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KING'S ISLAND

FLOOD RELIEF SCHEME

King's Island Flood Relief Scheme
Natura Impact Statement

Final Report

December 2019



Comhairle Cathrach
& Contae **Luimnigh**

Limerick City
& County Council



OPW

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Contract

This report describes work commissioned by Limerick City & County Council as part of Kings Island Flood Relief Scheme. Patricia Byrne, Tanya Slattery, Malin Lundberg, William Mulville and Hannah Mulcahy of JBA Consulting carried out this work.

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Purpose

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Abbreviations

AA Appropriate Assessment

AEP Annual Exceedance Probability

CIEEM..... Chartered Institute of Ecology and Environmental Management

CL Conservation Limit

DoEHLG..... Department of the Environment, Heritage and Local Government

EC European Community

EIA Environmental Impact Assessment

EIAR..... Environmental Impact Assessment Report

EPA..... Environmental Protection Agency

ESB..... Electricity Supply Board

FRS..... Flood Relief Scheme

IROPI Imperative Reasons of Overriding Public Interest

IUCN International Union for Conservation of Nature

LCCC Limerick City and County Council

NHA Natural Heritage Area

NIS..... Natura Impact Statement

NBDC..... National Biodiversity Data Centre

NPWS National Parks and Wildlife Services

OD..... Ordinance Datum

pNHA proposed Natural Heritage Area

QI Qualifying Interests

SAC..... Special Area of Conservation

SOP Standard of Protection

SPA Special Protection Area

SSCS Standing Scientific Committee on Salmon

ZOI..... Zone of Influence

1 Introduction

1.1 Background

JBA Consulting has been appointed by Limerick City and County Council, to undertake Environmental Consultancy services in relation to the King's Island Flood Relief Scheme (FRS) at King's Island in Limerick city. This includes providing information for the competent authority to assist them to undertake an Appropriate Assessment due to the proximity of Natura 2000 sites to the proposed Scheme.

The Zone of Influence within which potential impacts from any proposed project must be considered for significance, depends a variety of factors. This includes the nature, location and extent of the proposed works, the ecological receptors present within the Natura 2000 sites within the area and the potential for in-combination impacts (DoEHLG 2009).

The Natura 2000 sites identified as occurring within the Zone of Influence of the proposed works are;

- Lower River Shannon SAC 002165
- River Shannon and River Fergus Estuaries SPA 004077

This Natura Impact Statement (NIS) provides the results of the appraisal conducted for the King's Island FRS in accordance with Article 6(3) of the Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora).

1.2 Legislative Context

The Habitats Directive (Directive 92/43/EEC) aims to maintain or restore the favourable conservation status of habitats and species of community interest across Europe.

The requirements of Articles 6(3) and 6(4) of the Habitats Directive have been transposed into Irish legislation by means of the Habitats Regulations, 1997 (S.I. No. 94 of 1997) and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011)

Under the Directive a network of sites of nature conservation importance have been identified by each Member State as containing specified habitats or species requiring to be maintained or returned to favourable conservation status. In Ireland the network consists of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), and also candidate sites, which together form the *Natura 2000* network.

Article 6(3) of the Habitats Directive requires that, in relation to European designated sites (i.e. SACs and SPAs that form the *Natura 2000* network), *"any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives"*.

A competent authority (e.g. Local Authority) can only agree to a plan or project after having determined that it will not adversely affect the integrity of the site concerned.

Under article 6(4) of the Directive, if adverse impacts are likely, and in the absence of alternative options, a plan or project must nevertheless proceed for imperative reasons of overriding public interest (IROPI), including social or economic reasons, a Member State is required to take all compensatory measures necessary to ensure the overall integrity of the *Natura 2000* site network. The European Commission have to be informed of any compensatory measures adopted, unless a priority habitat type or species is present, in which case an opinion from the European Commission is required beforehand (unless the project has to proceed for imperative human health or public safety reasons, or to benefit to the environment).

1.3 Appropriate Assessment Process

Guidance on the Appropriate Assessment (AA) process was produced by the European Commission in 2002, which was subsequently developed into guidance specifically for Ireland by the Department of Environment, Heritage and Local Government (DoEHLG) (2009 rev 2010). These guidance documents identify a staged approach to conducting an AA, as shown Figure 1-1:

The Appropriate Assessment Process (from: Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities, DoEHLG, 2009 rev 2010)

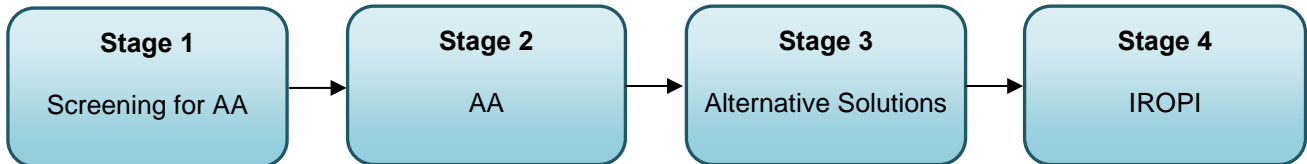


Figure 1-1: The Appropriate Assessment Process (from: Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities, DoEHLG, 2009 rev 2010)

1.3.1 Stage 1 - Screening for AA

The initial, screening stage of the Appropriate Assessment is to determine:

- a. whether the proposed plan or project is directly connected with, or necessary for, the management of the European designated site for nature conservation
- b. if it is likely to have a significant adverse effect on the European designated site, either individually or in combination with other plans or projects

For those sites where potential adverse impacts are identified, either alone or in combination with other plans or projects, further assessment is necessary to determine if the proposals will have an adverse impact on the integrity of a European designated site, taking into account the sites conservation objectives (i.e. the process proceeds to Stage 2).

1.3.2 Stage 2 - AA

This stage requires a more in-depth evaluation of the plan or project, and the potential direct and indirect impacts arising from it on the integrity and the interest features of the European designated site(s), alone and in-combination with other plans and projects, taking into account the site's structure, function and conservation objectives. Where required, mitigation or avoidance measures will be suggested.

The competent authority can only agree to the plan or project after having ascertained that it will not adversely affect the integrity of the site(s) concerned. If this cannot be determined, and where mitigation cannot be achieved, then alternative solutions will need to be considered (i.e. the process proceeds to Stage 3).

1.3.3 Stage 3 - Alternative Solutions

Where adverse impacts on the integrity of *Natura 2000* sites are identified, and mitigation cannot be satisfactorily implemented, alternative ways of achieving the objectives of the plan or project that avoid adverse impacts need to be considered. If none can be found, the process proceeds to Stage 4.

1.3.4 Stage 4 - IROPI

Where adverse impacts of a plan or project on the integrity of *Natura 2000* sites are identified and no alternative solutions exist, the plan will only be allowed to progress if imperative reasons of overriding public interest (IROPI) can be demonstrated. In this case compensatory measures will be required.

The process only proceeds through each of the four stages for certain plans or projects. For example, for a plan or project, not connected with management of a site, but where no likely significant impacts are identified, the process stops at stage 1. Throughout the process, the precautionary principle must be applied, so that any uncertainties do not result in adverse impacts on a site.

1.4 Methodology

This Natura Impact Statement has been prepared with regard to the following documents:

- DoEHLG (2009 rev 2010) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government.
- European Communities (EC) (2000) Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg. European Commission.
- EC (2002) Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg. European Commission.
- EC (2007) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission. European Commission.
- EC (2013) Interpretation Manual of European Union Habitats. Version EUR 28. European Commission.
- Fossitt, J. (2000). A Guide to Habitats in Ireland. The Heritage Council, Kilkenny.
- Guidelines for Ecological Impact Assessment in the UK and Ireland - Terrestrial, Freshwater and Coastal, Second Ed. (Chartered Institute of Ecology and Environmental Management (CIEEM), 2016)
- National Parks and Wildlife Service (NPWS) (2019a). The Status of EU Protected Habitats and Species in Ireland. Volume 1: Summary Overview. Unpublished NPWS report.
- NPWS (2019b). The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments. Unpublished NPWS report.
- NPWS (2019c). The Status of EU Protected Habitats and Species in Ireland. Volume 3: Species Assessments. Unpublished NPWS report.

1.4.1 Desktop Survey

A desktop survey was conducted of available published and unpublished information, along with a review of data available on the NPWS and National Biodiversity Data Centre (NBDC) web-based databases, in order to identify key habitats and species that may be present within relevant 2km grid squares, in particular those protected by European and national legislation. The data sources below were consulted for the desktop study;

- A number of ecological surveys (see section 3.2).
- NPWS website (www.npws.ie), (<https://www.npws.ie/>), where site synopses, Natura 2000 data forms and conservation objectives were obtained.
- National Biodiversity Data Centre (NBDC) Maps (<http://maps.biodiversityireland.ie/#/Map>)
- Environmental Protection Agency (EPA) maps website (<https://gis.epa.ie/EPAMaps/>)
- Water Maps (www.watermaps.wfdireland.ie)
- BirdLife International (www.birdlife.org)
- BirdWatch Ireland (www.birdwatchireland.ie)
- Limerick County Development Plan (www.limerick.ie/council/county-development-plan)
- Limerick Regeneration Framework Implementation Plan (www.limerick.ie/council/limerick-regeneration-framework-implementation-plan)
- National Otter Survey (Bailey et al., 2006)
- Water Framework Directive Fish Stock Survey of Transitional Waters in the Shannon International River Basin District (Kelly *et al.*, 2015)
- Whooper *Cygnus Cygnus* and Bewick's *C. columbianus* Swans in Ireland (Bolland *et al.*, 2010).

1.4.2 Ecological Surveys

To inform this NIS and the Environmental Impact Assessment (EIA) for the flood relief scheme, a number of assessments and ecological surveys have been conducted, including:

- A desk-based assessment was carried out to collate information regarding protected/notable species and statutorily designated nature conservation sites in, or within close proximity to, the study area.
- Ecological surveys (2015-2019) which included mapping of habitats present within the study area, recording evidence of any protected species (e.g. protected plants, Otter, Badger), a preliminary assessment of features with suitability for roosting bats and recording of any non-native invasive species found.
- Wintering and breeding bird surveys
- Fish habitat survey
- Protected plant survey of Opposite-leaved Pondweed *Groenlandia densa*

The results of these surveys have informed this NIS where relevant.

This report has been produced on currently available information, with the most up-to-date versions used. Where new or updated information becomes available, the client will consider and review the findings of this appraisal, if necessary, as the AA process is iterative in nature.

1.4.3 Consultation

As part of the consultation process, consultation meetings were held with National Parks and Wildlife Service (NPWS) during the concept and design phase of the proposed FRS on 2nd February 2016 and 11th May 2017. Consultation took place with NPWS regarding the survey licence and derogation licence obtained for the FRS with respect to Opposite-leaved Pondweed *Groenlandia densa* in 2017, 2018 and 2019. Consultation also took place with NPWS regarding the delineation of the SAC boundary and lamprey surveys in 2019. Consultation was made with Inland Fisheries Ireland in 2018 and 2019.

The observations and recommendations obtained as a result of the above consultations are included and addressed in this report.

1.5 Competent Persons

The assessment has been carried out by Patricia Byrne. She is an ecologist with JBA and had undertaken numerous Appropriate Assessment Screening reports and NIS assessments. The assessment has been reviewed by Niamh Burke, a Principal Ecologist with over 8 years' consultancy experience in undertaking assessments under the Habitats Directive.

1.6 Limitations and Constraints

The NIS assessment necessarily relies on some assumptions and it was inevitably subject to some limitations. These would not affect the conclusion, but the following points are recorded in order to ensure the basis of the assessment is clear:

- Information on the works and conditions on site are based on current knowledge at the time of writing. Changes to the site since surveys were undertaken cannot be accounted for.
- Some slight variation in the works methodology may occur, but these will only be minor changes. Where changes to methodology could impact on ecological features, an ecologist will be consulted to determine if the project needs reassessment.
- Adverse weather can cause delays to the schedule and alter the timing of works. This has been accounted for using a worst-case scenario where necessary.
- The NIS addresses issue around designated sites and does not exempt works from responsibilities related to habitats and species covered under separate national legislation.

2 Flood Relief Scheme Description

2.1 The 'Project'

The proposed flood relief scheme meets the criteria of a 'Project' as defined in the Habitats Directive and is not directly connected with or necessary to the management of any Natura 2000 site. Therefore, the project is subject to the requirements of the Appropriate Assessment process.

2.2 Project Location

King's Island is located at the north-east of Limerick City Centre (Appendix A.1). The area of the proposed development is shown by the red line around Kings Island. The area is a valuable asset to the city due to its historical importance, its ecological and archaeological significance, and its tourism potential. The island also contains a residential and community area with a large housing estate (St. Mary's Park) to the north and various terraces of houses to the south. The landscape of the island is urban with a low-lying area of wetland edging the north eastern part of the island.

The urban area consists of a combination of residential, administrative, commercial, educational, ecclesiastical, and tourism elements. In terms of the built environment, the north of the island is predominantly residential and due to poor transportation connections, it is somewhat disconnected from the rest of the city. The southern part of the island has a wider range of land uses, retail opportunities, and includes King John's Castle and other historic buildings. King's Island has a community centre in the south-west region, two soccer pitches to the east of the Island and three educational facilities in the south of the island (one mixed primary school and two Gael Scoileanna). City Hall houses all the offices for Limerick City and County Council (LCCC) and other public administrative functions.

2.3 Project Rationale

King's Island lies in the heart of Limerick City and is surrounded by the River Shannon and the Abbey River as shown in Appendix A.1. Rivers are tidal at this location and the island is historically susceptible to both tidal and fluvial flood risk. Existing flood defences are shown in Appendix A.2. There is a history of flooding in King's Island, the most recent events recorded in 1999, 2002, 2009, and 2014. Prolonged rainfall, spring tides, and storm surges have been the source of severe flooding (Limerick City & County Council *et al.*, 2013). King's Island and the surrounding area was badly flooded in early 2014 when there was an extremely high tide that overtopped the embankments around the Island and caused them to fail in one location. The result was displacement of residents and extensive property damage. Further flooding was experienced in 2016 as a result of another storm surge event in the Shannon Estuary. This flooding was confined to Merchants Quay, as the sandbags around the Island contained the tidal surge.

Much of the existing ground on the island is low-lying, particularly in the open spaces in the east of the island. The central spine of the island is generally quite elevated, with levels to the 'Englishtown' area (adjacent to the castle) being well in excess of the 0.5% Annual Exceedance Probability (AEP) flood level, which is approximately 4.8m. OD Elevations on the island range from 1.85mOD to 11mOD (JBA, 2018). Appendix A.1 shows where the existing embankments failed and were breached in the January 2014 flood event. Flood levels in this event were estimated to be approximately 4.55mOD and were high enough to induce significant structural damage to the existing embankments and necessitated the installation of remedial sheet piling. (JBA, 2018).

Major improvements to the flood defences are required to try to prevent re-occurrences of such flood events. As such, JBA Consulting/ARUP, were commissioned by Limerick City & County Council (LCCC) to provide engineering services for the King's Island Flood Relief Scheme (the Scheme).

The overarching objective of the project is to:

"...to assess, develop and design an appropriate viable, cost-effective and sustainable flood relief scheme which aims to minimise risk to human beings, the existing community, social amenity, environment and landscape character."

The scheme is to be developed primarily to protect the affected areas against fluvial and tidal flooding. In addition, consideration will be given to the potential impact of any flood relief scheme

on ground water and pluvial flood risk. The target standard of protection (SOP) is the 0.5% AEP tidal event.

2.4 Description of Proposed Development

The proposed development is a series of flood defences positioned around King's Island comprising both new and upgraded flood walls (incorporating glass panels in the urban areas) and embankments plus public realm improvements.

The proposed development can be described further in terms of flood cells, which are defined on the basis of the extent of the 0.5% AEP flood event across the Kings Island study area. There are two flood cells, Flood Cells A and B as shown in Appendix A.3 Flood Cell Sub-Areas.

Flood Cell A - This is the more residential part of the island and currently has a level of flood protection primarily provided by embankments, although walls also contribute to the perimeter protection. One of the key constraints of this area is the Lower River Shannon Special Area of Conservation (SAC) and the proximity of its boundary relative to the proposed flood relief options. It includes the ten sub-areas A1-A10.

Flood Cell B - This is the more commercial part of the study area. Where there is flood protection, it is in the form of quay walls. However, there is no defence provision around the Potato Market and civic buildings on Merchant's Quay. Relating new flood management measures to the existing built environment is the key constraint in the south of the island. It includes four sub-areas B1-B4.

2.4.1 Preliminary Engineering and Landscape Design Elements

A description of the engineering and landscape design elements of the projects is included below.

2.4.1.1 Flood Embankment Design

The proposed embankment for areas A3 to A5/A6 (Ch 0+330 to 0+1250) (see Appendix A.3) is set back on the inside of the existing embankment along the west and northwest of the island and then travels south between St. Mary's Park and the wetland before turning east and continuing along the inside of the existing embankment along the east of the island along the football pitches to Athlunkard Boat Club. Approximately 2,175 linear metres of embankment will be formed. The material will comprise 83,300m³ of inert engineering fill, 39,600m³ of landscape fill (class 4) and 15,700m³ of topsoil, totalling 138,600m³. The top of the embankments will be 0.2m above the flood defence level, which is 5.3mOD Malin on the River Shannon and 5.1mOD Malin on the Abbey River. The typical embankment height is 3 to 3.5m above ground level.

The embankment will be constructed of impermeable clay, with a top width of 5m, typically, with local widening points. The clay will typically slope down at a 1(V):3(H) slope on both sides. Topsoil excavation will be required along an approximately 3m wide strip beneath the embankment in order to key the embankment into the existing ground and block seepage along the base of the embankment.

Additional landscape fill and topsoil will be placed at a shallower gradient (typically 1(V):1.75(H)) along the slopes of the embankments in order to merge the proposed embankment with the existing embankment and blend into the surrounding landscape of St. Mary's Park. As a result, the total width will range from 16 to 60m but will vary depending on exact location. The surface will be seeded with meadow grassland. A new Bitmac footpath (3m wide) is proposed along the top of the embankment, with breakout areas to allow street furniture in the future.

Approximately 2050 linear metres of embankment will be formed. The material will comprise 83,300m³ of inert engineering fill, 39,600m³ of landscape fill (class 4) and 15,700m³ of topsoil, totalling 138,600m³. The top of the embankments will be at the flood defence level/ height of 5.3m.

The embankment will be constructed of impermeable clay, with a top width of 3m. The clay will slope down at a 1 to 3 slope on both sides. Topsoil excavation will be required along a 3m wide strip near the centre of the new embankment. This is to provide a water cut-off between the existing ground and clay embankment.

