yellow water lily (*Nuphar lutea*), water plantain (*Alisma plantago-aquatica*) and spiked water milfoil (*Myriophyllum spicatum*) grew marginally. The liverwort overleaf peltia (*Pellia epiphylla*) grew on shaded areas of muddy bank. Levels of siltation were moderate throughout (silt plumes underfoot) although marginal macrophyte beds and localised slacks featured heavier sediment deposition (thus supporting rooted macrophytes). There was approx. 30% cover of filamentous algae, indicating enrichment. Section A offered moderate to good nursery habitat for juvenile salmonids, locally, but was better suited to adult fish, with excellent holding habitat present.

Suitability for pearl mussel was good locally in more stable cobbles and a total of $n=30$ live and one dead mussel was recorded in Section A. Table 3.1 below summarises pearl mussel numbers and habitats within each of the survey sections.

Section B – $50 \leq 125$ m downstream of the bridge

Section B consisted of predominantly deep glide habitat, averaging 0.5-1m in depth. Generally, pools were more limited and localised than Section A further downstream. The substrata of section B were dominated by small boulder and cobble with coarse and medium gravels patches locally. The substrata were mostly unbedded but featured filamentous algal growth on up to 30% of the surface area. Growth of stream water crowfoot was frequent (30-40% cover overall), particularly in marginal areas. Yellow water lily, water plantain and spiked water milfoil were all occasional in slacker areas of flow. Isolated beds of branched bur-reed (*Sparganium erectum*) were present ($<1\%$). The section was bordered by agricultural grassland and mature ash, hazel and willow treelines on both banks. Section B offered good nursery habitat for juvenile salmonids with some localised good holding habitat for adult fish.

Suitability for pearl mussel was good throughout much of Section B given the presence of unbedded yet stable cobbles. The higher flow rate helped keep the bed cleaner (despite some silt plumes underfoot) than downstream, slower-energy areas. A total of $n=87$ live and one dead mussel were recorded in Section B (Table 3.1).



Plate 3.1 Adult pearl mussel present in semi-stable gravel and cobble matrix approx. 5m downstream of Ardcahan Bridge

Section C – 5-≤50m downstream of the bridge

Section C was defined by heavy growth of stream water crowfoot (80% cover overall) which was present in fast glide dominated habitat and often covered the full width of the 10-15m river channel. Averaging 0.3-0.6m deep with frequent riffles and few deeper pool areas, the substrata of section C were dominated by small boulder and cobble with coarse gravels in interstitial spaces (as per section B downstream). Coarse and medium gravels were more prevalent in riffle-glide habitat in the vicinity of the bridge (i.e. within 25m of the structure). Overall levels of siltation were low to moderate given higher flow rates helping clean the bed. The survey section was bordered by agricultural grassland and mature ash, hazel and willow treelines on both banks. Section C offered excellent nursery habitat for juvenile salmonids.

The density of pearl mussel throughout Section C was low given the heavy growth of stream water crowfoot vegetation. Nonetheless, a total of $n=21$ mussels (all alive) were recorded in less heavily vegetated patches featuring stable, clean substrata (Table 3.1).

Section D – 0-≤5m downstream of the bridge

Immediately downstream of Ardcahan Bridge the river featured a semi-natural profile, 25m wide and averaging 0.3-0.5m deep. Deeper pools to >1m were present locally. Fast riffle and shallow glide habitat predominated with extensive beds of stream water crowfoot covering 30-40% surface area. Siltation was heavy locally along the west bank of the River Bandon but largely confined to marginal pool areas where small clusters of mussels were living in very poor conditions (high algae and silt cover). Overall, the predominant cobble and coarse gravel substrata were of good quality in faster flowing glide and riffle areas (i.e. clean, unbedded) downstream of the bridge apron. However, relatively high filamentous algal cover was evident as per other downstream survey sections (approx. 40%). Localised beds of hemlock water dropwort (*Oenanthe crocata*) grew on gravel shoals. In deeper pool areas with silt deposition (south bank), small beds of branched bur-reed & water plantain were present. Some small patches of Canadian pondweed (*Elodea canadensis*) were present in marginal slacks which supported silt accumulations. The riparian zone was dominated by low lying grey willow vegetation which corresponds well to wet willow woodland habitat. Section B offered excellent nursery for juvenile salmonids. The evident proliferation of species such as minnow (*Phoxinus phoxinus*) and stone loach (*Barbatula barbatula*) is further indicative of nutrient enrichment (O’Brian et al., 2019).

Section D provided some good pearl mussel habitat and supported several clusters of pearl mussels, albeit sedimentation and enrichment were impacting the population (Table 3.1). A total of $n=92$ mussels were recorded. All were alive although approx. 20% were partially covered in sediment and or filamentous algae.



Plate 3.2 Section D immediately downstream of Ardcahan Bridge

Section E – underneath the bridge structure (bridge apron)

Ardcahan Bridge is a five-arch structure, each spanning approx. 5-6m. Water was flowing under the three middle arches (2, 3 and 4) at the time of survey, with ponding present in the outermost arches (1 and 5). The bridge apron of arches 2, 3 and 4 are constructed of cobbled rip rap, with an average depth of 0.2-0.3m and an accelerated flow. Due to the undulating nature of the aprons, localised patches coarse gravel and cobble were present in interstitial spaces. Some of these areas supported limited growth of stream water crowfoot (arches 3 and 4).

Section E provided poor pearl mussel habitat overall but several highly localised pockets of suitable substrata were present on the bridge apron in arches 2, 3 and 4. Mussels were often lodged in the apron structure. A total of $n=11$ live mussels were recorded, with two empty shells present (Table 3.1).

Section F – 0-≥5m upstream of the bridge

Immediately upstream of the bridge, the river retained a semi-natural profile (as downstream) in a channel approx. 25m wide. The substrata were dominated by well mixed cobbles with coarse and medium gravels in shallow (0.2-0.4m average) moderate-fast glide habitat. Some patches of finer gravels were present also. Stream water crowfoot growth was high across the channel, accounting for up to 40% surface area. This provided some very good salmonid nursery habitat. The section was bordered on both banks by mature willow and ash treelines (corresponding to wet willow woodland habitat) and agricultural grassland. The section offered some good salmonid nursery habitat given the high cover of macrophytes.

Section F provided moderate pearl mussel habitat overall with the density of mussels low given the high growth and cover of macrophyte vegetation. Sedimentation was also moderate with silt plumes underfoot and localised surface deposition visible. A total of $n=5$ mussels (all alive) were recorded in a single agglomeration amongst cobble and mixed gravels upstream of the 3rd bridge arch (Table 3.1).

Section G – 5-≥50m upstream of the bridge

Section G the River Bandon retained a semi-natural profile (as downstream) in a 15-20m wide channel. Upstream of the Bandon-Caha confluence (approx. 35m upstream of Ardcahan Bridge), the respective river channels narrowed to 10-12m. The habitat was dominated by deep glide throughout (averaging 0.5-0.7m), with depths of >1.2m present in the Bandon channel upstream of the confluence. Localised pool was present also. Substrata comprised primarily small boulder and cobble with coarse gravels. Silt accumulations were more prevalent in the Bandon channel upstream of the confluence and at the confluence itself. Growth of macrophytes was relatively high and was dominated by stream water crowfoot (up to 40% surface area) with localised beds of hemlock water drop on exposed cobble shoals. Spiked water milfoil was present but rare and mixed with crowfoot vegetation. Localised broad-leaved pondweed (*Potamogeton natans*), water plantain and bog bean (*Menyanthes trifoliata*) were present at the river confluence. The Bandon channel also supported localised yellow lily and branched bur-reed upstream of the confluence. The channel was bordered by mature willow treelines with ash on both banks. The section offered some good salmonid nursery habitat but more so in the way of adult holding habitat.

Section G provided poorer pearl mussel habitat overall, which improved moving upstream into the Caha River. The majority of the pearl mussels recorded were along the west bank under crowfoot vegetation and or upstream of the Caha River confluence in shaded cobble and gravel. A total of $n=62$ live mussels were recorded, with five empty shells identified (Table 3.1).