The slopes of the embankment will be graded and surfaced with landscape fill and topsoil respectively, at a 10 to 30-degree slope on the side of St. Mary's Park, and sloped downward so that the end meets the top of the existing embankment. Overall, with the total width will range from 16 to 70m but will vary at different locations and is designed to blend into St. Mary's Park. The

surface would be seeded with meadow grassland. A new Bitmac footpath (3m wide) is proposed along the top of the embankment, with breakout areas to allow street furniture in the future.

2.4.2 Flood Wall Design

The proposed wall in Area A1 (see Appendix A.3 Flood Cell Sub-Areas) will be a continuation of the existing flood defence wall constructed at Verdant Pace, with steps to allow access to the river. The wall will be founded on piles.

In Area A2 (Appendix A.3), a flood defence reinforced concrete wall, with stone facing on both sides, founded on piles is proposed. The existing footpath will be raised to maintain a pedestrian view and guarding height of 1.1m. Excavations will be required to a depth of approximately 1m for the wall foundation and pile cap.

In Area A6 (Appendix A.3), a flood defence reinforced concrete wall founded on piles will tie into the proposed embankment at the northern end of Athlunkard boat club. There will also be an additional piled retaining wall to support a raised ground height for the new vehicle access at this location. Excavations will be required to a depth of approximately 1m for the wall foundation and pile cap.

The proposed wall design for Area A7 (Appendix A.3) will be raised from its existing level to the flood defence level and strengthened, requiring excavation to construct the wall foundations. Excavations will be required to a depth of approximately 1.5m to construct the wall foundations.

In Area A9 (Appendix A.3) the existing parapet wall is to be replaced with a new reinforced concrete wall, to a height of 1.4m above ground level, which will be faced to match the existing stone finish. The wall will be founded on piles to be constructed from a jack-up barge or pontoon in the Abbey River. The existing footpath will be excavated in order to construct the new wall and foundations, which will be approximately 1m in depth. Demolition of the existing wall parapet will also be required.

In Area A10 (Appendix A.3) the entire length of the wall will be replaced with a new reinforced concrete wall with stone cladding to a maximum height of 1.4m, to match the existing stone finish. The existing footpath will be excavated in order to construct the new wall and foundations. Excavations of approximately 3 to 4m depth will be required to install a mass concrete backing wall. Demolition of the existing wall parapet will also be required. Ground anchors through the existing quay wall may also be required to strengthen to existing quay wall.

In areas B1/B2, (Appendix A.3) the proposed new parapet wall will be a gravity wall with ground anchors through the existing quay wall, interspersed with stretched glass flood defence panels founded on a mass concrete backing. Existing large trees will be protected, managed (crown raised and removal of basal sucker) and retained during the construction of the new concrete walls and glass panels. Excavation will be required for installation of the mass concrete backing and flood wall to a depth of 3 to 4m, in the location of the glass panels.

The proposed flood defence walls in Area B3 (Appendix A.3) consist mainly of glass panels founded on a mass concrete backing wall. Excavation of 3 to 4m depth will be required for the mass concrete backing wall. Around the Courthouse, it is proposed to remove the existing boardwalk and construct a new flood defence wall with glass panels, founded on piles. Additional concrete L-walls will be required in the area around the entrance to Curragower Boat Club and the Sylvester O'Halloran Bridge. A pedestrian access ramp will also be provided at the Sylvester O'Halloran Bridge entrance, while a flood gate will maintain access to the boat club. Excavations up to 1.5m depth will be required for the wall foundations at these locations.

2.4.3 Lighting Design

The lighting design along the pedestrian and cycling pathway at the proposed King's Island Flood Relief Scheme development will be as per the following relevant guidelines and standards:

- BS 5489 Code of practice for the design of road lighting;
- IS EN 13201 Road Lighting requirements;
- Bats & Lighting Guidance Notes for Planners, engineers, architects and developers (Bat conservation Ireland, December 2010);
- CIBSE Lighting Guide 6 Illuminating the Outdoor Environment; and

- CIBSE Lighting the Environment - A guide to good urban lighting.

The light fittings on the proposed embankment around St. Mary's Park will be mounted at 6m above ground level and at approximately 30m centres. The columns would be of aluminium and their colour and finish is as shown in the Landscape Strategy Document accompanying the planning application.

All light fittings will be LED, have asymmetrical projection i.e. directional, and with colour temperature of 2700K (warm spectrum preferred by bats). The radiation will be above 500nm to avoid the blue or UV light, most disturbing to bats. The lights will be positioned facing away from the River Shannon to minimize impact on bats along this route; i.e. in Area A3, the lights will be facing east, while in Area 4, the lights will be facing west as the footpath alignment on the embankment turns to run parallel with St Munchin's Street.

The lights will be on during hours of darkness to provide a minimum light level for security to the footpath on the proposed embankment. The lights will be dimmable with individual photocells fitted to each light fitting, which will allow the lights to switch on automatically at dusk at a low output and slowly dim up to their full output as the natural light decreases. This will minimize light spill for mammals at dusk which is their peak time for feeding when they exit roosts/setts/holts for foraging. The lighting will also be controlled by occupancy/motion sensors so that it will remain at a low output if there was no pedestrian traffic or mammal activity nearby. This will also mitigate light overspill into the rear of residential properties on St Munchin's Street although tree planting in this area will filter the lighting from the embankment into the rear of the properties.

2.4.4 Landscape Design and Public Realm

The Landscape Design comprises landscape and visual mitigation plus public realm proposals across the scheme. The landscape design proposals are presented in the Landscape Design and Public Realm Strategy which forms part of this planning application.

Landscape design works include:

- Visual mitigation to the existing riverside wall to blend the finishes and coping into the proposed wall in areas A1/A2;
- Softening of the gradients and landscape proposals of the engineering flood embankment to enhance the adjacent public open space in area A3;
- Tree planting to filter visibility from embankment to the rear of properties in St Munchin's Street in area A4.

Additional public realm aspects will include:

- Pitch reorientation and environmental enhancement around the Star Rovers sport pitches in area A5;
- Provision of a 3m wide combined footpath and cycle path around the north of the island around St. Mary's Park and the SAC (in areas A3-A5), which will include improved lighting, spaces for permanent outdoor furniture, and improved connections to the residential streets in St. Mary's Park;
- Upgrading of footpaths, and tree planting within the urban areas A6-A10 and B1-3;
- Suitable wall finishes to blend in with the historic flood walls, and the addition of transparent glass panels to improve views out to the Abbey River and the River Shannon in areas A6-A10 and B1-3.

Refer to Arup/ Nicholas de Jong Landscape Design and Public Realm Strategy Report and Drawings (2019).

2.4.5 Proposed Option

On the basis of the information provided above and detailed in the Options Assessment Report (JBA and Arup, 2018), the emerging preferred option comprises direct defences along the inner alignment for area A4, and along the outer alignment for areas A1-A3 and A5-B3. This is the combination which meets the Limerick City and County Council/OPW brief for passive flood defence, and one area of demountable flood barriers around Merchant's Quay. It also provides advantages identified through multi-criteria analysis (MCA), including significant benefits arising from avoiding works within the SAC boundary at the north of the island. This NIS describes the impacts from the preferred option, which is described in detail in Appendix B.1.

2.4.6 Outline Construction Overview

An Outline Construction Method Statement is given in Appendix B.2 which gives an overview of the steps required during the construction phase for each area of flood defences. This is summarised in the section below. The Outline Method Statement should be read in conjunction with this section to give a full understanding of the works as proposed.

Excavation and Infilling

Excavation and import of soil will be required for construction of the embankments. It is estimated that approximately 138,600 m³ of soil will be required for the construction of the 2,050 linear metres of embankment at different locations around the island.

Surface Water Run-off and Groundwater Pumping

Groundwater pumping will be required where the water table is encountered during excavations, most likely around the quay walls (George's Quay and Sir Harry's Mall). Appropriate mitigation will be required to ensure that groundwater discharged via pumping is not contaminated with suspended solids.

Instream Works and Works Near Water

Works at Merchant's Quay and the Absolute Hotel are constrained by the available space for machinery to operate from the banks, and so will require the use of jack-up rigs on the bed of the River Shannon and Abbey River to be used as work platforms. There will be two areas of instream works on the Abbey River (Area A9) and Shannon River (Area B3) (see Appendix 0):

(1) A9: At the south east corner of the Absolute Hotel, instream work on the Abbey River is proposed. This is necessary for construction of a section of reinforced concrete wall to replace the existing parapet wall which is below the design flood defence level. Instream works will comprise the construction of a temporary, enclosed working platform on stilts (jack up rig) adjacent to the wall to allow part of the construction works to occur from the river side.

(2) B3: At the south west of the Courthouse, instream work on the Shannon River is proposed. This is necessary for construction of a section of board walk around the Courthouse and would include sealing of existing joints, tanking of walls, removal of vents on walls adjacent to the river prior to the construction of the boardwalk and glass panels. Instream works will comprise the construction of a jack-up rig to allow part of the construction works to occur from the river side.

These working platforms will be moved respective of the needs during each phase of construction including demolition of existing walls, excavation, and installation of new walls. Installation of the rigs will involve dropping legs onto the bed of the river and bolting into the side of the quay walls.

The use of jack-up rigs reduces the impact on the riverbed to just the area beneath the 4 supporting legs. The legs of the rig (1.5m x 1.5m base plate) will be placed on the riverbed in order to provide support to the rig. The rig will be secured to the flood defence walls. The rig (barge) itself will be approximately 12m wide x 20m long. A netting apron will be suspended off the side of the barge, to catch any debris, in order to prevent debris falling into the river. As the works progress the rig will be moved along the defence walls, requiring the legs to be repositioned. The lengths of walls affected are 37m at Area A9 and 300m at Area B3. Works at A9 on the Abbey River in front of the Absolute Hotel requires 2x setups with duration of works of 2-3 months, resulting in approximately 18m² area of substrate being affected. Works at Area B3 on the Shannon River in front of the Court House requires 3x setups, with duration of works 5-6 months, resulting in approximately 27m² area of substrate being affected. A total of 45 m² of substrate will be affected. No introduction of rock infill is required as part of the set-up or operation of the jack-up rig.

Risk of flooding during construction

There is a possibility that a flood will occur on King's Island during the construction phase, as the duration of construction is approximately 18 months. To ensure that King's Island does not become more vulnerable to flooding during construction, the old flood embankments around the north of the island will be left in situ until the new embankments are finished.

The old flood defences which must be demolished on the south side of the island will become vulnerable to flooding during the period of construction. In particular, the areas A9 south of the Absolute Hotel, Area A10 Abbey Bridge to Baal's Bridge, and Area B2 at the pontoon access, will

be vulnerable. It is noted that these areas are currently vulnerable to flooding, and the construction phase will not increase this vulnerability in a significant way.

2.4.7 Sub-area construction requirements

A1 Construction Method

Both the wet and dry sides of the coping will be painted across the full length of Verdant Place. Between Thomond Bridge and the new flood defence wall, install a concrete coping and safety railing to the appropriate guarding height. No excavation or in-river works will be required.

A2 Construction Requirements

To install the flood wall, the existing embankment will be excavated, and the vehicle barriers, footpath and sandbags removed. Excavation will be required to a depth of approximately 1.5m to install the RC wall, and then additional excavations for the bored piles which will be dug to bedrock level (approximately 11m in this area).

A3 Construction Requirements

A construction compound is proposed in the northwest corner of St. Mary's Park. The proposed embankment will be positioned so avoid encroaching on the location for the proposed open drain. A buffer zone of approximately 10m will be maintained away from the proposed open drain and the construction compound will be bunded to avoid any discharge to the proposed open drain.

The proposed open drain to host the protected pond weed will be constructed before the proposed embankment is formed. This is to ensure that the pond weed can be translocated immediately and avoid being stored off site. The construction sequence for the proposed open drain is as follows:

- Excavate the proposed open drain.
- Ensure that the base of the open drain is hydraulically disconnected from the river by means of:
 - a) maintaining a minimum thickness of approx. 1m clay at the base of the open drain (most likely) or
 - b) additional excavation to insert a suitable lining at the base of the open drain.
- Allow the open drain to fill (from surface water and ground water flow).
- Relocate the pondweed, as per NPWS requirements.
- Establish an exclusion zone around the open drain for the remaining duration of the works.
- Fill in the existing drain.

The existing sandbags, footpath, and concrete plinth along the edge of the River Shannon will be excavated and removed. The rest of the existing embankment will remain in place and tied into the sloped surface of the new embankment. The alluvial woodland (a protected habitat and part of the SAC) on the river side of the existing embankment will remain untouched.

Topsoil excavation will be required along a 3m wide strip underneath the clay embankment. This is to provide adequate foundation to form the clay embankments and prevent the seepage of water between the existing ground and the proposed embankment.

A4 Construction Requirements

Emergency sheet pile cutting-down works

The existing sheet piles will be cut down to 200mm below ground level and backfilled with existing soil, work will be carried out from the wet side and not from within the adjacent SAC. The bitmac footpath path adjacent to the sheet piling will be approximately 120lin.m and 2.5m wide. The existing ground will be excavated to approximately 200mm depth to allow for construction of the footpath.

Japanese Knotweed Bund

In advance of works at the Japanese knotweed bund, all visible growth will be sprayed. The north-western section of the bund will be relocated to the south-east side of the bund to allow space for embankment construction. Any damaged root-barrier membrane will be replaced. Appropriate environmental biosecurity measures will be implemented when working in this area.

Embankment construction

Topsoil excavation will be required along a 3m wide strip to provide adequate foundation to form the clay embankments along this extent. The lower half of the embankments will be constructed and allowed to settle.

Drainage will be installed on the dry side of the embankments. Excavation will be required in the SAC to connect the existing open drains to the new embankments on the wet side.

A5 Construction Requirements

Pitches and AstroTurf will be relocated as per agreement with Star Rovers FC. Construction will take place in the off-season for the club (July-August) to minimise disruptions to Star Rovers. Excavation of the existing footpath, sandbags, and concrete plinth will take place over the width of the proposed embankment.

The destruction of a badger sett located in the bankside of the open drain is required to accommodate the proposed development. Correspondence with NPWS regarding the destruction of the sett has confirmed that a license is not required. The Department of Culture, Heritage and the Gaeltacht have issued a letter stating that neither the Dept nor NPWS oppose the works, provided the report mitigation and TII's guidelines, and any variant of the above as specified by regional staff, are followed.

A6 Construction Requirements

To proceed with works in the northern section, the boundary wall of the Athlunkard Boat Club will be demolished. The existing footpath, sandbags, concrete wall, and topsoil will be removed. Bored piles will be installed along the length of wall. An in-situ reinforced concrete capping beam and flood wall will be installed. A new embankment will be constructed. A new vehicle access route and footpath will be constructed on top of the new embankment. Grading and excavation works will be required on the banks of the Abbey River to construct the access track behind the boat club.

Similar demolition, wall construction, and embankment construction works will take place at the southern section, however only once the new vehicle access is made available to the boat club (as per agreement with Athlunkard Boat Club).

Excavations will be required to install the flood wall (1-3m), the manhole (4m depth x 2m diameter), and intertidal storage tank (2m depth x 10m width x 10m length). The proposed flood wall will be supported on bored piles.

Three small trees (including a White beam, a Cherry and Norway Maple) are recommended for removal south of the boat club to facilitate construction of the new wall, replacement trees will be implemented as part of the landscape design for the project.

A7 Construction Requirements

Excavations will be required to a depth of approximately 1.5m to construct the wall foundations. Construction of the new footpath, steps, and ramps will require temporary closure of the road during the construction phase.

A8 Construction Requirements

The paved footpath surface will be removed from the access ramp on both sides of the boardwalk. The ground will be leveled, and footpath will be repaved.

A9 Construction Requirements

Due to limited space on the walkway and road, a barge/jack-up rig will be installed on the bed of the Abbey River to give additional space for machinery to operate, and to catch any debris falling onto the river side of the wall during excavation.

To install the piles, drilling will be required into the existing stone wall. Construction of the concrete foundations will require excavation up to 1.5m.

The footpath will be excavated in order to install the concrete foundations. It will be reinstated at the end of the construction phase.

A10 Construction Requirements

The existing footpath will be excavated in order to construct the new wall and foundations. Excavations of approximately 2.5 to 3m depth will be required. Two existing small trees on the walkway will be removed to accommodate construction; they will be replaced with like for like species on completion of the construction works.

Drilling will take place through the existing wall to a depth of approximately 5m, in order to install the steel stitching bars.

At the section of wall to be retained, the masonry parapet coping will be removed and stored for later reinstatement.

B1 Construction Requirements

Excavation will be required for installation of the mass concrete backing and flood wall. This work will be complete from the Quay and will require closing the footpath and road for the duration of the works.

Trees will be pruned as per arborist recommendations to allow sufficient head room for construction.

At the section of wall to be retained, the masonry parapet coping will be removed and stored for later reinstatement.

B2 Construction Requirements

Excavation will be required for installation of the mass concrete backing and flood wall. This work will be completed from the Quay and will require closing the footpath and road for the duration of the works. Glass panelling will be installed where indicated in the design.

Trees will be pruned as per arborist recommendation, to allow head space for construction. Drilling will take place through the existing wall to a depth of approximately 5m to install the steel stitching bars.

In the Pontoon Access area, 1 no. tree will be removed to facilitate the works. The existing parapet wall will be removed. The wall will be excavated and the new flood wall cast.

B3 Construction Requirements

Excavation will be required for installation of the mass concrete backing and flood wall.

- **Potato Market**

This work will be complete from the island side and will require closing the footpaths and Potato Market parking area for the duration of the works.

The Potato Market viewing platform and railing will be removed. The Sarsfield pedestrian bridge will be closed for the duration of the works.

The Potato Market walls will be demolished, excavated, replaced in some places, and retained/repared in others.

- **Curragower Boat Club**

At the Curragower Boat Club, excavation will be required along the length of the proposed wall and flood gate. The existing road will be re-levelled. The depth of excavation under the flood gate will be approximately 1m.

- **Courthouse**

Excavation will be required for installation of the mass concrete backing and flood wall. This work will be complete from the river and will require closing the footpath for the duration of the works. Due to limited space on the walkway, a barge/jack-up rig will be installed on the bed of the Shannon River to give additional space for machinery to operate, and to catch any debris falling onto the river side of the wall during excavation. It is expected that 3 set-ups will be required to carry out the proposed works.

The boardwalk will be demolished. Bored concrete piles will be installed as part of the concrete foundation for the glass panelling. Glass panelling will be installed where indicated in the design;

- Between the Courthouse and King John's Castle

Past the courthouse, 6 no. early mature Lime trees between the Council offices and the glass panelling will be removed for construction and replaced with appropriate species on completion of the construction works.

Excavation will be required to support the concrete backing of the existing wall. The footpath will be removed and reinstated following installation of the wall foundation.