Plate 3.3 Section G upstream of Ardcahan Bridge (on left River Bandon, on right River Caha)

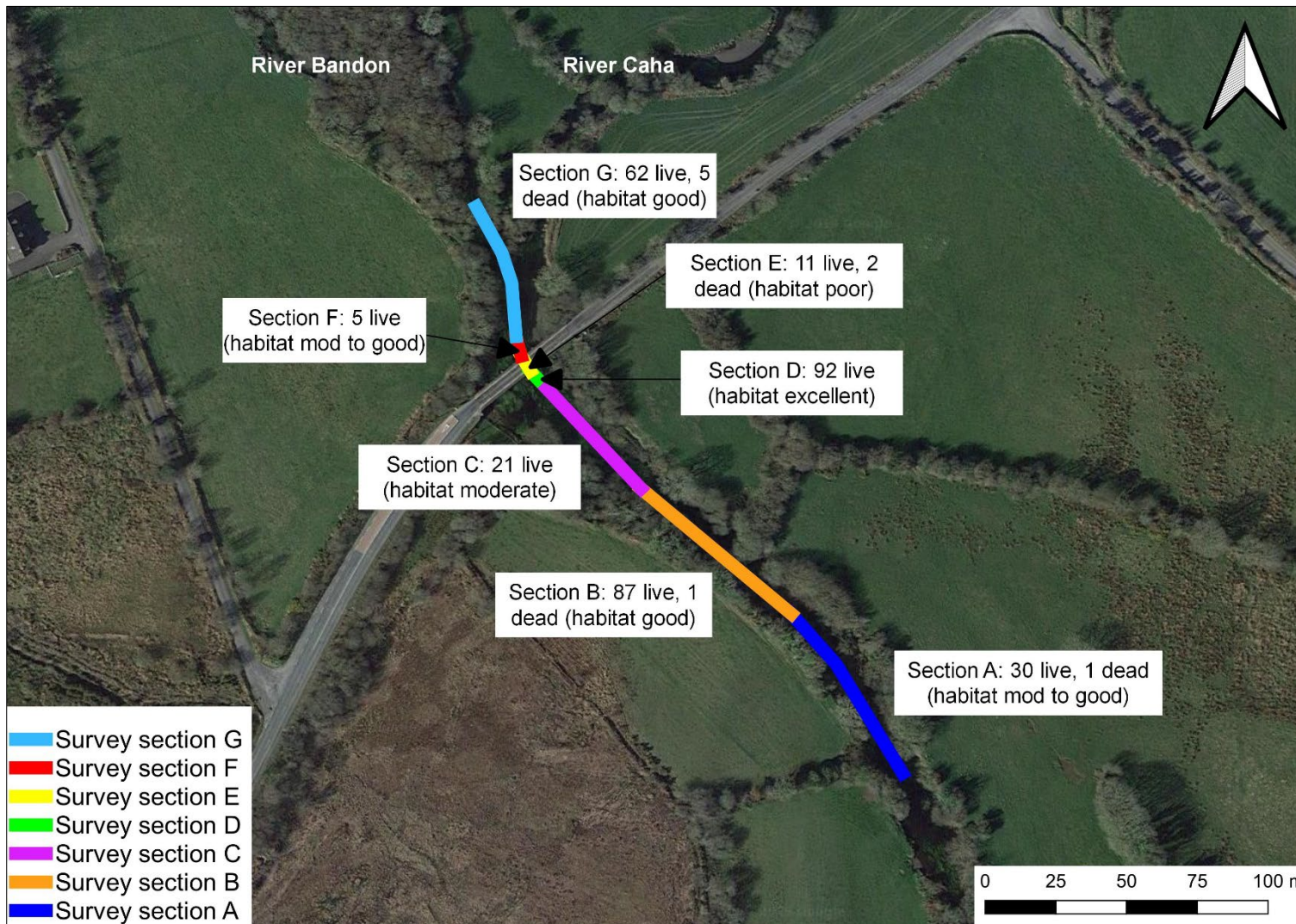


Figure 3.2 Survey sections at Ardcahan Bridge with pearl mussel numbers recorded July 2019

Table 3.1 Survey sections with pearl mussel numbers & habitat summaries for Ardcahan Bridge, River Bandon.