2.4.8 Access and Egress

Access, egress and material transport to the site will be via road. Access of the jack-up rigs to work on the quay walls at Area A9 and B3 will be by crane (Appendix G).

2.4.9 Programme

The proposed programme of works is to be carried out over a two year period starting in October 2020 or March 2021. Works at the north east of the site will take place outside of the wintering bird season (October-March) throughout the period of works. It is expected that the construction phase will take place over 18 months.

2.4.10 Duration of the Works:

The works are expected to take two years.

2.5 Project Zone of Influence

As the works are confined to King's Island and will largely use existing infrastructure the project will primarily affect the site only. However, due to the proximity to the River Shannon, a 2km distance for surface water impacts on any supporting habitats and SPA species has been considered.

2.6 Project Summary

Table 2-1 presents a summary of the elements of the Project that are relevant for ecology.

Table 2-1: Summary of project elements relevant to ecology of Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA

Project Elements	Comment
Size and scale	<p>The proposed works comprise a series of flood defences positioned around King's Island comprising both new and upgraded flood walls and embankments plus associated townscape improvements.</p> <p>Embankments will be located inside the original embankment on the north western part of the island, and a new embankment will be constructed to the east of St Mary's Estate on the north eastern part of the island. The central structural core of the embankment will comprise an impermeable clay.</p> <p>Construction of the west embankment necessitates the relocation of a drainage ditch containing the protected species Opposite-leaved Pondweed <i>Groelandia densa</i> (As this species occurs outside of a Natura 2000 site, the associated impacts and mitigation for this species are assessed in the EIAR, JBA, 2019).</p> <p>Site compound for embankments works will be located at the north west of the site.</p> <p>Works on the quay walls will take place from the landward side, except at Area A9 and B3 where jack-up rigs will be employed to work from the river side.</p>
Land-take	There will be no land take from the Lower River Shannon SAC.
Distance from Natura 2000 site or key features of the site	Lower River Shannon SAC surrounds King's Island and includes most of the marsh area at the north east of the island. The works will take place largely at the boundary of the SAC in the northern part of King's Island; The existing sandbags, footpath, and

Project Elements	Comment
	<p>concrete plinth along western embankment and SAC boundary will be removed and new embankment will be located inside the old embankment and will therefore be outside the SAC. The new eastern embankment will be located at the boundary of the SAC bordering the marsh habitat, but again outside the SAC. A new concrete wall to be constructed to the west of the creche is again just outside the boundary of the SAC. Works on the quay walls are on the boundary of the SAC.</p> <p>Works however will take place within the SAC at four locations, a) at the north end of King's Island where sheet piling will be cut b) within the marsh area of the SAC to the east of St Mary's Estate where an existing shallow drain will be deepened and widened, c) at the north west of the site where a new storm outfall with non-return valve, and works incorporating access ramp for fishermen will be located and d) within the Abbey River at Area A9 and Shannon River B3, where jack-up rigs will be temporarily located. River Shannon and River Fergus Estuaries SPA is located <1km south of King's Island</p>
Resource requirements (water abstraction etc.)	There will be no water abstraction requirements
Emissions (disposal to land, water or air)	<p>Temporary Impacts: Water:</p> <p>Several potential pollutants will be utilised at the site, including diesel, engine/hydraulic oils, concrete, etc. The potential for temporary impacts are through unintentional discharge of these chemicals to surface water from where they could spread up to 2km before being sufficiently diluted to prevent impacts. Within the 2km zone, there is the potential for negative effects on all aquatic habitats and species.</p> <p>The construction of new embankments will expose considerable areas of bare earth. Surface water runoff could bring large amounts of suspended solids into drainage ditches and on into the Shannon and Abbey Rivers. Infilling and relocation of ditch could also add to the impacts.</p> <p>Jack-up rigs will be temporarily located in two areas (A9 and B3). The pads at the base of the legs of these have the potential to disturb the substrate of the river. The temporary resuspension of sediment into the water column while the rigs are emplaced, will not have a significant impact on the mudflats and sandflat habitat of the Shannon River SAC which is located 800m downstream. Estuaries are dynamic environments and the variable movement of large volumes of suspended particles are part of their natural processes. However, the fine sediment element of substrate within the River Abbey (Area A9) and Shannon River (Area B3) represents potential habitat for lamprey ammocoetes which could be compressed and disturbed.</p> <p>An accident in launch of rig, or machinery or materials used in upgrading of walls falling into the river from the jack-up rig, could reduce water quality.</p>

Project Elements	Comment
	<p>Air: Air pollution will be restricted to emissions from working machinery and will not have a significant impact on habitats or species of qualifying interest.</p> <p>Permanent Impacts: There will be no extra emissions generated as a result of the operation of the upgraded quay walls or embankments, therefore there will be no permanent impacts.</p>
Excavation requirements	<p>The construction of the embankments will require shallow excavation along their length, prior to its construction. This is to provide a cut-off trench (3m width x2m depth) filled with embankment fill material to prevent landward water seepage. Excavation to approximately 1m depth for installation of the filter drain on the inside of embankments,</p> <p>Excavation and movement of part of the Japanese Knotweed (<i>Reynoutria japonica</i>) bund,</p> <p>Two filter drains from the eastern embankment will require connection with existing east-west open drainage ditches in the flood plain. This will entail shallow excavation (2.5m x 0.55m) by JCB into flood plain (marsh habitat) prior to construction of embankment. The northerly drain will extend 45m into the SAC. The southerly drain will not require extension into the SAC. Once excavated the ditches/open drains will revegetate and function as they did previously.</p> <p>The new storm outfall at the north west of the site, with non-return valve, and works incorporating access ramp for fishermen, will require excavation to 2m depth through original embankment, with dimensions of 2m at base, widening to 5m at the top. To bring the outfall to the Shannon River will require excavation through approx. 22m of riverbank habitat within the SAC.</p> <p>Access to cut sheet piling requires exposure of soil 300mm either side of piling</p> <p>Insertion of path north of sheet piling requires excavation of 350mm depth x 2.4m width of soil prior to laying 150mm hardcore, with capping of Compacted CL 804 and 100mm of Macadam.</p> <p>Excavation of fishermen's path to north west of King's Island requires excavation of 600mm depth x 3m width of soil prior to laying 150mm hardcore, with capping of Compacted CL 804 and 100mm of Macadam. 25m of this 50m path will be within the SAC.</p> <p>Excavation for pilings to support new concrete wall at Verdant Place will entail rock socketed piles bored 2m into bedrock. This will be outside of, but bordering, the SAC boundary.</p> <p>Existing sandbags, footpath, and concrete plinth along western embankment (along SAC boundary) will be excavated and removed.</p> <p>Decommissioning of old outfall at north west of island will involve removing pipe from existing drain and infilling the hole with soil.</p>
Transportation requirements	<p>Transport will be required for large amounts of fill material for the construction of the embankments. Access for heavy plant and machinery, including large excavators (20- 30Ton), large dump trucks and hydraulic excavators with grab attachments will take place on roads into and on King's Island.</p> <p>Jack-up rigs are required for access to the quay walls at Area A9</p>

Project Elements	Comment
	and Area B3 from the river. These will be craned onto the water and floated to the rig locations from nearby access points on the Abbey River and Shannon River.
Duration of construction, operation, decommissioning etc.	Duration of construction: Two years Duration of operation: Permanent

3 Ecology Baseline

3.1 Overview

King's Island is predominantly a low lying urban/suburban environment, with a significant portion of the north-east side of the island, which is located within the SAC, consisting of wetlands, playing fields and other amenity areas. The River Shannon and the Abbey River bound King's Island to the west and east respectively and are tidal in nature.

3.1.1 Desktop Study

A desk-based assessment was carried out to collate information regarding protected/notable species and statutorily designated nature conservation sites in, or within close proximity to, the study area. Data has been collected from a range of sources (see Section 1.4).

Information for statutory designated sites including Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Ramsar Sites, Natural Heritage Areas (NHAs) and proposed NHAs (pNHA) was collected from the online resources provided by the National Parks and Wildlife Service (www.npws.ie).

3.2 Ecological Surveys

Numerous ecological surveys were undertaken between 2015 and 2019. The first ecological walkover survey of the area was conducted by JBA Consulting ecologists on 09/09/2015 to record the habitats and flora of the scheme as part of the Constraints Study. The purpose of this survey was also to detect the presence or likely presence of protected species that may be impacted by the scheme and identify the need for further surveys, if necessary. The survey was chiefly concerned with recording and mapping habitats suitable for protected habitats and species; and notes were also made on other flora and fauna. The survey area covered the proposed scheme study area, following the roads and pathways that surround Kings Island in its entirety, along the River Shannon and the Abbey River.

To further inform the NIS and Environmental Impact Assessment (EIA) for the flood relief scheme, a number of specific ecological surveys and assessments on habitats, protected flora, invasive non-native species, bats, birds and fish were also conducted during 2016, 2017, 2018 and 2019 (re-surveying) for the proposed scheme, by a number of specialist ecologists and other technical specialists as seen in Table 3-1.

Table 3-1. Details of specialised ecological surveys conducted in 2015 - 2019.

Name	Company	Role	Ecological Receptor	Dates
Anne Murray	JBA Consulting	Ecologist and Bird Specialist	Breeding Birds and Wintering birds	May & July 2016 / December 2015 & January 2016
Dr. Kieran Connolly	Kieran Connolly	Botanist	Invasive species and flora	January 2015
Niamh Sweeney & Catalina Herrera	JBA Consulting	Ecologist and Aquatic Specialist; Environmental Scientist	Invasive species	January 2017
Tanya Slattery & Catalina Herrera	JBA Consulting	Ecologist and Botanist; Environmental Scientist	Large Mammals and Flora	January, March & April 2017
Ross Macklin	Triturus Environmental Services	Fisheries Scientist	Fisheries	September 2016
Dr Tina Aughney	Bat Eco Services	Bat Specialist	Bats	July 2016
Dr. Joanne Denyer & Tanya Slattery	Denyer Ecology and JBA Consulting	Aquatic plant specialist and Botanist	<i>Groenlandia densa</i>	April 2017
Tanya Slattery	JBA Consulting	Ecologist and Botanist	Detailed habitat survey of Sir Harry's Mall Habitat	8 March 2018
Niamh Burke, Hannah Mulcahy & Patricia Byrne	JBA Consulting	Ecologists and Botanist	Detailed re-surveying of habitats at north of island	April 2019
William Mulville & Hannah Mulcahy	JBA Consulting	Ecologists	Wintering birds Amphibians Otter	April 2019
Hannah Mulcahy & Jean Hamilton	JBA Consulting	Botanist	Botanical and invasive species survey (north-eastern section)	May 2019
Hannah Mulcahy & Jean Hamilton	JBA Consulting	Botanist	Botanical survey marsh relevés (north-eastern section)	July 2019

3.2.1 Methodology

Habitats

Habitats were surveyed following standard methodology (Smith *et al.*, 2011) and were classified, where applicable, according to The Interpretation Manual of European Union Habitats (European Communities, 2013), wherein habitats considered to be of the highest nature conservation importance at a European level are listed on Annex I of the Habitats Directive. The designation of

SAC sites, such as Lower River Shannon SAC, is also based, at least in part, on the presence of Annex I habitats, which are then deemed to compose the 'qualifying interests' of the site.

Habitats were also considered under the national habitat classification system of Fossitt (2000), particularly as only some of the habitats at the site could be classified among those listed on Annex I of the Habitats Directive. Nomenclature for higher plants principally follows Parnell and Curtis (2012). Habitat boundaries were recorded with the aid of aerial images of the site while in the field.

Flora of particular ecological interest, including non-native invasive species such as Japanese Knotweed (*Reynoutria japonica*), Giant Hogweed (*Heracleum mantegazzianum*), and Himalayan Balsam (*Impatiens glandulifera*), and/or protected species such as Opposite-leaved Pondweed (*Groelandia densa*) were recorded and mapped when observed during all surveys. Records of invasive species were determined to be substantial enough to require further surveying and an invasive species management plan. Relevés of Marsh habitat were carried out using standard methodology using the Domin scale.

Fauna

Mammals (Otter & Badger)

Otter (*Lutra lutra*) are listed on Annex II and IV of the EC Habitats Directive (92/43/EEC), Appendix 1 of CITES and Appendix II of the Bern Convention (Council of Europe, 1979). Intensive surveys (including 2019 re-surveying) were carried out to establish the value of the area to Otter using the NRA (2009) guidelines 'Ecological Surveying Techniques for Protected Flora and Fauna during the planning of National Road Schemes' and the 'Guidelines for the Treatment of Otters Prior to the Construction of National Roads Schemes' (NRA, 2008). These guidelines included indirect survey methods for identifying spraints/scats, tracks, feeding remains, slides, holts and couches.

Badger (*Meles meles*) are protected under the Wildlife Act (1976) and Wildlife Amendment Act (2000). Badger was searched for, in order to establish if lands adjacent to the proposed works may be used by badger e.g. embankments etc. Indirect observations of Badger activity were searched for during the survey, including setts, latrines, prints and signs of badger foraging. This survey was carried out using best-practice guidance outlined in 'Ecological Surveying Techniques for Protected Flora and Fauna during the planning of National Road Schemes' and the 'Guidelines for the Treatment of Badger Prior to the Construction of National Roads Schemes' (NRA, 2005).

Bats

Bats are protected species under the Wildlife Act (1976) and Wildlife Amendment Act (2000). All bat species are protected under Annex IV of the EU Habitats Directive, while the Lesser Horseshoe bat is listed under Annex II. Any structures and trees likely to be impacted by site preparatory and construction works were inspected to determine their potential value for roosting bats during a daytime survey, using the methods specified in the Bat Conservation Trust (BCT) Bat Surveys for Professional Ecologists - Good Practice Guidelines (3rd ed.) (Collins, 2016). Any Potential Roosting Features (PRFs) were identified during this survey. Following on from identifying PRFs, dusk emergence and/or dawn re-entry surveys were conducted at any PRFs. Static detector systems were then used to confirm suspected commuting routes and foraging areas within suitable foraging habitats near linear features.

Birds (Wintering & Breeding)

Wintering surveys were carried out to establish the use of Kings Island by wintering waterbirds including important birds of the SPA downstream. Wintering bird survey methods used included the 'look – see' method as used in the I-Webs Irish Wetland Bird Survey (Crowe & Holt 2013), during the period of September to March. Birds recorded during the survey were placed in an international, national and local context to identify species of conservation importance. The wintering bird surveys concentrated on the areas of Kings Island most likely to be used by wintering birds, such as the wetland of the SAC and also the amenity areas of the island, which were noted to be regularly used by waders.

Breeding bird survey methodology requires a minimum of two bird count visits (Bibby, 2000) which are carried out during early and late periods of the breeding season, to increase the chances of detection of early and late migrant species, and to improve estimates of resident species. The riparian breeding bird surveys methods followed Cummins et. al, 2010. The breeding status of birds encountered within the site were classified in three categories: confirmed, probable and possible breeders. The watercourses that fall within the survey extent were surveyed for any

breeding bird activity, with particular attention paid to riparian vegetation and woodland. Areas of scrub along the ditches were also surveyed for breeding activity where possible to gain access. All bridges and other structures which may offer nesting opportunities, within the surveyed extent were examined for nesting birds.

Amphibians

There are three species of amphibians in Ireland: The Natterjack toad (*Bufo (Epidalea) calmita*), Common (smooth) newt (*Triturus (Lissotriton) vulgaris*) and Common frog (*Rana temporaria*). Amphibian species identified as present during the desktop survey through the National Biodiversity Data Centre's website were surveyed for using methods adapted from 'Common Standards Monitoring Guidance for Reptiles and Amphibians. Joint Nature Conservation Committee' (JNCC 2004) and 'Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes' (NRA, 2009).

Fish

A desktop review was carried out to identify the areas that were important to fish within the study area and immediate environs. This included the fish species designated as conservation objectives under the Lower River Shannon SAC (listed below) as well as other species of conservation interest, European Eel *Anguilla anguilla*, Smelt *Osmerus eperlanus* and estuarine fish species. The site surveys obtained detailed information at the specific flood relief working areas detailed in Appendix B.

- Sea lamprey *Petromyzon marinus* [1095]
- River lamprey *Lampetra fluviatilis* [1099]
- Brook lamprey *Lampetra planeri* [1096]
- Atlantic salmon *Salmo salar* [1106]

Survey areas were located on the Lower River Shannon and the Abbey River, respectively, in the northern part of Limerick City (Appendix C.1). The Lower River Shannon was surveyed between the Parteen Railway Bridge and Sarsfield Bridge while the entire length of the Abbey River was surveyed.

Fisheries habitat mapping was prepared to provide information on the areas of importance for the species utilising the lower River Shannon and Abbey River as identified above. River profile maps were prepared for the River Shannon at King's Island and the Abbey River tributary, respectively to target note areas of special fisheries importance. The fisheries habitat map was also informed by the literature available for the fisheries resource of the lower River Shannon. The fisheries habitat maps were also informed by a site survey which divided the river channels into discrete sections, based on sections of channel sharing common habitat characteristics.

The Lower River Shannon Fisheries value at King's Island in the footprint of the works was evaluated on a species-by-species basis in order to highlight any species-specific sensitivities. This provided a baseline to contextualise the likely level of impact based on the design proposals of flood defence works.

Invasive Species

Invasive species present on site which have legal implications if left untreated include Japanese Knotweed, Giant Hogweed, and Himalayan Balsam. They can spread rapidly over suitable habitat, including riverbanks, wetlands or disused waste land (Invasive Species Ireland 2017b). Section 49 and 50 of Part 6 of the European Communities (Birds and Natural Habitats) Regulations 2011 restricts the dispersal, spread and transportation of these invasive species.

Following the Flora and Habitats surveys, the requirement to conduct specific invasive species surveys was identified. Data gathered during the preliminary invasive species survey on King's Island in September 2015 was supplemented with results from the surveys conducted during the flora seasons of July 2016 and May 2019. These results were used to form the basis for the King's Island Invasive Species Management Plan (JBA, 2019b).

3.2.2 Habitat and Flora Field Survey Results

The main habitats recorded are listed in Table 3-2. The habitat map of the proposed scheme is detailed in Appendix 0 The boundary of the SAC largely surrounds the embankments and flood defence walls of King's Island, but cuts north-south through the marsh habitat on the north east of the island.

Table 3-2: Habitats recorded in and adjacent to the proposed site (* = Priority habitat).

Habitat	Fossitt Habitat code	EU Annex 1 habitat code
Tidal rivers and Estuaries	CW2 & MW4	1130
Riparian woodland	WN5	
Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>)		91EO*
Tall Herb swamps	FS2	
Drainage ditches	FW4	
Marsh	GM1	
Wet Grassland	GS4	
Improved agricultural grassland	GA1	
Treelines	WL2	
Amenity grassland	GA2	
Dry meadows and grassy verges	GS2	
Recolonising bare ground	ED3	
Buildings and artificial surfaces	BL3	

Tidal Rivers (CW2) and Estuaries (MW4)

The River Shannon and River Abbey are tidal rivers that surround King's Island. The Shannon Estuary is located downstream of King's Island.

WN5/91EO Riparian woodland / Annex I Alluvial forests

The riparian woodland within the survey area is of the 'gallery' type, which encompasses river margin woodlands that are subject to frequent flooding, or where water levels fluctuate due to tidal movements in the lower reaches of rivers. This habitat category includes the Annex I habitat Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-padion*, *Alnion incanae*, *Salicion albae*) (91EO) (Fossitt, 2000).

Riparian woodland fringes the edge of King's Island (Figure 3-1). This habitat extends northwards along the eastern margin, from O'Dwyers Bridge to the north western edge. This riparian woodland is dominated by stands of Willow (*Salix* spp.), the total cover of which is generally at least 10% and frequently substantially greater - and includes Osier (*S. viminalis*), Crack-willow (*S. fragilis*), Grey Willow (*S. cinerea* subsp. *Oleifolia*) and Almond Willow (*S. triandr*). Alder (*Alnus glutinosa*) and Ash (*Fraxinus excelsior*) are generally occasional throughout.

Among the herbaceous species in the understory are Cuckooflower (*Cardamine pratensis*), Water horsetail (*Equisetum fluviatile*), Meadowsweet (*Filipendula ulmaria*), Yellow Iris (*Iris pseudacorus*), Water Mint (*Mentha aquatica*), Hemlock water-dropwort (*Oenanthe crocata*), Reed Canary-grass (*Phalaris arundinacea*), Creeping Buttercup (*Ranunculus repens*), Water Figwort (*Scrophularia auriculata*), and Common Nettle (*Urtica dioica*). Marsh-marigold (*Caltha palustris*) and the nationally rare Summer snowflake (*Leucojum aestivum*) are common, typically in wetter ground near the riverbank. The moss, *Leskea polycarpa*, which characteristically grows on the branches and trunks of trees in the flood zones of lowland rivers and streams, is present on trees in the habitat. Other species include Club Rush (*Schoenoplectus* spp.), Bindweed (*Calystegia sepium*), Bramble (*Rubus fruticosus* agg.) and Willowherb (*Epilobium* spp.). Himalayan Balsam, which is an introduced and invasive species, is abundant throughout the riparian woodland habitat.

Fossitt (2000) describes the affinity of the wet woodland type, Wet pedunculate oak-ash woodland WN4, with the priority Annex I habitat 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-padion*, *Alnion incanae*, *salicon albae*) (91E0)', but does not recognise similar affinity between that Annex I habitat and Riparian woodland, WN5. However, the definition of the Annex I habitat in the Interpretation Manual of European Union habitats (European Commission, 2013) indicates clear floristic affinities with the woodland type surveyed here, while also emphasising the constant characteristic of occurrence on heavy soils that are periodically inundated by the annual rise of a river level, as is the case with the Riparian woodland at King's Island.

A habitat specific survey was conducted on this habitat to assess its potential as the Annex I Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) 91E0* Priority feature. Much of this habitat was found to represent the Annex I habitat, which is also rare in a national context and consequently of significant conservation value.



Figure 3-1: Riparian woodland/ Alluvial Forests *[91E0] in winter

Tall Herb Swamps (FS2)

The riparian woodland becomes somewhat discontinuous near the northern end of King's Island where there are some small patches of riverbank vegetation in which tree cover is greatly reduced or absent, and the habitat may be considered as Tall-herb swamp (FS2). Tall-herb swamps are stands of herbaceous vegetation that occur in wet areas where the water table is above the ground surface for most of the year, or where water levels fluctuate regularly as in the case of tidal sections of rivers (Fossitt, 2000). Herbaceous vegetation is similar to that found within the adjacent riparian woodland, comprising species such as Meadow-sweet, the invasive species Himalayan Balsam, Water Mint) and Hemlock Water-dropwort, although some species such as Reed Sweet-grass (*Glyceria maxima*) and Yellow Iris become significantly more common here.

A habitat-specific survey was conducted on this habitat to assess its potential as the EU Annex I habitat 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels. Due to the absence of a range of typical species this habitat was found not to represent the Annex I habitat in question.

Drainage ditches (FW4)

There are a number of ditches on the island. The main drainage ditches run along the inside of the embankment on King's Island and are mainly for land drainage purposes. The drainage ditch on the west (Figure 3-2) has two outflows into the Shannon River, though one is blocked at present. The drainage ditch on the east of the island has one outflow ('Green Lady') to the Abbey River.

Vegetation within and on the banks of the drainage ditch on the west of King's Island included Reed Sweet-grass, Yellow Iris, Water Horsetail (*Equisetum fluviatile*) and Bulrush (*Typha latifolia*). A section of this drainage ditch contains the protected species Opposite-leaved Pondweed (*Groenlandia densa*) and so was surveyed and characterised further by an aquatic specialist (Section 3.2.2.1)

Nearby borehole and trial pit investigations have shown that the ditch is located in an area of relatively impermeable clay, underlain by sand and gravel. The existing ditch is fed both by surface water run-off from surrounding lands and groundwater through the lower sand/ gravel layer (Denyer, 2019).

The ditch section with *Groenlandia densa* had relatively clear water with low overall algal cover at the time of survey. Aquatic macrophytes were abundant in the channel and the ditch had a shallow eastern bank, grading into wet grassland to the east. There was no shading by scrub or tall vegetation and the ditch was in mid-successional stage with small amounts of open water and a mixture of submerged, floating and emergent vegetation. Water sampling shows that the ditch has a pH between 7.5 and 8 (highly calcareous) and is neither brackish nor highly polluted (Denyer, 2017).

Six shallow drainage channels run across marsh habitat to the east of the site (Figure 3-3). The drainage ditch at the south east of the site flows north into the flood plain (Figure 3-4).



Figure 3-2: Ditch at north west of King's Island containing Opposite-leaved Pondweed



Figure 3-3: Drainage channel across marsh habitat- looking west



Figure 3-4: Drainage ditch at south east of site in flood- looking north into flood plain

Marsh (GM1)

The more extensive area of wet fields on the eastern side of the site (and to the west of the Abbey River and adjacent embankment) contains habitat that can be classified as marsh. The water levels fluctuate regularly here, and the water table may be above ground for much of the year. One of the surveys, carried out in early summer, found the water level to be relatively low with little standing water. The marsh is grazed by local horses (Figure 3-5). The marsh floods extensively in winter (Figure 3-6).

The species recorded during the summer survey included Creeping Bent (*Agrostis stolonifera*), Wild Angelica (*Angelica sylvestris*), Fool's Water-cress (*Apium nodiflorum*), Cuckooflower (*Cardamine pratensis*), Reed Sweet-grass, Yellow Iris, Water Mint, Lesser Spearwort (*Ranunculus flammula*) and Creeping Buttercup. The complementary survey carried out in spring 2019 also recorded Starwort (*Callitriche* spp.), Marsh Ragwort (*Senecio aquaticus*), Marsh Yellow-cress (*Rorippa palustris*), Red Bartsia (*Odontites vernus* subsp. *vernus*), Marsh Horsetail (*Equisetum palustre*), Water Parsnip (*Berula erecta*), White Clover (*Trifolium repens*), Common Sedge (*Carex nigra*), Summer Snowflake, Common Bent (*Agrostis capillaris*), Red Fescue (*Festuca rubra*), Broad Dock (*Rumex obtusifolius*) and Curly Dock (*Rumex crispus*).

The channelized areas through the marsh were dominated by Reed Sweet grass, Yellow Iris, Water-plantain (*Alisma plantago-aquatica*), Water Horsetail, Branched Bur-reed (*Sparganium erectum*), Bulrush, Water Mint, Red Bartsia (*Odontites vernus* subsp. *vernus*) and algal species. Bulrush was present, particularly in wet channels in the northern part of the habitat. The understorey of wetland plants in this habitat could not be assessed due to access restrictions.



Figure 3-5: Marsh in dry conditions



Figure 3-6: Marsh under flood conditions (March 2019)

The marsh vegetation was resurveyed in July 2019 using the Domin scale in 2x2 m relevés at four locations along the boundary of the marsh and the planned eastern embankment, in the area that the embankment will be placed. Results of this survey are seen in

Table 3-3. Locations are marked on the habitat map in Appendix 0. The table shows the overall species list from the four relevés, with minimum, median, and maximum Domin cover scale for each species, and the frequency. Creeping Buttercup was the most dominant and most frequent species, with a cover of more than 50% in all four relevés. Reed Sweet-grass occurred in all four relevés but had a low cover. Broad Dock and Yellow Iris occurred in 3 relevés with a high coverage. Creeping Bent and Yorkshire Fog (*Holcus lanatus*) were the only grasses recorded, with a low median cover of less than 4%. Water Mint, Water Forget-me-not (*Myosotis scorpioides*), Curly Dock (*Rumex crispus*) and Fool's Watercress were frequently found during the survey.

The relevé data was entered into ERICA software hosted by NBDC. It was found that Relevé 1 related to Irish Vegetation Community (IVC) habitat FE3C (Common Spike-rush – Creeping Bent marsh/fen), Relevés 2 and 3 were GL2A (Creeping Bent – Creeping Buttercup marsh-grassland), and Relevé 4 was GL2C (Yorkshire-fog – Perennial Rye-grass grassland), although all of these except Relevé 2 were considered transitional. GL2A (Biodiversity Ireland, 2019) has affinities with Fossitt GM1 Freshwater Marsh and the EU Annex 1 habitat 6430 (Hydrophilous tall herb). In lowland areas of Ireland the community of the Annex 1 habitat is dominated by tall hydrophilous herbs, such as Wild Angelica, Meadowsweet, Yellow Iris, Yellow Loosestrife (*Lysimachia vulgaris*), Purple-loosestrife (*Lythrum salicaria*) and Common Valerian (*Valeriana officinalis*) (NPWS, 2013). Horsetails such as Water Horsetail and Marsh Horsetail can also occur. However, the range of species was insufficient or not present in the Marsh area and it was not considered representative of the Annex 1 habitat 6430.

Table 3-3: Relevé data from four sites on marsh habitat on flood plain

Common name	Species	Cover			Frequency
		Min	(med)	max	
Creeping Buttercup	<i>Ranunculus repens</i>	8	(8.5)	9	v
Reed Sweet-grass	<i>Glyceria maxima</i>	1	(4.5)	5	v
Broad Dock	<i>Rumex obtusifolius</i>	1	(4)	8	iv
Yellow Iris	<i>Iris pseudacorus</i>	4	(4)	5	iv
Creeping Bent	<i>Agrostis stolonifera</i>	2	(3)	6	iv
Yorkshire Fog	<i>Holcus lanatus</i>	+	(3)	5	iv
Water Mint	<i>Mentha aquatica</i>	5	-	7	iii
Water forget-me-not	<i>Myosotis scorpioides</i>	3	(5)	7	iii
Curly Dock	<i>Rumex crispus</i>	2	(2.5)	3	iii
Fool's Water-cress	<i>Apium nodiflorum</i>	+	(2.75)	5	iii
Cleavers	<i>Galium aparine</i>	2			iii
Marsh Bedstraw	<i>Galium palustre</i>	2			iii
Marsh Yellow-cress	<i>Rorippa palustris</i>	4	-	9	ii
Toad Rush	<i>Juncus bufonius</i>	3			ii
Brooklime	<i>Veronica beccabunga</i>	3			ii
White Clover	<i>Trifolium repens</i>	3			ii
Sharp-flowered rush/ Jointed Rush	<i>Juncus articulatus/ acutiflorus</i>	2			ii
Lesser Stitchwort	<i>Stellaria graminea</i>	2			ii
Chickweed	<i>Stellaria media</i>	2			ii
Meadow Foxtail	<i>Alopecurus geniculatus</i>	2			ii
Wavy Bittercress	<i>Cardamine flexuosa</i>	2			ii
Gypsywort	<i>Lycopus europaeus</i>	1			ii
Greater Plantain	<i>Plantago major</i>	1			ii
Starwort spp.	<i>Callitriche sp.</i>	1			ii
Bog Stitchwort	<i>Stellaria alsine</i>	1			ii
Redshank	<i>Persicaria maculosa</i>	+			ii
Hoary Willowherb	<i>Epilobium parviflorum</i>	+			ii

Wet grassland (GS4)

Wet grassland habitat occurs on wet or waterlogged mineral or organic soils that are poorly-drained or, in some cases, subjected to seasonal or periodic flooding. On sloping ground, wet grassland is mainly confined to clay-rich gleys and loams, or organic soils that are wet but not waterlogged (Fossitt, 2000). The wet grassland habitat is mainly located to the north of the island. A narrow strip of wet grassland habitat exists along the western edge of the island (Figure 3-7) which is bordered by a treeline. This wet grassland habitat was dominated by grasses such as Yorkshire Fog and Creeping Bent (*Agrostis stolonifera*). Rushes (*Juncus* spp.), Horsetails (*Equisetum* spp.), Yellow Iris and Reed Sweet-grass were abundant in patches within the wet grassland habitat. Broadleaved herbs such as Creeping Buttercup, Spearwort (*Ranunculus flammula*), Marsh Thistle (*Cirsium palustre*), Meadowsweet, Water Mint, Ribwort Plantain (*Plantago lanceolata*), Dock (*Rumex* spp.), Figwort (*Scrophularia* spp.) and Clover (*Trifolium* spp.) and Willowherbs (*Epilobium* spp.). Himalayan Balsam is abundant in the wet grassland habitats to the east of the island.



Figure 3-7: Wet grassland near north west ditch

Treelines (WL2)

The treelines within the island consist of Ash (*Fraxinus excelsior*), Sycamore (*Acer pseudoplatanus*), Horse Chestnut (*Aesculus hippocastanum*), Elder (*Sambucus nigra*), willows (*Salix* spp.) and limes (*Tilia* spp.). A treeline of immature willow is located adjacent to the ditch to the north of the island (Figure 3-8).



Figure 3-8: Willow treeline between north west ditch and embankment

Improved agricultural grassland GA1

The area to the east of St Mary's estate between the garden walls and the marsh habitat is largely grassland. There are some areas of bare soil where the ground has been poached by horses (Figure 3-9). Species include Bent grasses (*Agrostis* spp.), Annual Meadow-grass (*Poa annua*), Dock and Daisy (*Bellis perennis*), with some Nettle in places.

At the time of the 2017 ecological survey, bare and recolonising ground existed between the residential housing of St Mary's estate and SAC boundary as demolition works had just taken place. By 2019, the area had mostly recolonised.



Figure 3-9: Poached grassland to east of St Mary's estate (looking north)

Amenity Grassland (GA2)

Amenity grassland is situated around the areas of residential housing on King's Island (Figure 3-10). These areas include greens to the west of the island and playing pitches to the east.



Figure 3-10: Amenity grassland (looking south)

Dry meadows and grassy verges (GS2)

A thin strip of grassy verge exists either side of the footpath on the eastern side of King's Island. This verge is slightly wet in nature given its location on King's Island. This is dominated by Nettle, Common Knapweed (*Centaurea nigra*), Willowherbs (*Epilobium* spp.), Bramble, clovers (*Trifolium* spp.) and ragworts (*Senecio* spp.). The only grass that was discernible was Cock's-foot (*Dactylis glomerata*).

Recolonising bare ground (ED3) and Spoil and bare ground (ED2)

A pathway, worn to bare ground, was recorded to the north of the sheet piling (Figure 3-11).

(BL3) Buildings and artificial surfaces

This category is dominated by residential housing on King's Island. A tarmac footpath runs around the perimeter of the Island, inside the embankment. Steel sheet piling (Figure 3-11) has been erected on the north of the Island to stabilise the embankment.



Figure 3-11: Sheet piling and bare ground pathway

3.2.2.1 Protected Flora

Opposite-leaved Pondweed (*Groenlandia densa*)

Opposite-leaved Pondweed (*G. densa*) (Figure 3-12) was observed in the ditch to the north west of the site during the walkover survey on the 17/01/2017 by botanist Tanya Slattery (JBA). As this plant is protected under the Flora Protection Order, confirmation of the species identification, based on photographs taken during the survey, was obtained by Aquatic Macrophyte specialist Joanne Denyer. Joanne Denyer proceeded to obtain a derogation license from the NPWS, in order to survey and confirm the extent of the range of the pondweed within this area and develop possible translocation or alternative habitat development plans in consultation with the NPWS.

Opposite-leaved Pondweed is normally found in calcareous waters of rivers, streams, canals, ditches and ponds. In Ireland, this species is typically associated with areas that are periodically disturbed, including canals, drains and tidal stretches of rivers. It is one of the subtypes of one of the qualifying features of the Lower River Shannon SAC (NPWS 2012a) and can tolerate a certain level of disturbance. It had not previously been identified on King's Island or within the said drainage ditch.

Appendix 0 shows the main areas of Opposite-leaved Pondweed plants observed in a section of the ditch approximately 200m in length (mapped using GPS) during April 2017. In the southern section of the ditch (where the transect was located), Opposite-leaved Pondweed was present throughout the channel and only particularly dense populations have been mapped. The plants appeared healthy at the time of survey and had been present in the ditch during January, suggesting they had overwintered in the ditch.

To the north and south of the section with Opposite-leaved Pondweed, the ditch is infilling and overgrown suggesting that no ditch clearance had been undertaken recently. To the north the channel is shaded by scrub and dense patches of Duckweed (*Lemna* spp.) and litter dominate the water surface. To the south, the ditch channel is dominated by tall monocots such as Bulrush, Reed Sweet-grass and Bur-reed *Sparganium* spp. Opposite-leaved Pondweed was not recorded from these overgrown ditch sections.

Macrophytes growing with Opposite-leaved Pondweed at the time of surveys included Common Stonewort (*Chara vulgaris*), Thread-leaved Water-crowfoot (*Ranunculus cf. trichophyllus*) (not flowering), Blue-fruited Water-starwort (*Callitriche obtusangula*) (not flowering or fruiting), Reed Sweet-grass, Bur-reed (not flowering), Least Duckweed (*Lemna minuta*) Common Duckweed (*Lemna minor*), Water Horsetail, filamentous algae, Brooklime (*Veronica beccabunga*), Pink Water-speedwell (*Veronica catenata*) and Yellow Iris .



Figure 3-12: Opposite-leaved Pondweed (Denyer, 2017)

Opposite-leaved Pondweed is protected by Section 21 of the Wildlife Act (1976) and is listed on the Flora (Protection) Order (2015). It is listed as 'Near Threatened' on the Irish Vascular Plant Red List (Wyse Jackson *et al.*, 2016); and is identified as one of the three high conservation elements (sub-types) of the Feature of Interest of the Annex I habitat Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation [3260] within the Lower River Shannon Special Area of Conservation (SAC) (NPWS, 2012a).