Survey section	Notes	No. pearl mussel recorded
A	Start of survey area moving upstream from deep pool habitat c.200m downstream of bridge. 30% cover of filamentous algae, substrata partially bedded. Small pockets of <i>Ranunculus penicillatus</i> . Moderate salmonid nursery but better for adult fish due to abundant deep holding habitat. Suitability for pearl mussel good locally in more stable cobbles.	30 live, 1 dead
B	Deeper glide, 0.5-1m. Frequent <i>Ranunculus penicillatus</i> , mostly in margins. Dominated by relatively stable small boulder & cobble with coarse & medium gravels in between. Substrata mostly unbedded (moderate siltation) but up to 30% cover filamentous algae. Moderate to good salmonid nursery but better for adult fish. Suitability for pearl mussel good throughout in more stable cobbles.	87 live, 1 dead
C	Shallower fast glide section in downstream vicinity of bridge (5-≤50m). Dominated by heavy growth of <i>Ranunculus penicillatus</i> (80%). Small cobble & boulder with frequent interstitial gravels. Low to moderate levels of siltation. Excellent salmonid nursery. Low density of pearl mussel given high macrophyte cover and siltation. Moderate suitability given poorer bed stability.	21 live
D	Shallow riffle & glide habitat within 5m downstream of bridge. Fast riffle & shallow glide, 0.3-0.5m deep with localised pools. Cobble and coarse gravel substrata (clean, loose unbedded) in fast flowing areas but high filamentous algal cover at time of survey (40%). Heavy siltation along west bank. Extensive <i>Ranunculus penicillatus</i> beds (30-40%). Very good salmonid nursery. Moderate quality pearl mussel habitat but sedimentation and enrichment deteriorating the river bed and impacting mussel.	92 live
E	Shallow, fast glide flowing over cobbled bridge apron. 3 no. wet arches out of 5 supported pearl mussels in low numbers. Sub-optimal habitat overall but some mussels lodged in between cobble rip rap & also in interstitial patches of gravel substrata on apron.	11 live, 2 dead
F	Moderate-fast glide habitat ≤5m upstream of Ardcahan Bridge, 0.2-0.4m deep. Substrata composed of well mixed cobbles with coarse & medium gravels. Heavy growth of <i>Ranunculus penicillatus</i> (40%), primarily along west bank, provided some very good salmonid nursery habitat. Moderate quality pearl mussel habitat due to siltation and poorer bed stability and highly localised due to macrophyte growth (single cluster only above 3 rd arch)	5 live
G	Deeper, slower flowing glide habitat (0.5-0.7m), deepening upstream of Bandon-Caha river confluence. Deeper pools frequent between deep glide areas. Substrata composed primarily of small boulder & cobble with coarse gravels. Silt accumulations more prevalent in Bandon channel upstream of confluence & at confluence with improved habitat in the River Caha. Growth of <i>Ranunculus penicillatus</i> relatively high (40%). Good salmonid nursery & some very good adult holding habitat. Pearl mussels scattered throughout with higher densities in the River Caha upstream of confluence.	62 live, 5 dead

4. Discussion

A total of $n=308$ live pearl mussels and $n=9$ empty shells were recorded from the sections of river (c. 0.265km of channel) surveyed in the vicinity of Ardcahan Bridge on the River Bandon in July 2019. No pearl mussels were recorded from the survey reaches on the (Bandon) River Blackwater in the vicinity of Lisheenleigh Bridge (c. 1.78km of channel).

Pearl mussels were well distributed throughout the Ardcahan survey sections with the highest densities recorded in the immediate downstream vicinity ($\leq 5\text{m}$) of the bridge structure (section D, $n=92$ mussels, Figure 3.1, Table 3.1). At this location, unbedded cobble and gravel substrata provided stable footing opportunities for mussels in deep glide areas downstream of the bridge. However, filamentous algal cover (indicating enrichment) and siltation were evidently causing stress to some mussels (approx. 20% of individuals) in this area at the time of survey. Other areas such as survey section B (50- $\leq 125\text{m}$ downstream of bridge), which comprised stable cobble in deeper glide, also supported moderate quality pearl mussel habitat (87 live mussels recorded), albeit siltation pressures were still evident. Indeed, siltation and eutrophication pressures have already been identified as significant in the Bandon catchment and are seriously impacting pearl mussel habitat (NS2, 2010). Recent significant native woodland removal and instream works approx. 6.5km upstream at Keenrath (pers. obs.) during 2018 and 2019 has resulted in further destruction of pearl mussel habitat and evident deterioration of water quality. Continued pressure from land use activities is continuing the long-term trend of habitat deterioration in the catchment and has to be reversed in order to restore habitat quality for pearl mussel if the river population is to be prevented from extinction.