These sub-types of the Annex 1 habitat are dependent upon the presence of indicator species. Triangular Club-rush *Schoenoplectus triquetus*, another of the sub-types, is known to occur along the north west riverbank of King's Island. This species was not identified during any of the ecological surveys, though it was potentially recorded during the fisheries surveys between Thomond Bridge and Curragower Falls on the west of King's Island (see Section 3.2.3.2). The second sub-type, Opposite-leaved Pondweed *Groenlandia densa* was known to be present in the Limerick Canal entering the Abbey River. The ditch containing Opposite-leaved Pondweed was recorded in the north of King's Island, however the habitat was assessed as not being of sufficient quality to be classified as the Annex 1 habitat Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation [3260] (Denyer, 2017).

Opposite-leaved Pondweed was not visibly apparent in the ditch or recorded by JBA ecologists during the re-surveying of habitats on King's Island in spring/summer of 2019. However, this result does not preclude the presence of the species, which may still occur within the ditch..

3.2.3 Protected Fauna

Terrestrial Mammals (Otter & Badger)

The surrounding habitats of the embankments, with tall herb swamps, riparian woodland, treelines and the adjacent Shannon and Abbey Rivers, provide extensive potential habitat for breeding or resting locations for Otter. The marsh habitat offers Otter an opportunity to forage. A mammal survey was conducted on the 17/01/2017 and the area was resurveyed on the 04/04/2019. Evidence of Otter was not observed during either survey or noted on any of the other ecological surveys conducted however, this may be due to several factors. The bank of the river, where many of the normal traces of otter would be observed, is within a tidal zone and so is regularly inundated with water. Furthermore, this area is frequently disturbed by human and domestic animal activity so evidence of Otter that could be present within these areas is likely to be destroyed. The rivers surrounding King's Island should still be considered suitable foraging and commuting habitats (NPWS, 2013).

An outlier Badger sett was observed on the north side of the football pitches, directly adjacent to the drainage ditch. Badger droppings were recorded in the middle of the marsh habitat in April 2019 and a Badger was captured on video in May 2019 from overnight camera traps set up near the sett.

Bats

King's Island was surveyed (Aughney, 2016), in relation to potential bat roosts and bat foraging areas.

Four species of bats were recorded foraging and commuting within the survey area. There were no roosting sites recorded within the current flood defence walls. All four of these bat species (Common pipistrelle *Pipistrellus pipistrellus*, Soprano pipistrelle *Pipistrellus pygmaeus*, Daubenton's bat *Myotis daubentonii* and Leisler's bat *Nyctalus leisleri*), are considered common bat species.

Despite the lack of bat roosts within the current flood defence walls, ecology and presence of these species would indicate that both the terrestrial and aquatic environment on King's Island are important foraging and commuting routes for bats. This emphasises the importance of these habitats for the suite of bat species recorded on-site.

3.2.3.1 Birds

Desktop study

King's Island spans across four 2km national grids on the National Biodiversity Data Centre's map viewer; R55U, R55T, R55E and R55Y (NBDC 2016). The most recent records and locations of protected and notable bird species available from the National Biodiversity Data Centre for these 2km grid areas are provided in Appendix C.4.1.

Surveys

Part of King's Island occurs within the Lower River Shannon SAC and comprises a marsh that is used by wintering birds on the north eastern side of the island especially during flood periods. Although King's Island is not part of the SPA, some of the wintering birds that use the marsh area (see Appendix C.4.2 and C.4.3) are designated features of the River Shannon and River Fergus Estuaries (Site Code: 004077), a Special Protection Area (SPA) that occurs further downstream of Kings Island. These include Whooper Swan *Cygnus cygnus*, Pintail *Anas acuta*, Lapwing *Vanellus vanellus* and Black-headed Gull *Chroicocephalus ridibundus*. Other red listed birds of conservation concern recorded on the marsh include Tufted Duck *Aythya fuligula*, and Golden Eye *Bucephala clangula*. The surveys were carried out after periods of heavy rain during December 2015 and January 2016 when a lengthy period of very high flooding occurred, which included the marsh area of the SAC. This area was resurveyed 4/04/2019 on a rising tide.

Wintering bird species recorded on the amenity grasslands on the north west of King's Island fronting Oliver Plunkett St. (see Appendix C.4.4) include the red listed Black-headed Gull.

Breeding birds and their breeding status recorded within the site are listed in Appendix C.4.5.

3.2.3.2 Fish

A desktop review and fisheries habitat survey were undertaken on the fisheries composition of the River Shannon and Abbey River in the vicinity of King’s Island to categorise the importance of the channels to support fish populations (Table 3-4). The sensitivities of these species in terms of their vulnerability to pollution, their respective spawning seasons and their migratory patterns are discussed within the text with particular emphasis on fish species that are qualifying Interests of the Lower River Shannon SAC (Macklin & Brazier, 2018).

Table 3-4: Status of fish species in adjoining river habitats listed as Qualifying Interests in the Lower River Shannon SAC (site code: 2165) (Source: Macklin & Brazier, 2018)

Species	Annexed	IUCN Status (Ireland) King et al., 2011	Presence in vicinity of King’s Island	Life strategy	Recorded by Inland Fisheries Ireland (2008, 2014) or Ecofact (2011)
Sea Lamprey	II	Least concern	Yes	Anadromous Migrant (migrates to sea)	Yes, recorded by Ecofact (2011) in the Abbey River.
Brook Lamprey	II	Least concern	Status unknown	Not strictly migratory	No (but may be present in Abbey River and River Shannon above weir). River/ brook ammocoetes recorded in the Abbey River (Ecofact, 2011).
River Lamprey	II & VI	Least concern	Status unknown	Anadromous migrant (migrates to sea)	Transformed River Lamprey recorded by Ecofact (2011) in the Abbey River.
Atlantic salmon	II	Least concern	Yes	Anadromous migrant (migrates to sea)	Yes, recorded by IFI, 2008

Physical Characteristics

The Lower River Shannon (IE_SH_060_0900) is located in Hydrometric Area 25 and is contained within the Shannon International River Basin District. The River Shannon in Limerick City can be considered a tidal channel as the river is subject to tidal fluctuation and thus salinity changes but still receives high volumes of freshwater from upstream. The transitional water quality of the Limerick Docks site that includes the study area (EPA Code: E_SH_060_0900) as measured between 2010-2012, is considered as being of ‘Good Status’ or ‘Unpolluted’ according to the Water Framework Directive monitoring (EPA, 2019). The geology of the Limerick Dock’s and King’s Island is situated on Visean Limestone (undifferentiated) per the Geological Survey of Ireland.

Riparian Habitat

The riparian zone of the River Shannon and the Abbey River in the vicinity of King’s Island possesses good quality natural and semi-natural habitat but the southern end of King’s Island is progressively more built up with residential and commercial properties. The natural riparian zones of the channel according to Fossitt classification (2001) were locally defined by marsh vegetation (GM1), non-native scrub (WS3), mixed sediment shores (LS5) and more localised tall reed and herb vegetation (FS1). Other riparian features included treelines (WL1), sea walls (CC1) and amenity grassland (GA2), improved grassland (GA1) and wet grassland (GS4). Upstream of Thomond Bridge riparian areas were encroached by invasive non-native scrub (WS3) comprising of Himalayan Balsam, Japanese Knotweed and Giant Hogweed.

The riparian habitat of the Lower River Shannon between Thomond Bridge and Corbally Bridge was largely of built ground (BL3) with small riparian fringes of vegetation fronting the waterlines.

On the right-hand bank between Thomond Bridge and Curragower Falls there was a small area of FS1 comprising Club-rush vegetation (*Scirpus* spp.). However, it is most likely Triangular club-rush which is protected under the Wildlife Acts (1976 and 2000), as it is listed on the Flora Protection Order 1999. The species has been confirmed in this area near Curragower Falls (Reynolds, 2013). The mixed sediment shores (LS5) of Clancy's Strand comprised cobble, coarse gravel and mud with limited vegetation apart from some sparse Triangular Club Rush and Purple Loosestrife on the littorals with Sea Plantain (*Plantago maritime*) on the more open sediment.

The quay walls and bridge aprons contained Red Valerian (*Centhrathus ruber*), Maiden Hair Spleenwort (*Asplenium trichomanes*) and more localised Buddleia (*Buddleia daviddi*) and Figwort.

Macrophyte plant species were typically scarce in the channels of the Lower River Shannon and Abbey River, with low surface area cover given the fast current and high turbidity. Common Water Starwort (*Calitriche stagnlais*) was present in very small and localised stands upstream of Curragower Falls on the River Shannon along with very common *Cladophora* sp. Very localised areas of Horned Pondweed (*Zanichellia palustris*) were seen in the Lower Abbey River as with Eurasian Water-milfoil (*Myriophyllum spicatum*). Some emerging Water Plantain (*Alisma plantago aquatica*) was also present. The aquatic moss species *Fontanalis antipyretica* was very abundant in the Lower River Shannon between Thomond Bridge and Curragower Falls.

Opposite-leaved Pondweed was not observed between Thomond Bridge and Sarsfield Bridge but is highly likely to occur in slack water areas of the Abbey River. It was known to thrive in the adjoining Park Canal, east of Baal's Bridge (Reynolds et al., 2006), though it has not been recorded there since 2006. Littoral macrophytes included Brooklime, Water mint, Cuckoo flower and Fool's watercress which were locally common upstream of Curragower Falls.

Fish habitat mapping

Fisheries habitat mapping was prepared to provide a snapshot of the areas of importance for the species utilising the lower River Shannon and Abbey River. Typically, glide habitat dominated the main channel of the River Shannon downstream of Thomond Bridge (at low tide), constituting 60% of the habitat with pool and riffle comprising 30% by surface area and Curagower Falls the remaining 10%. Glide and pool habitat accounted for 45% each of the surface area of the Abbey River with artificial weir habitat accounting for the remaining 10% of the total habitat area. Upstream of Baal's Bridge the Abbey River becomes exclusively deeper pool habitat with localised marginal shallows. Similarly, the Lower River Shannon upstream of the historical Salmon traps is predominantly deeper pool habitat (see Appendix C.5.1 and Appendix 0).

The substrates in both the main channel of the River Shannon and lower Abbey River (i.e. downstream of Athlunkard Bridge) were dominated by boulder and cobble with coarse gravels (Figure 3-13). Localised fines were present as beds interspersed with gravels and locally as beds where the current permitted settlement but is never extensive (Appendix 0). Mud, silt and sand mixtures dominated the Abbey River upstream of Athlunkard Bridge, with mixed sediment shorelines at Clancy's Strand (Figure 3-14) downstream of Thomond Bridge on the Lower River Shannon. Some localised soft sediment banks were also present adjoining the reeded littorals of the Lower River Shannon upstream of the historical salmon traps (see Appendix 0).



Figure 3-13: Cobble & gravel substrata of the Lower River Shannon downstream of the Abbey River confluence (credit: R. Macklin)



Figure 3-14: Mixed sediment area at Clancy's Strand (Smelt Spawning Area) (credit: R. Macklin)

Fish species

Of the qualifying interests, Atlantic Salmon, Sea lamprey and River Lamprey are likely to occur within the river channels overlapping the proposed works areas, as they are both anadromous fish species (i.e. spawn in freshwater and return to the sea), meaning they are obligate migrants through the river channel. Ecofact Environmental Consultants (Ecofact, 2011) recorded River/Brook lamprey ammocoetes (*Lampetra* spp.), in addition to Sea Lamprey ammocoetes and transformed River Lamprey within the lower Abbey River (i.e. between the Park canal confluence and Authurs Quay). While no Atlantic Salmon were recorded during the survey the species may still occur at low densities within the Abbey River. It is likely that all three lamprey species also occur in the main channel of the River Shannon west of King's Island given the presence of littoral beds of fines, good water flows and gravels which would support these species. Atlantic Salmon would likely occur at lower densities here as better-quality habitat overall exists upstream (e.g. Mulkear River & Castleconnell). A review of the qualifying interest fish species occurring within the receiving habitats are discussed below.

Atlantic Salmon

The River Shannon is listed on the Quantification of the Freshwater Salmon Habitat Asset as containing 3.28% of the national fluvial accessible habitat to Atlantic Salmon (McGinnity et al., 2003). The diversion of water from the main river channel in 1929 caused a profound impact on the salmonid spawning habitat of the Lower River Shannon (Went, 1970), while the dam construction cut the catchment in half. This was reflected by the declining numbers of returning salmon. During 2003, 1904 salmon were counted at the Ardnacrusha / Parteen counters compared with 23,322 fish in 1963 at the nearby Thomond weir (Salmon trap here now closed). Most recently the Standing Scientific Committee on Salmon (2016) have stated that the passage of fish above the dams in the Lower River Shannon SAC is below 5% of the conservation limit (CL) meaning that the escapement of fish is extremely low and thus favourable conservation status is not being met.

The River Shannon has the largest wetted area catchment upstream of any dammed river system in Ireland (30,895,619 m²) meaning the CL value is comparably large at 49,638 Salmon (SSCS, 2017). However, the 2011-2015 data on fish passage illustrates a figure of 2,148 Salmon passing through the dams, a mere 4.3% of the conservation limit value.

The most important recreational Salmon fishery exists at Castleconnell, 11km upstream of Limerick City which contains six beats, each of 800m in length. The River Shannon Management Plan initiated by the ESB in 1992, helps sustain the fishery by releasing 150,000 adipose fin clipped Salmon every year (ESB, 2011) with these fish forming the bulk of those passing through the dams (i.e. fin clipped fish; SSCS, 2016). The Lower River Shannon between Thomond Bridge and Sarsfield Bridge contains important transitory holding pool habitat for adult Salmon (i.e. when viewing the study area in closest proximity to King's Island). Some large pools exist directly downstream of Thomond Bridge and also downstream of Curragower falls (see Appendix C.5.1). Salmon run in phases throughout the year with large Salmon, known as 'springers' in the springtime, smaller sized summer 'grilse' and late running autumn fish. As such the holding pool habitats downstream of Thomond Bridge and Curragower Falls may contain Salmon in phases throughout the year. The most sensitive time for impacts to Salmon is likely to be during April when smolts move downstream in their migration to the open sea. Smolts 'mill' (shoal up) in pools around structures and weirs on route back to sea. Given that smolts can occur in large densities as they shoal together, and represent the future run of Salmon to their natal river, they are highly important for future recruitment of the stock. Refer to table in Appendix C.5.4 for the seasonal sensitivity periods for all key protected fish species present in the Lower River Shannon and Abbey River.

Following the construction of the Shannon H.E.P Scheme and dropping water levels, the nature of the riverbed in the Lower River Shannon changed and it took time for new spawning habitat to form following the natural regrading of river gravels. More recently, returning spawning fish use areas upstream of King's Island on the Lower River Shannon to spawn including Castleconnell, Doonass, Plassey and Corbally (Reale, 2011).

Thus, the adjoining areas of habitat in the Abbey River and Lower River Shannon are not considered of significant importance for spawning. The Mulkear River also remains a critically important tributary for contribution to the spawning stock in addition to being one of Ireland's finest lamprey habitats.

Lamprey species

All three species of lamprey, Brook, River and Sea lamprey are known to occur in the Lower River Shannon (Igoe *et al.* 2004). The tidal water in the Limerick Docks area, downstream of Curragower Falls, would be less suitable for lamprey ammocoetes as there is limited soft burrowing substrata and the salinity levels may be unfavourable depending on the species. However, the species do exist in the soft margins of the Lower River Shannon upstream of the historical salmon traps. Lamprey ammocoetes River/Brook and Sea lamprey have been recorded in this area by Ecofact consultants (Ecofact, 2011).

Sea lamprey are a panmictic anadromous fish, and thus move from sea water to freshwater to spawn (anadromy), with populations from various European rivers capable of mixing (panmixia). The pool habitat below Curragower falls, downstream of King's Island/Thomond Bridge would be an important transitory resting area for Sea lamprey moving upriver on the Shannon to known spawning areas such as in the Mulkear River tributary at Annacotty and below the hydroelectric dams on the Lower River Shannon at Castleconnel. According to Igoe *et al.* (2004) large numbers of Sea Lamprey were also harvested annually at Plassy (upstream of King's Island near the University of Limerick Campus). The tributaries of the Lower River Shannon, particularly the Mulkear and the main channel of the Lower River Shannon between Plassey and Parteen Dam, where suitable spawning exists are considered important areas of the Lower River Shannon for adult lamprey (Igoe *et al.* 2004, Curd, 2009).

Suitable spawning habitat likely also exists downstream of Ardnacrusha Dam where large numbers of juvenile lamprey species (unspecified) have been captured during glass eel surveys (Igoe *et al.* 2004). In summary habitat adjoining King's Island, particularly downstream of Curragower falls would be an important migratory holding area for lamprey moving upstream to spawning grounds as stated. Additionally, the soft sediment littorals of both the Abbey River and River Shannon upstream of the weir provides habitat for ammocoetes (likely all three species).

Other surveys

Inland Fisheries Ireland surveys

During 2008 and 2014, as part of Water Framework Directive fish monitoring, Inland Fisheries Ireland sampled the lower River Shannon in the vicinity of Limerick City (referred to as the Limerick Docks). The sampling was undertaken using beach seine netting, beam trawling and fyke netting, both upstream and downstream of King's Island (within a 2km radius). Beam trawls were carried out at King's Island on the River Shannon (above Thomond Weir, approx. <1km upstream Verdant Place) and fyke nets were set in the Abbey River in Corbally. Beach seines were used downstream of Thomond Bridge (approx. 500m downstream Verdant Place).

Approximately sixteen species of fish were captured over both survey periods, including Flounder, Smelt, Three-spined Stickleback, Roach, European Eel, Sprat, Dace, Perch, Sand Goby, Brown Trout, Lamprey spp., Plaice, Thick-lipped Grey Mullet, Common Goby, Pike and Atlantic Salmon. Flounder were the most common species captured in both years (n=42; n=247), followed by Roach (n=29; n=38) and European Eel (n=21; n=30). A large number of Smelt (n=138) were recorded in 2014.

With the exception of European Eel, Atlantic Salmon and Brown Trout, none of the other species captured by Inland Fisheries Ireland during their surveys are considered commercially valuable apart from their value as angling species (e.g. Perch, Pike, Roach and Dace). Typically, Pike, percids and cyprinid fish species (i.e. those mentioned above) are more tolerant of poor water quality than salmonids (i.e.: Brown Trout and Atlantic Salmon) and are thus considered less vulnerable to water pollution associated with flood relief works.