Given the location of the Ardcahan Bridge site within the River Bandon SAC, and the widespread decline of pearl mussel numbers within the catchment (NS2, 2010), it is critically important to prevent any silt or pollution escapement during bridge repair works through strict adherence to a works method statement or Construction Environmental Management Plan (CEMP). It is also important to monitor water quality throughout the construction period to prevent any spikes in siltation etc. as these may travel to the primary Bandon pearl mussel population centre downstream of Dunmanway. This caution also applies to Lisheenleigh Bridge works given the presence of a pearl mussel populations on the River Blackwater downstream of Geara Bridge.

The presence of low numbers of pearl mussels on the existing Ardcahan Bridge apron, and moderately high densities of mussels within close proximity to the bridge structure means that instream works will not be possible without significant impacts to pearl mussel. Given the known decline in mussel numbers within the Bandon catchment due to water quality impacts from land use practices, every effort should be made to preserve extant populations and prevent further deterioration of the substrata and water quality of the rivers within the River Bandon SAC site and wider Bandon catchment.

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Appendix A Freshwater pearl mussel detailed records for Ardcahan Bridge, July 2019

Survey section	No. pearl mussel	Notes	ITM x	ITM y
A	30 live, 1 dead	Section begins at deep (>2m) pool habitat at ITM 0524334, 0555640.		
B	87 live, 1 dead	Section ends at end of <i>Ranunculus</i> zone ITM 0524307, 0555703.		
C	21 live	Section characterised by very heavy growth of <i>Ranunculus penicillatus</i> (80% cover). Section ends at ITM 0524209, 0555782.		
D	12 live	5m d/s bridge. Cluster situated in area of soft sediment adjoining <i>Ranunculus</i> bed with abundant filamentous algae. Area of slack flow at time of survey. 0.1-0.2m water depth. All alive but covered in filamentous algae and or sediment, under stress.	524196	555774
D	11 live	5m d/s bridge. Cluster situated in mixed gravels in shallow riffle flanked by <i>Ranunculus</i> beds. Sedimentation evident but not as high as on nearby mussels. 0.1-0.25m depth. All alive, some partially covered by sediment.	524199	555776
D	53 live	Large cluster of mussels located under heavy <i>Ranunculus</i> cover 3m d/s bridge, immediately below apron of middle arch (3 rd). Closest downstream mussels to bridge structure.	524204	555781
D	16 live	Cluster under dense <i>Ranunculus</i> bed, cobble substrata, 3m d/s of apron of 4 th arch (from south bank).	524208	555784
E	2 alive, 1 dead	On cobbles under bridge arch. Two live mussels on d/s side of 2 nd arch (from south bank) in patch of coarse gravel and cobble, right of centre point facing upstream.	524205	555777
E	5 alive	Mussels scattered under arch, mostly right of centre point. Mostly in cobble of apron. Two mussels under <i>Ranunculus</i> bed at upstream end of arch in more gravel dominated substrata.	524196	555779
E	4 alive	Mussels mostly on upstream end of 4 th arch (from south bank), centre point. In cobble apron again as per previous arch. Two under <i>Ranunculus</i> bed.	524196	555795
E	1 dead	One dead shell under 5 th arch (northernmost arch). No real water flow at time of survey, ponding only so no habitat for live mussels.	524213	555789
F	5 live	Single small cluster of mussels, all grouped together adjoining dense <i>Ranunculus</i> beds, upstream of middle arch. Mussels in cobbles mixed with coarse gravels.	524194	555788

G	44 live, 5 dead	Mussels scattered throughout section but mostly along left hand side of river (facing upstream) under and in association with dense <i>Ranunculus</i> beds which cover 60% surface area of section (entire south bank side). As channel braids at confluence the bed changes to finer (still coarse) gravels and smaller cobble/boulder.	524203	555794
G	18 live	Lower number of mussels located upstream of Bandon-Caha confluence in Bandon channel. Cobble dominated with high riparian shading from willow, locally swifter flows. 20% <i>Ranunculus</i> cover upstream of denser <i>Ranunculus</i> beds. 6-8m wide channel.	524190	555824



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