3.2.4 Invasive non-native species

Invasive non-native species were recorded along the river walls, existing embankment, riparian habitats and in the undeveloped land of King's Island, both within and outside of the designated areas (Appendix D).

The main invasive species that were noted on King's Island include:

- Japanese Knotweed (*Reynoutria japonica*);
- Giant Hogweed (*Heracleum mantegazzianum*);

- Himalayan Balsam (*Impatiens glandulifera*);
- Buddleia (Butterfly Bush) (*Buddleja davidii*);
- Winter Heliotrope (*Petasites fragrans*);
- Common Ragwort (*Senecio jacobea*);
- Broad-leaved Dock (*Rumex obtusifolius*);
- Spear thistle (*Cirsium vulgare*)

Some of these recorded non-native or alien invasive species, including Himalayan Balsam, Japanese Knotweed and Giant Hogweed are listed in the Third Schedule (Part 1) of the European Communities (Birds and Natural Habitats) Regulations 2011. These are being treated on King's Island under an invasive species management plan (JBA, 2019b), as they are a risk to obtention of the conservation objectives of the designated sites. Regulation 49 and 50 restrict the dispersal, spread and transportation of these invasive species. Buddleia and Winter Heliotrope are amber listed by invasive species Ireland. Common Ragwort, Broad-leaved Dock and Spear Thistle are noxious weed under the Noxious Weed Act 1936.

Himalayan Balsam was abundant along the edges of the island within the riparian woodland and wet grassland habitats. Numerous stands of Japanese Knotweed were located along the boundary line of the SAC and adjoining housing estate. In 2017, the location of Giant Hogweed was limited to the outer fringe of the island, among the riparian woodland and wet grassland areas. However, by 2019 it was recorded on either side of the pathway on the western embankment, on the embankment itself and in the ditch that contains Opposite-leaved Pondweed.

Winter Heliotrope was observed during the survey in January and may only be a more recently established plant. It was observed along grassy verges and embankments to the south-east of the site, where Himalayan Balsam was previously observed. Winter Heliotrope has been known to benefit from the removal of Himalayan Balsam (Hulme and Bremner 2006).

4 Screening for Appropriate Assessment

4.1 Natura 2000 sites

The DOEHLG (2009) guidance identifies that the Appropriate Assessment screening stage of a plan or project should consider the following Natura 2000 sites:

- Any Natura 2000 sites within or adjacent to the plan or project area.
- Any Natura 2000 sites within the likely zone of impact of the plan or project. This is dependent on the nature and scale of the plan, with 15km generally recommended for plans, but potentially much less for projects.
- Any Natura 2000 sites that are more than 15km from the plan or project area, but may potentially be impacted upon, for example, through a hydrological connection.

Natura 2000 sites located within 15km of the proposed FRS at King's Island are listed in Table 4-1 and shown in Appendix E.1.

Table 4-1: Natura 2000 sites within 15km of the proposed FRS

Site Name	Designation	Site Code	Approximate Distance to Development Site
Lower River Shannon	SAC	002165	<0.1km
Slieve Bernagh Bog	SAC	002312	14.7km
Askeaton Fen Complex	SAC	002279	15.0km
Tory Hill	SAC	000439	13.8km
Glenomra Wood	SAC	001013	8.3km
Ratty River Cave	SAC	002316	13.0km
Danes Hole Poulnalecka	SAC	000030	12.7km
Clare Glen	SAC	000930	14.9km
River Shannon and Fergus	SPA	004077	0.6km
Slievefelim to Silvermines Mountains	SPA	004165	14.5km

Of the Natura 2000 sites listed in Table 4-1, the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA have hydrological connectivity to the proposed FRS. Due to their proximity to King's Island (see Appendix 0), the proposed FRS also poses potential impacts via land and air pathways to the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA.

The remaining Natura 2000 sites in Table 4-1 are not hydrologically linked to the proposed FRS and given their distance from the project, impacts via land and air pathways are not anticipated.

Thus, the Natura 2000 sites within the zone of potential impact of the Scheme are;

- Lower River Shannon SAC, and
- River Shannon and River Fergus Estuaries SPA.

The potential impacts on these two Natura 2000 sites is predominantly through impacts on surface and groundwater quality, alterations to groundwater flows, changes to riparian and instream habitats affecting fish and aquatic invertebrates, all of which may have an indirect impact on the foraging opportunities of designated species of the SAC such as Otter and bird species of the SPA. Given the presence of the invasive non-native species, namely Japanese Knotweed, Giant Hogweed and Himalayan Balsam, on King's Island, there is potential for these to spread and cause further negative impacts on the Natura 2000 sites.

The proposed project is not directly connected with or necessary to the management of any Natura 2000 site. It is, accordingly, necessary for the competent authority to assess whether the proposed development, either individually or in combination with other plans or projects, would be likely to have significant effects on any Natura 2000 site.

Given the presence of surface water, groundwater and land and air pathways and the potential impacts posed by the proposed Scheme on the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA, it is concluded by the authors of this report that it is not possible to rule out (screen out) likely significant impacts on these Natura 2000 sites. Therefore, it is recommended by the authors of this report that the proposed King's Island FRS should be brought forward to the second stage of the Appropriate Assessment process.

5 Natura 2000 Sites within the Zone of Influence of the Scheme

5.1 Introduction

This chapter provides baseline information on the Natura 2000 sites within the Zone of Influence (ZoI) of the Scheme, as screened-in in Section 4. There are two Natura 2000 sites that occur within the ZoI;

- Lower River Shannon SAC, and
- River Shannon and River Fergus Estuaries SPA.

5.2 Lower River Shannon SAC (002165)

The Lower River Shannon SAC is an extensive Special Area of Conservation (SAC) encompassing the Rivers Shannon, Feale, Mulkear and Fergus. The River Shannon within this SAC flows through Carboniferous limestone as far as Foynes town and west of Foynes, through mostly Namurian shales and flagstones. The section of the River Shannon, which is adjacent to the proposed development site, is part of the Shannon Estuary and so is influenced by the tides. Salinity levels vary throughout the estuary (NPWS, 2013). Saltmarsh and mud flat habitats are present along the estuary, with specialised colonisers of mud dominating areas between the two habitats. There are 10 different benthic community types recorded within this SAC two of which are within the zone of influence of the proposed development site including (NPWS, 2012b):

- Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex
- Estuarine subtidal muddy sand to mixed sediment with gammarids community complex

The Shannon Estuary provides support to large numbers of wintering water birds, including some Annex I species including Great Northern Diver, Whooper Swan, Pale-bellied Brent Goose, Golden Plover and Bar-tailed Godwit. Otter has been commonly found in the River Shannon, as have Salmon and Lamprey (NPWS, 2013).

Several Irish Red Data Book species have been recorded within this SAC including (but not limited to) Triangular Club-rush (*Scirpus triquetrus*) and Opposite-leaved Pondweed (*Groenlandia densa*). Triangular Club-rush is a rare and highly threatened vascular plant in Ireland with restricted distribution to tidal stretches of the River Shannon. It is protected under the Wildlife Acts (1976 and 2000) and is listed on the Flora Protection order 2015. Opposite-leaved Pondweed is typically associated in Ireland with tidal stretches of rivers or disturbed watercourses. It is protected under the Wildlife Acts (1976 and 2000) and is listed on the Flora Protection Order 2015 (NPWS, 2012b). Locations where Opposite-leaved Pondweed and Triangular Club-rush are present on this site are classified as sub-types of the Annex I habitat Water courses of plain to montane levels with the *Ranunculion fluitans* and *Callitriche-Batrachion* vegetation (3260).

5.2.1 Qualifying Interests

The site is a SAC selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

- Sandbanks which are slightly covered by sea water all the time [1110]
- Estuaries [1130]
- Mudflats and sandflats not covered by seawater at low tide [1140]
- Coastal lagoons [1150]
- Large shallow inlets and bays [1160]
- Reefs [1170]
- Perennial vegetation of stony banks [1220]
- Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]
- *Salicornia* and other annuals colonising mud and sand [1310]

- Atlantic salt meadows (*Glauco-Puccinellietalia maritima*) [1330]
- Mediterranean salt meadows (*Juncetalia maritimi*) [1410]
- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]
- Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410]
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]
- *Margaritifera margaritifera* (Freshwater Pearl Mussel) [1029]
- *Petromyzon marinus* (Sea Lamprey) [1095]
- *Lampetra planeri* (Brook Lamprey) [1096]
- *Lampetra fluviatilis* (River Lamprey) [1099]
- *Salmo salar* (Salmon) [1106]
- *Tursiops truncatus* (Common Bottlenose Dolphin) [1349]
- *Lutra lutra* (Otter) [1355]

Not all the qualifying features of the SAC occur in the Zone of Influence of the proposed project at King's Island, based on the ecological surveys and data sources referenced in the above sections, and therefore only the relevant features are considered in this assessment. The qualifying features that could be potentially significantly impacted through surface water, groundwater and land and air pathways are;

- Estuaries [1130]
- Mudflats and sandflats not covered by seawater at low tide [1140]
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]
- *Petromyzon marinus* (Sea Lamprey) [1095]
- *Lampetra planeri* (Brook Lamprey) [1096]
- *Lampetra fluviatilis* (River Lamprey) [1099]
- *Salmo salar* (Salmon) [1106]
- *Lutra lutra* (Otter) [1355]

5.2.2 Conservation Objectives

The conservation objectives for the relevant species and habitats of the Lower River Shannon SAC are given in Table 5-1 and are taken from the NPWS Conservation Objectives Document (NPWS 2012b).

Table 5-1: Conservation objectives for relevant qualifying interests at Lower River Shannon SAC (002162) (NPWS, 2012b; NPWS, 2013)

Qualifying Interest	Estuaries	
National Overall Conservation Status	Unfavorable-Inadequate	
Conservation Objective	To maintain the favourable conservation condition of Estuaries in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:	
Attribute	Measure	Target
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes
Community distribution	Hectares	Conserve the following community types in a natural condition: Intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex; Estuarine subtidal muddy

		sand to mixed sediment with gammarids community complex; Subtidal sand to mixed sediment with <i>Nucula nucleus</i> community complex; Furoid-dominant intertidal reef community complex; Faunal turf-dominated subtidal reef community; and Anemone-dominated subtidal reef community.
Qualifying Interest	Mudflats and sandflats not covered by seawater at low tide	
National Overall Conservation Status	Unfavorable-Inadequate	
Conservation Objective	To maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:	
<i>Attribute</i>	<i>Measure</i>	<i>Target</i>
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes.
Community distribution	Hectares	Conserve the following community types in a natural condition: Intertidal sand with <i>Scolecopsis squamata</i> and <i>Pontocrates</i> spp. community; and intertidal sand to mixed sediment with polychaetes, molluscs and crustaceans community complex.
Qualifying Interest	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (Alno-Padion, <i>Alnion incanae</i>, <i>Salicion albae</i>) [91E0]	
National Overall Conservation Status	Bad (trend: improving +)	
Conservation Objective	To restore the favourable conservation condition of Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (Alno-Padion, <i>Alnion incanae</i> , <i>Salicion albae</i>) in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:	
<i>Attribute</i>	<i>Measure</i>	<i>Target</i>
Habitat area	Hectares	Area stable or increasing, subject to natural processes, at least c.8.5ha for sites surveyed
Habitat distribution	Occurrence	No decline
Woodland size	Hectares	Area stable or increasing. Where topographically possible, "large" woods at least 25ha in size and "small" woods at least 3ha in size
Woodland structure: cover and height	Percentage and metres	Diverse structure with a relatively closed canopy containing mature trees; subcanopy layer with semi- mature trees and shrubs; and well-developed herb layer
Woodland structure: community diversity and extent	Hectares	Maintain diversity and extent of community types
Woodland structure: natural regeneration	Seedling: sapling: pole ratio	Seedlings, saplings and pole age-classes occur in adequate proportions to ensure survival of woodland canopy
Hydrological regime: flooding depth/height of water table	Metres	Appropriate hydrological regime necessary for maintenance of alluvial vegetation
Woodland structure: dead wood	m ³ per hectare; number per hectare	At least 30m ³ /ha of fallen timber greater than 10cm diameter; 30 snags/ha; both categories should include stems greater than 40cm diameter (greater than 20cm diameter in the case of alder)
Woodland structure: veteran trees	Number per hectare	No decline
Woodland structure: indicators of local	Occurrence	No decline

distinctiveness		
Vegetation composition: native tree cover	Percentage	No decline. Native tree cover not less than 95%
Vegetation composition: typical species	Occurrence	A variety of typical native species present, depending on woodland type, including alder (<i>Alnus glutinosa</i>), willows (<i>Salix spp</i>) and, locally, oak (<i>Quercus robur</i>) and ash (<i>Fraxinus excelsior</i>) and birch (<i>Betula pubescens</i>)
Vegetation composition: negative indicator species	Occurrence	Negative indicator species, particularly non-native invasive species, absent or under control
Qualifying Interest	Sea Lamprey <i>Petromyzon marinus</i>	
National Overall Conservation Status	Bad	
Conservation Objectives	To restore the favourable conservation condition of Sea Lamprey in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:	
Attribute	Measure	Target
Distribution: extent of anadromy	% of river accessible	Greater than 75% of main stem length of rivers accessible from estuary
Population structure of juveniles	Number of age/size groups	At least three age/size groups present
Juvenile density in fine sediment	Juveniles/m ²	Juvenile density at least 1/m ²
Extent and distribution of spawning habitat	m ² and occurrence	No decline in extent and distribution of spawning beds.
Availability of juvenile habitat	Number of positive sites in 3rd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive.
Qualifying Interest	Brook Lamprey <i>Lampetra planeri</i>	
National Overall Conservation Status	Favourable	
Conservation Objective	To maintain the favourable conservation condition of Brook Lamprey in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:	
Attribute	Measure	Target
Distribution	% of river accessible	Access to all water courses down to first order streams
Population structure of juveniles	Number of age/size groups	At least three age/size groups of brook/river lamprey present
Juvenile density in fine sediment	Juveniles/m ²	Mean catchment juvenile density of brook/river lamprey at least 2/m ²
Extent and distribution of spawning habitat	m ² and occurrence	No decline in extent and distribution of spawning beds
Availability of juvenile habitat	Number of positive sites in 2nd order channels (and greater),	More than 50% of sample sites positive.

	downstream of spawning areas	
Qualifying Interest	River Lamprey <i>Lampetra fluviatilis</i>	
National Overall Conservation Status	Favourable	
Conservation Objective	To maintain the favourable conservation condition of River Lamprey in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:	
Attribute	Measure	Target
Distribution	% of river accessible	Access to all water courses down to first order streams
Population structure of juveniles	Number of age/size groups	At least three age/size groups of river/brook lamprey present
Juvenile density in fine sediment	Juveniles/m ²	Mean catchment juvenile density of brook/river lamprey at least 2/m ²
Extent and distribution of spawning habitat	m ² and occurrence	No decline in extent and distribution of spawning beds
Availability of juvenile habitat	Number of positive sites in 2nd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive. See map 10 for recorded locations of brook/river lamprey juveniles
Qualifying Interest	Atlantic Salmon <i>Salmo salar</i> (only in fresh water)	
National Overall Conservation Status	Unfavourable inadequate	
Conservation Objective	To restore the favourable conservation condition of Salmon in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:	
Attribute	Measure	Target
Distribution: extent of anadromy	% of river accessible	100% of river channels down to second order accessible from estuary
Adult spawning fish	Number	Conservation Limit (CL) for each system consistently exceeded
Salmon fry abundance	Number of fry/5 minutes electrofishing	Maintain or exceed 0+ fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry/5 min sampling
Out-migrating smolt abundance	Number	No significant decline
Number and distribution of redds	Number and occurrence	No decline in number and distribution of spawning redds due to anthropogenic causes
Water quality	EPA Q value	At least Q4 at all sites sampled by EPA
Qualifying Interest	Otter <i>Lutra lutra</i>	
National Overall Conservation Status	Favourable	
Conservation Objective	To restore the favourable conservation condition of Otter in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:	
Attribute	Measure	Target
Distribution	Percentage positive	No significant decline

	survey sites	
Extent of terrestrial habitat	Hectares	No significant decline. Area mapped and calculated as 596.8ha above high water mark (HWM); 958.9ha along riverbanks/ around ponds
Extent of marine habitat	Hectares	No significant decline. Area mapped and calculated as 4,461.6ha
Extent of freshwater (river) habitat	Kilometres	No significant decline. Length mapped and calculated as 599.54km
Extent of freshwater (lake) habitat	Hectares	No significant decline. Length mapped and calculated as 500.1km
Extent of freshwater (lake/lagoon) habitat	Hectares	No significant decline. Area mapped and calculated as 125.6ha
Couching sites and holts	Number	No significant decline
Fish biomass available	Kilograms	No significant decline
Barriers to connectivity	Number	No significant increase

5.2.3 Site Vulnerabilities

There is a wide range of land uses within the SAC. The most common use of the terrestrial parts is grazing by cattle, and some areas have been damaged through over-grazing and poaching. Much of the land adjacent to the rivers and estuaries has been improved or reclaimed and is protected by embankments (especially along the Fergus estuary). Further, reclamation continues to pose a threat, as do flood relief works (e.g. dredging of rivers). Gravel extraction poses a major threat on the Feale.

In the past, Cord-grass (*Spartina* spp.) was planted to assist in land reclamation. This has spread widely and may oust less vigorous colonisers of mud and may also reduce the area of mudflat available to feeding birds.

Domestic and industrial wastes are discharged into the Shannon, but water quality is generally satisfactory, except in the upper estuary where it reflects the sewage load from Limerick City. Analyses for trace metals suggest a relatively clean estuary with no influences of industrial discharges apparent. Further industrial development along the Shannon and water polluting operations are potential threats.

More recently invasive species such as Japanese Knotweed, Giant Hogweed and Himalayan Balsam have become a notable threat throughout the Lower River Shannon (NPWS, 2013). Threats and pressures to Lower River Shannon SAC are listed in Table 5-2.

Table 5-2: Threats and pressures to Lower River Shannon SAC (NPWS, 2017a)

Code	Threat or pressure	Ranking and Location
I01	invasive non-native species	L, i
A08	Fertilisation	M, o
A04	grazing	M, i
H04	Air pollution, air-borne pollutants	M, o
A08	Fertilisation	M, i
E01	Urbanised areas, human habitation	M, o
D01.01	paths, tracks, cycling tracks	L, i
K02.03	eutrophication (natural)	M, o
G01.01	nautical sports	L, i
B	Sylviculture, forestry	L, i
F01	Marine and Freshwater Aquaculture	L, i
F03.01	Hunting	L, i
C01.01.02	removal of beach materials	L, i
C01.03.01	hand cutting of peat	L, i
E03	Discharges	M, o
J02.01.01	polderisation	M, i
J02.10	management of aquatic and bank vegetation for drainage purposes	L, i
E03	Discharges	M, i
J02.01.02	reclamation of land from sea, estuary or marsh	M, o
J02.12.01	sea defence or coast protection works, tidal barrages	L, i
Location: i = inside, o = outside, b = both		
Rank: H = high, M = medium, L = low		

5.3 River Shannon and River Fergus Estuaries SPA (004077)

This site is of great ornithological interest, being of international importance on account of the numbers of wintering birds it supports. It also supports internationally important numbers of three species, i.e. Dunlin, Black-tailed Godwit and Redshank. In addition, there are 16 species that have populations of national importance. For several of the bird species, it is the top site in the country. Also of note is that three of the species which occur regularly are listed on Annex I of the E.U. Birds Directive i.e. Whooper Swan, Golden Plover and Bar-tailed Godwit. The site is most effectively censused from the air and this is carried out most winters (NPWS, 2015).

5.3.1 Qualifying Interests

The River Shannon and River Fergus Estuaries SPA is designated for the following Qualifying Interests:

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

Given the mobile nature of the Qualifying Interests of this SPA, the proximity of the proposed FRS and the usage of King's Island by SPA bird species as recorded during the wintering bird surveys, all SPA bird species shall be considered in the assessment.

5.3.2 Conservation Objectives

The overall Conservation Objectives for the River Shannon and River Fergus Estuaries SPA is to maintain the favourable conservation condition of the Features of Interest for which the SPA has been selected (NPWS 2012c).

The favourable conservation status of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

The conservation objective for non-breeding birds Special Conservation Interests of River Shannon and River Fergus Estuaries SPA are as follows (NPWS, 2012c) and are summarised in Table 5-3.

Table 5-3: Conservation Objectives for non-breeding birds of River Shannon and River Fergus Estuaries SPA (NPWS 2012c)

Objective 1: To maintain the favourable conservation condition of the non-breeding waterbird Special Conservation Interest species listed for the River Shannon and River Fergus Estuaries SPA, which is defined by the following list of attributes and targets:			
Parameter	Attribute	Measure	Target
Population	Population Trend	Percentage change as per population trend assessment using waterbird count data collected through the Irish Wetland Bird Survey and other surveys	The long-term population trend should be stable or increasing
Range	Distribution	Range, timing or intensity of use of areas used by waterbirds, as determined by regular low tide and other waterbird surveys	There should be no significant decrease in the range, timing or intensity of use of areas by the waterbird species of Special Conservation Interest other than that occurring from natural patterns of variation
Objective 2: To maintain the favourable conservation condition of the wetland habitat at the River Shannon and River Fergus Estuaries SPA as a resource for the regularly-occurring migratory waterbirds that utilise it, which is defined by the following list of attributes and targets:			
Parameter	Attribute	Measure	Target
Area	Wetland habitat	Area (Ha)	The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 32,261 Ha, other than that occurring from natural patterns of variation.

5.3.3 Site Vulnerabilities

Identified negative threats and pressures on the River Shannon and River Fergus Estuaries SPA are listed in Table 5-4.

Table 5-4: Threats and pressures to River Shannon and River Fergus Estuaries SPA (NPWS, 2017b)

Code	Threat or pressure	Ranking and Location
E02	Industrial or commercial areas	H, o
G01.01	nautical sports	M, i
E03	Discharges	H, i
D03.02	Shipping lanes	M, i
A08	Fertilisation	H, o
F01	Marine and Freshwater Aquaculture	M, i
E01	Urbanised areas, human habitation	H, o
Location: i = inside, o = outside, b = both		
Rank: H = high, M = medium, L = low		

5.4 Summary of Natura 2000 Qualifying Interests in Zone of Influence

The habitats or species known to be present or are considered likely to be present within the zone of influence of the proposed project are listed in Table 5-5.

Table 5-5: Habitats or species known to be present, or are considered likely to be present within the zone of influence of the proposed project and National Conservation Status

Natura 2000 site	Qualifying Interest	National Conservation Status
Lower River Shannon SAC	Estuaries [1130]	Unfavourable
	Mudflats and sandflats not covered by seawater at low tide [1140]	Unfavourable
	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (Alno-Padion, Alnion incanae, Salicion albae) [91E0]	Bad
	<i>Petromyzon marinus</i> (Sea Lamprey) [1095]	Bad
	<i>Lampetra planeri</i> (Brook Lamprey) [1096]	Favourable
	<i>Lampetra fluviatilis</i> (River Lamprey) [1099]	Favourable
	<i>Salmo salar</i> (Salmon) [1106]	Unfavourable
	<i>Lutra lutra</i> (Otter) [1355]	Favourable
River Shannon and River Fergus Estuaries SPA	Cormorant (<i>Phalacrocorax carbo</i>) [A017]	Favourable
	Whooper Swan (<i>Cygnus cygnus</i>) [A038]	Favourable
	Light-bellied Brent Goose (<i>Branta bernicla hrota</i>) [A046]	Favourable
	Shelduck (<i>Tadorna tadorna</i>) [A048]	Favourable
	Wigeon (<i>Anas penelope</i>) [A050]	Favourable
	Teal (<i>Anas crecca</i>) [A052]	Favourable
	Pintail (<i>Anas acuta</i>) [A054]	Favourable
	Shoveler (<i>Anas clypeata</i>) [A056]	Favourable
	Scaup (<i>Aythya marila</i>) [A062]	Favourable
	Ringed Plover (<i>Charadrius hiaticula</i>) [A137]	Favourable
	Golden Plover (<i>Pluvialis apricaria</i>) [A140]	Favourable
	Grey Plover (<i>Pluvialis squatarola</i>) [A141]	Favourable
	Lapwing (<i>Vanellus vanellus</i>) [A142]	Favourable
	Knot (<i>Calidris canutus</i>) [A143]	Favourable
	Dunlin (<i>Calidris alpina</i>) [A149]	Favourable
	Black-tailed Godwit (<i>Limosa limosa</i>) [A156]	Favourable
	Bar-tailed Godwit (<i>Limosa lapponica</i>) [A157]	Favourable
	Curlew (<i>Numenius arquata</i>) [A160]	Favourable
	Redshank (<i>Tringa totanus</i>) [A162]	Favourable
	Greenshank (<i>Tringa nebularia</i>) [A164]	Favourable
Black-headed Gull (<i>Chroicocephalus ridibundus</i>) [A179]	Favourable	
Wetland and Waterbirds [A999]	Favourable	

6 Other Relevant Plans and Projects

6.1.1 Cumulative Effects

The site is situated in an island location surrounded by watercourses and connected by bridges to Limerick city. The area is zoned for nature, amenity, residential and commercial use with existing facilities located within the housing estates to the north and commercial/historic areas to the south.

There are likely to be many applications for development within and adjacent to Limerick city in the future. Cumulative Impacts are those which result from incremental changes caused by other past, present or reasonably foreseeable developments together with the Flood Relief Scheme. Cumulative impacts were assessed by looking at all previous developments and current developments for which planning has been received within 10km of the proposed site location. A consideration of development objectives in the current development plans in the area was also carried out. This cumulative assessment has considered cumulative impacts that are:

- (a) Likely;
- (b) Significant; and
- (c) Relating to an event which has either occurred or is reasonably foreseeable together with the impacts from this development.

A search in relation to plans and projects that may have the potential to result in cumulative impacts was carried out. A number of projects have the potential for cumulative impacts with the King's Island Flood Relief Scheme. These are described below. Some of these projects have not yet gone to planning stage. All these projects will likewise have to consider the impacts from the King's Island FRS.

The potential cumulative impacts of these schemes on the two Natura 2000 sites Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA is summarised below. If the construction periods of these developments are to overlap, there is potential to impact on Lower River Shannon SAC through reduced surface water quality. These effects will be temporary.

Data sources included the following:

Killaloe Bypass/Shannon Bridge Crossing and R494 Improvement Scheme

The proposed Killaloe Bypass, Shannon Bridge Crossing and R494 Improvement Scheme, Co. Clare will provide a western bypass of Killaloe, a new bridge crossing of the River Shannon and an upgrade of the existing R494 regional road from Ballina to the N7 at Birdhill. The proposed site is located approximately 16.5km north-east of the King's Island FRS site. The proposed bypass, bridge and road improvements have been subject to NIS and EIS which was approved by An Bord Pleanála. Construction of this project has yet to commence, with the most recent statement from Clare County Council (March 2019) stating that the designs were still be finalised and land acquisition for the project was still on-going.

The impact of the proposed scheme on the ecological environment along the proposed route will be locally significant for the River Shannon and associated habitats where the new Shannon Bridge crossing will be located. With mitigation, the ecological integrity of the Lower River Shannon SAC will not be adversely affected (Roughan & O'Donovan Consulting Engineers, Clare County Council/North Tipperary County Council (2012).

Due to the temporary nature of the works, the mitigation measures included in the development, the distance from the present project and the dilution effect of the Shannon River, no cumulative impacts on the two Natura 2000 sites are expected.

Limerick Northern Distributor Road

The scheme will comprise of the design and construction of approximately 10km of a northern distributor road that will include a crossing of the Ardnacrusa Tailrace and the River Shannon, with possible crossings of the Blackwater and Mulkear Rivers. The proposed scheme will provide a road around Limerick City, improving accessibility to the city from County Clare and relieving pressure on the existing river crossings in the City Centre. The proposed development is located approximately 450m north-west of the King's Island FRS site at its closest proximity (Phase 1 area), while the majority of the road scheme is located beyond 2km (west, north and east) of King's

Island. After being subjected to the environmental and planning process Phase 1 (Coonagh - Knockalisheen) the scheme has commenced construction and is expected to be completed before Kings Island is constructed (commencement expected Autumn 2020).

No likely significant cumulative impact is expected from Phase 1 given that cumulative impacts would have been considered during the environmental and planning process.

Phase 1 of this scheme has commenced, with Phase 2 currently in design stages. Phase 1 (Coonagh-Knockalisheen) is under construction, and as this section of the project is not located near the River Shannon, it is therefore anticipated that it will not have any cumulative impacts with the King's Island Flood Relief Scheme in relation to the Lower River Shannon SAC. Phase 2 is in the design stage but has not received planning permission and is therefore not a committed scheme. As it is not possible to state in known detail whether Phase 2 will present cumulative impacts in combination with the King's Island Flood Relief Scheme at this stage, no detailed assessment of likely cumulative impacts can be assessed as part of the EIAR for this project.

Limerick City and Environs Flood Relief Scheme (FRS)

The Catchment Flood Risk Assessment and Management (CFRAM) recommends progressing the project-level development and assessment of a Flood Relief Scheme for Limerick City & Environs. Included within this is the proposed upgrade to the Castletroy Flood Relief Scheme. The upgrade of existing flood defences to consist of the following; extension to an existing flood defence berm along the Shannon and Mulkear riverbanks; the upgrade and rerouting of the existing surface water drainage system; provision of attenuation ponds; and improvements to the existing storm water sewer system. The proposed Castletroy FRS upgrade site is located approximately 4.5km east of the King's Island FRS site.

The proposed Limerick City and Environs FRS upgrade is currently at the 'Further Information' stage of its planning application. As it is not possible to state in known detail whether the Castletroy FRS upgrade will present cumulative impacts in combination with the King's Island Flood Relief Scheme at this stage, no detailed assessment of likely cumulative impacts can be assessed as part of the EIAR for this project.

Castleconnell Flood Relief Scheme (FRS)

The proposed Castleconnell Flood Relief Scheme, Co. Limerick is located approximately 8.1km north-east of the King's Island FRS site. This project is at Preplanning (Constraints and Options stage) with construction estimated at earliest 2022. Construction for Kings Island FRS is scheduled between 2020 and 2022 therefore Kings Island construction will be completed prior to Castleconnell commencement.

The Flood Risk Management Plan for the Shannon Upper and Lower River Basin (OPW, 2018) includes a set of proposed measures for the cost effective and sustainable, long term management of flood risk in the River Basin including the areas where the flood risk has been determined as being potentially significant. The plan includes feasible measures developed through a range of programmes and policy initiative including flood risk prevention and preparedness measures developed by OPW to implement Government policy and flood protection measures identified through the National Catchment Flood Risk Assessment and Management (CFRAM) Programme.

Both Kings Island (Fluvial/Coastal flood risk) and Castleconnell (Fluvial flood risk) FRS's are described in the Flood Risk Management Plan for the Shannon Upper and Lower River Basin. The Plan has been subject to Strategic Environmental Assessment (SEA) to determine benefits and impacts on the environment and to identify mitigation and monitoring measures necessary to avoid or minimise such impacts.

No cumulative impacts are expected from Castleconnell FRS.

6.1.2 Springfield Flood Relief Scheme (FRS)

The Springfield area is located approximately 5km north-east of the proposed King's Island FRS. The initial plans for the Springfield Flood Relief Scheme, Co. Clare was withdrawn by Clare County Council on 9th of August 2018. However, in the March 2019 Clare County Council Chief Executive Report, it was stated that the council had met with the Office of Public Works and Consultants to discuss the issues raised in new draft feasibility study report. The executive report further outlined that a programme of work was agreed upon by the above to progress the project.

Should the Springfield FRS progress further into the planning process, it will be subject to in-depth environmental assessment, which will presumably consider any cumulative impacts from this development if approved. However, since it is not possible to state in known detail whether the Springfield FRS will present cumulative impacts in combination with the King's Island FRS at this stage, no detailed assessment of likely cumulative impacts can be assessed as part of this NIS.

Opera Site, Limerick City

The proposed regeneration of the Opera Site as part of the Limerick Twenty Thirty includes a mixed-use development, comprising offices, retail, culture, licenced premises and other ancillary uses. The Opera Site is located on the opposite side of the Abbey River and south of the R445, approximately 50m south of the King's Island site boundary. The site occupies the majority of a city block and is bound by streets all around. The project is expected to take 4 years and 6 months, and it is anticipated that construction will overlap with the present project should both projects receive statutory consent.

In the absence of mitigation, the main impacts from the Opera project during construction that could be considered significant with regards to cumulative effects with King's Island FRS are;

- The installation of a new outfall to the Abbey River (in Charlotte's Quay, adjacent the Lower River Shannon SAC) to service a new surface water sewer. During construction, there is potential for dust, silt, oils, fluids, paints, and/or concrete washings, etc. to temporarily enter the Abbey River and impact water quality and aquatic species

However, the Construction Methodology and Phasing Management Plan (CMPP) for the Opera site includes pollution and spill control measures which will mitigate against any of these potential impacts.

During operation, no cumulative impacts are predicted, taking into account the following design mitigation (AECOM, 2019):

- The SUDS system included in the design of the new surface water sewer which will remove silt from roof and pedestrianised hardstanding run-off, prior to run-off entering the Abbey River within the Lower River Shannon SAC; and
- The proposed diversion of surface water from basement carparking areas (which will be contaminated with elevated levels of detergents in contrast to roof and pedestrianised hardstanding run-off) into an existing combined sewer, which will carry this contaminated surface water to the existing licensed Bunlicky Waste Water Treatment Plant (WwTP) for treatment prior to discharge to the Lower River Shannon SAC.
- Confirmation from Irish Water that the load generated by the proposed development can be catered for. Potential pollution impacts from the discharge of treated effluent in the River Shannon, following treatment at Bunlicky WwTP are therefore considered non-significant.

Although the Opera Site has not received planning permission and is therefore not a committed scheme, given the above, no likely significant cumulative impact on the Lower River Shannon SAC is expected should it be granted planning permission.

Limerick Urban Centre Revitalisation - O'Connell Street

The Limerick Urban Centre Revitalisation - O'Connell Street, otherwise known as the LUCROC project, is a commitment to the revitalisation of O'Connell Street. The project is located between the junctions of Denmark Street and the Crescent, with Phase I between Denmark Street and Cecil Street, approximately 400 metres in length. This proposed revitalisation project is located approximately 330m south-west of the King's Island FRS site, and the River Shannon (Lower) is located approximately 200m from the development area.

A planning application for Phase I of this project has recently been submitted under the Part 8 planning process. It is anticipated that, should the LUCROC project be granted planning permission, it would be constructed over the following two years, i.e. the construction period may overlap with the King's Island Flood Relief Scheme.

There will be no direct discharges to surface water during the construction phase of the LUCROC development. The likelihood that the release of contaminated surface water could cause a

significant effect to the Lower River Shannon SAC is considered highly unlikely given the existing drainage network in place and the nature of the activities proposed.

Surface water run-off which is collected on site will be released via the existing network to a closed wastewater collection network which is treated in the Bunlicky WwTP prior to discharge to the Shannon estuary, in accordance with the EPA wastewater discharge licence. As such, the construction phase of the proposed development is not predicted to result in a significant negative effect on hydrology or surface water quality.

During the operational phase surface water run-off, will be released to the existing closed network which is treated in the Bunlicky WwTP prior to discharge to the Shannon estuary, in accordance with the EPA wastewater discharge licence (ARUP, 2019). As such, no significant negative effects on hydrology or surface water quality are envisaged during the operational phase of the proposed development.

Similar to the Opera site, LUCROC has not received planning permission and is therefore not a committed scheme. However, given the above factors, no likely significant cumulative impact on the two Natura 2000 sites is expected should it be granted planning permission.

Mungret Local Infrastructure Housing

The Mungret Local Infrastructure Housing, one of aspects of the Limerick Twenty Thirty plan, includes the upgrading of roads to allow for the development of 450 homes by 2021, with a potential estimate of 2,700 homes to be provided on the lands. The infrastructure will also ensure the delivery of a post primary school in the area within the next 3 years. The 200-unit first phase of the development is expected to be completed by end of 2021. The Mungret development is located approximately 5.5km south-west of the King's Island FRS site

The development is currently in the Master planning stage, with a planning permission to follow. As it is not possible to state in known detail whether the Mungret Local Infrastructure Housing development will present cumulative impacts in combination with the King's Island Flood Relief Scheme at this stage, no detailed assessment of likely cumulative impacts can be assessed as part of this NIS.

International Rugby Experience Building, O'Connell Street

The International Rugby Experience Building on O'Connell Street involves works at No. 42 O'Connell St/No.1 Cecil Street to create a rugby museum and cultural site. The site is located approximately 670m south-west of the proposed King's Island FRS site on the other side of the Abbey River. The International Rugby Experience Building received Conditional Permission on 14th of February 2018, with an amendment granted Conditional Permission on 2nd of April 2019.

Due to the nature and location of the International Rugby Experience Building development in Limerick City, 225m away from the Lower Shannon River SAC, no likely significant cumulative impact on the two Natura 2000 sites is expected.

Corbally Housing Development, Corbally Road

The housing development proposed within the Corbally area is located adjacent to Corbally Road to the east and the railway lines to the north and north east. This housing development will comprise of 27 housing units, along with vehicle and pedestrian access and other ancillary features. This proposed development is located approximately 215m east of the proposed King's Island FRS site.

The development is currently in the planning stage, with only a provision plan for site in place that has yet to be finalised. Should this development progress further through the planning process, it will be subject to in depth environmental assessment, which will presumably consider any cumulative impacts from this development if approved. However, since it is not possible to state in known detail whether the Corbally Housing Development Housing will present cumulative impacts in combination with the King's Island FRS at this stage, no detailed assessment of likely cumulative impacts on the two Natura 2000 sites can be assessed as part of this NIS.

6.1.3 Orchard Housing Development, King's Island

A housing complex for elderly persons is proposed on King's Island and has been submitted as a Part 8 application to LCCC. The site is divided into two plots, known as the Orchard Site and the

Garden Site, on either side of Old Dominick Street, comprising 27 residential units. The Orchard Site is at the location of the existing temporary car park for King John's Castle. The proposed development will be approximately 0.6ha and will also incorporate a pedestrian walkway and green space, and parking spaces to serve the housing units. The development will also involve the reduction of Old Dominick Street from a two-way street to a one-way street and widening of pedestrian pavement.

The Orchard development is still at the planning approval stage. There is no proposal to use Old Dominick Street or the section of Island Road bordering this site for haul routes or site access for the present project. As it is not possible to state in known detail whether the Orchard Housing Development will present cumulative impacts in combination with the King's Island Flood Relief Scheme at this stage, no detailed assessment of likely cumulative impacts can be assessed as part of this NIS.

6.2 Summary Cumulative Effects

The projects and plans listed above are considered in combination with the currently proposed project in the Appropriate Assessment section below.

7 Stage 2 Appropriate Assessment

7.1 Introduction

This section presents a detailed assessment of the potential impact of the proposed project on the qualifying interests of the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA.

Section 7.2 assesses the screened in Natura 2000 sites in more detail and examines where potentially adverse impacts may arise from the sources of impact identified. Where potentially adverse impacts are identified, avoidance and mitigation measures are proposed. These are discussed in Section 7.3.

7.2 Identification of Potential Sources of Impact

This section further examines the source > pathway > receptor chains that could potentially result in adverse impacts arising on the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA.

Some qualifying interests of the Natura 2000 sites are not likely to be significantly impacted due to the location of the works in relation to their distribution.

The habitats and species likely to be impacted by the works are listed below. The estuarine waters of the River Shannon surrounding King's Island are susceptible to impacts from the proposed project, as are Mudflats and sandflats habitat downstream of King's Island. Alluvial forest habitat, lamprey species, Salmon, Otter and wintering water birds could also be impacted by the proposed works.

We consider it important to note that while Opposite-leaved Pondweed (*Groenlandia densa*) is a protected species that occurs within a drainage ditch on King's Island, the ditch is not within the boundary of the Lower Shannon SAC. As assessment and mitigation of impacts within a NIS only relates to QI's within Natura 2000 sites, Opposite-leaved Pondweed cannot be assessed and mitigated for within this NIS. This was agreed with NPWS at a meeting in Limerick, 2 July 2019. The impacts on this species and agreed mitigation approaches are detailed in the Biodiversity Chapter 8 of the Environmental Impact Assessment Report (EIAR) for King's Island FRS (JBA, 2019).

Habitats and species likely to be impacted by the works:

- Estuaries [1130]
- Mudflats and sandflats not covered by seawater at low tide [1140]
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]
- Sea Lamprey (*Petromyzon marinus*) [1095]
- Brook Lamprey (*Lampetra planeri*) [1096]
- River Lamprey (*Lampetra fluviatilis*) [1099]
- Salmon (*Salmo salar*) [1106]
- Otter (*Lutra lutra*) [1355]
- Wintering water birds

7.2.1 Construction Phase:

7.2.1.1 Potential Sources of Impact via Surface Water Pathways

Spill or leakage incidents or surface water runoff leading to site materials entering the Shannon and Abbey Rivers [1130, 1140]

During site preparation, the excavation and construction of new embankments and drainage system, and the upgrading of the flood defence walls, there is potential for accidental release of suspended solids, nutrients and pollutants into the groundwater and watercourses within King's Island and associated habitats over the two-year construction period.

The construction of new embankments on the north of the island will require some excavation of topsoil and subsoil along the line of the new eastern embankment, the bringing in of large amounts of fill material to the site, and the excavation of a new ditch for the relocation of Opposite-leaved Pondweed. These activities could expose large amounts of unvegetated soil. After heavy rain there is potential for surface water runoff to bring silt into the Shannon and Abbey rivers via drainage ditches and outfalls, which could impact on the quality of the river/estuarine water and the substrate quality requirements of Salmon and lamprey species.

Excavation and removal of existing sandbags, footpath, and concrete plinth will be carried out along the length (1km) of the western embankment, which borders the riverbank of the Shannon SAC, and along the length of works adjacent to the Abbey River. The works will expose bare earth and if carried out during wet weather could result in significant sediment delivery to the River Shannon and Abbey River.

The replacement of concrete barriers with a 70m new concrete wall near Verdant Place crèche, is directly adjacent to the riverbank of the Shannon River and is on the SAC boundary. The works also require piling. The river is therefore susceptible to impacts from surface runoff from disturbed soil and concrete spillages.

The cutting of the sheet piling within the SAC will require cutting back of vegetation and excavation of 300mm below ground level to expose the piling prior to cutting. After cutting, the exposed edge of the sheet piling will be re-covered with soil. The works will expose bare earth and if carried out in a period of wet weather could result in surface runoff of silt into the Shannon and Abbey Rivers.

The laying of Macadam topped path to the north of the sheet piling (connecting the paved areas of path on the present eastern embankment with the paths on top of the new centre and western embankments) will require excavation of 50m length x 255mm depth x 2.4m width of soil prior to laying 200mm stone, with capping of Macadam. The excavation of soil in preparation for a replacement 50m fisherman's path (25m of which will be within the SAC) to existing mooring points at the north west of King's Island (Area A4) will also require excavation 600mm depth and 3m width prior to capping with stone and Macadam, also allowing 0.5m either side for battered slope to stabilise the excavation. These excavated areas will expose bare earth, and if carried out during wet weather, could result in surface runoff of silt into the Shannon and Abbey Rivers.

Polluting materials from accidental spills could enter the estuarine waters and have a deleterious effect on water quality and on the various community types living within the Annex 1 Mudflats and sandflats habitat, either through direct toxicity, smothering, or alteration of the mud/sand substrate.

Construction works can impact directly on fish populations through the direct mortality of adult cohorts and/or juvenile fish in addition to killing eggs on/or within river substrata should chemicals such as hydrocarbons or concrete be introduced into the water column. Indirect impacts can occur as a result of the smothering of spawning substrata with suspended solids making them unviable for spawning and thus reducing the longer-term prospects of survival for fish populations. Significant repair works such flood defence wall installation or reparation works may give rise to the release of suspended solids downstream.

The integrity of the SAC would be affected by reduction in quality of the habitats as well as impacts on the species that rely on them. It is likely that pollutants would be diluted as they moved within the estuary, and effects would not reach beyond 2km.

Juvenile Lamprey [species codes 1095, 1096, 1099]

During the upgrading of the flood defence walls a jack-up rig will be temporarily deployed in the Abbey River and River Shannon at Areas A9 and B3 respectively (Appendix 0). The legs of the rig (1.5m x 1.5m base plate) will be placed on the riverbed in order to provide support to the rig. The rig will be secured to the flood defence walls. The rig (barge) itself will be approximately 12m wide x 20m long. As the works progress the rig will be moved along the defence walls, requiring the legs to be repositioned. The lengths of walls affected are 37m at Area A9 and 300m at Area B3. Works at A9 on the Abbey River in front of the Absolute Hotel requires 2x setups with duration of works of 2-3 months, resulting in approximately 18m² area of substrate being affected. Works at Area B3 on the Shannon River in front of the Court House requires 3x setups, with duration of works 5-6 months, resulting in approximately 27m² area of substrate being affected. A total of 45 m² of substrate will be affected.

The pressure from the leg bases will compress the sediment and impact on any burrowing juvenile lamprey species present. Juvenile lamprey or ammocoetes live as burrowing filter feeders in the sediment for up to five years or more. Lamprey play a role in river ecosystems both biologically (nutrient recycling) and physically, where they are considered 'ecosystem engineers'. They are therefore an important element of river/estuarine ecosystem structure and function. Three species of lamprey are qualifying interests of the Lower River Shannon SAC. By affecting several cohorts of this species of fish, the future recruitment of these fish populations could be significantly impacted.

7.2.1.2 Potential Sources of Impact via land and air

Marsh habitat

Construction of the embankment on the north east of the island is near the boundary of the SAC. Though the marsh is not an Annex 1 habitat, it does act as supporting habitat to the Shannon and Abbey Rivers and the Annex 1 Estuaries habitat. There will be some loss of marsh habitat to the embankment (7,082 m² or 5.85%) as agreed with NPWS, where this marsh area is above the flood level. This area of marsh is relatively higher than the remaining lands, 2.4mOD against 1.8-2mOD and will not impact on the functioning of the marsh environment.

The marsh area could be impacted by physical disturbance as the embankment is being constructed. This could cause a change in the flood plain level, affecting the rise and fall of the flooding regime and vegetation composition of the marsh.

Works also intend to extend two pre-existing open drains on the marsh habitat to the proposed head wall of the filter drain on the west side of the eastern embankment. These will be fitted with non-return valves. This will allow water draining off the west side of that embankment to drain into the flood plain/marsh habitat. This will require a slight widening (to 2.5m) and deepening (0.50m) of a section of two pre-existing open drains across grassland and marsh habitat resulting in a temporary physical impact on the marsh/ditch habitat. The northern drain will be approximately 50m in length (area 125m²). 45m (area 112.5m²) of that will be within the SAC. The southern drain will be approximately 20 m in length (area 50m²). The overall area of marsh temporarily affected by the widening and deepening of drains is likely to be approximately 175m²

Marsh/ditch habitat will revegetate naturally and function as previously.

Alluvial forest [91E0]

Alluvial forest on the riverbank on the west of the island within the SAC could be impacted by the construction of a new drainage outfall requiring the excavation through the existing western embankment and riverbank. Excavations could damage the root structure and reduce the area of riparian/alluvial woodland.

Excavation and removal of existing sandbags, footpath, and concrete plinth along existing embankments adjacent to Alluvial woodland could cause incursion into woodland and damage to the habitat.

Wintering Waterbirds

Construction works along the boundary of the designated site will generate noise and disturbance as a result of machinery operation and workforce movement during the two year phase of the project. This will impact the wintering waterbirds using the flood plain area of the site and the areas of amenity grassland fronting Oliver Plunkett St. Based on bird surveys and best scientific judgement it is considered that these birds are most likely part of the populations of wintering waterbirds designated as part of River Shannon and River Fergus SPA. During cold spells in the winter, the effect of disturbance on these birds could be particularly severe, resulting in increased stress and additional energy expenditure.

Summary

A summary of impacts on the various attributes and targets of the QIs of the Lower River Shannon SAC and River Shannon and River Fergus SPA prior to mitigation are found in

Table 7-1 and Table 7-2 respectively. QIs, Attributes and Measures are derived from Table 5-1 and Table 5-3 (after NPWS, 2012b; NPWS, 2013; NPWS 2012c).

Table 7-1: Potential impacts on the attributes of the designated features of Lower River Shannon SAC

Qualifying Interest	Attribute	Measure	Potential Impacts
1130 Estuaries/	Habitat area	Hectares	Embankment construction could alter level of flood plain and therefore the area available as supporting habitat to Shannon/Abbey rivers and estuarine waters
	Community distribution	Hectares	Pollution from hydrocarbon spills, concrete dust and silt runoff could impact water quality and community types
Mudflats and sandflats not covered by seawater at low tide [1140]	Habitat area	Hectares	NA Impact from construction and any potential pollutants will not affect the area of mudflats and sandflats
	Community distribution	Hectares	Pollution from hydrocarbon spills, concrete dust and silt runoff could impact water quality and community types
Alluvial forests [91E0]	Habitat area	Hectares	Excavations of bankside for drainage outfall could damage the root structure and reduce the area of riparian/alluvial woodland Excavation and removal of existing sandbags, footpath, and concrete plinth along existing embankments adjacent to Alluvial woodland could cause incursion into woodland and damage to the habitat
Otter <i>Lutra lutra</i>	Extent of terrestrial habitat	Hectares	Night-time lighting near watercourses during construction phase will cause disturbance to commuting and foraging Otter
	Extent of marine habitat	Hectares	N/A
	Extent of freshwater (river) habitat	Kilometres	NA
	Extent of freshwater (lake) habitat	Kilometres	N/A
	Couching sites and holts	Number	N/A
	Fish biomass available	Kilograms	Impacts on water quality from discharges and impacts from jack-up rigs at Area A9 and B3 have the potential to impact on populations of fish and juvenile lamprey and therefore could impact the availability of prey items for Otter
River Lamprey <i>Lampetra fluviatilis</i> Sea Lamprey <i>Petromyzon marinus</i>	Distribution: extent of anadromy	% of river accessible	NA No barriers to fish migration
Brook Lamprey <i>Lampetra planeri</i> River Lamprey <i>Lampetra fluviatilis</i> Sea Lamprey <i>Petromyzon marinus</i>	Population structure of juveniles	Number of age/ size groups	Disturbance from pads of jack-up rig at Area A9 and B3 on bottom substrate and Impacts on water quality from discharges may affect population structure of juveniles
	Juvenile density in fine sediment	Juveniles/m ²	Disturbance from pads of jack-up rig at Area A9 and B3 on bottom substrate and Impacts on water quality from discharges may affect juvenile density in fine sediment
	Extent and distribution of spawning habitat	m ² and occurrence	NA- spawning habitat further upstream (e.g. Castleconnell and Mulkear tributary)

Qualifying Interest	Attribute	Measure	Potential Impacts
	Availability of juvenile habitat	Number of positive sites in 2nd order channels (and greater), downstream of spawning areas	Disturbance from pads of jack-up rig at Area A9 and B3 on bottom substrate and impacts on water quality from discharges may affect juvenile density in fine sediment
Atlantic Salmon <i>Salmo salar</i> (only in fresh water)	Distribution: extent of anadromy	% of river accessible	NA No barriers to fish migration
	Adult spawning fish	Number	Impacts on water quality from discharges may affect populations noted
	Salmon fry abundance	Number of fry/5 minutes electrofishing	Impacts on water quality from discharges may affect populations noted
	Out-migrating smolt abundance	Number	Impacts on water quality from discharges may affect populations noted
	Number and distribution of redds	Number and occurrence	Impacts on water quality from discharges may affect populations noted
	Water quality	EPQ Q value	Impacts from discharges may affect water quality

Table 7-2: Potential impacts on the attributes of the designated features of River Shannon and River Fergus Estuaries SPA

Qualifying Interest	Attribute	Measure	Potential Impacts
Cormorant (<i>Phalacrocorax carbo</i>) [A017] Whooper Swan (<i>Cygnus cygnus</i>) [A038] Light-bellied Brent Goose (<i>Branta bernicla hrota</i>) [A046] Shelduck (<i>Tadorna tadorna</i>) [A048] Wigeon (<i>Anas penelope</i>) [A050] Teal (<i>Anas crecca</i>) [A052] Pintail (<i>Anas acuta</i>) [A054] Shoveler (<i>Anas clypeata</i>) [A056] Scaup (<i>Aythya marila</i>) [A062] Ringed Plover (<i>Charadrius hiaticula</i>) [A137] Golden Plover (<i>Pluvialis apricaria</i>) [A140] Grey Plover (<i>Pluvialis squatarola</i>) [A141] Lapwing (<i>Vanellus vanellus</i>) [A142] Knot (<i>Calidris canutus</i>) [A143] Dunlin (<i>Calidris</i>	Distribution	Number and range of areas used by waterbirds	Impacts on feeding resources could impact indirectly on migratory wintering birds Not all bird species listed appear to use King's Island but using the precautionary principle, disturbance from construction work and operations could impact on the success of those wintering birds that utilise the flood plain area to the north east of King's Island

<i>alpina</i> [A149] Black-tailed Godwit (<i>Limosa limosa</i>) [A156] Bar-tailed Godwit (<i>Limosa lapponica</i>) [A157] Curlew (<i>Numenius arquata</i>) [A160] Redshank (<i>Tringa totanus</i>) [A162] Greenshank (<i>Tringa nebularia</i>) [A164] Black-headed Gull (<i>Chroicocephalus ridibundus</i>) [A179]			
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7.2.2 Invasive Non-native Species

Invasive Non-native Species have the potential to spread during construction works and impact on habitats including Annex 1 Alluvial forest habitat (see Appendix D for distribution). Invasive species have legal implications if left untreated, including Japanese Knotweed, Giant Hogweed, and Himalayan Balsam. They can spread rapidly over suitable habitat, including riverbanks, wetlands or disused waste land. Section 49 and 50 of Part 6 of the European Communities (Birds and Natural Habitats) Regulations 2011 restricts the dispersal, spread and transportation of these invasive species.

7.3 Operational Impacts

7.3.1.1 Potential Sources of Impact via Surface Water Pathways

Water quality

As the flood defence walls are permanent structures and the embankments will be revegetated the operation of the FRS will generally not result in any additional discharges to the SAC or SPA.

However periodic maintenance of embankments and drainage scheme (i.e. clearing of build-up of silt) will contribute additional particulate matter to the water courses. This could have an impact on water quality and sensitive Qualifying Interests Salmon and lamprey species in the Lower Shannon SAC.

The temporary release and resuspension of sediment into the water column during maintenance works. However, this is not expected to have a significant impact on the mudflats and sandflats habitat. Estuaries are dynamic environments and the variable movement of large volumes of suspended particles are part of their natural processes.

7.3.1.2 Potential Sources of Impact via land and air

Otter

A new lighting scheme at night along the path on top of the embankments will discourage foraging and commuting routes of Otter on the riverbank and flood plain. Potential operational impacts on the attributes of Otter are listed in Table 7-3.

Table 7-3: Potential operational impacts on the attributes of Otter

Qualifying Interest	Attribute	Measure	Potential Impacts
Otter <i>Lutra lutra</i>	Extent of terrestrial habitat	Hectares	Night-time lighting of paths on embankments will cause disturbance to commuting and foraging Otter near riverbank and flood plain
	Extent of marine habitat	Hectares	N/A
	Extent of freshwater (river) habitat	Kilometres	N/A
	Extent of freshwater (lake) habitat	Kilometres	N/A
	Couching sites and holts	Number	N/A
	Fish biomass available	Kilograms	N/A

Wintering Birds

Wintering wetland birds use the marsh area of King's Island during periods of high water and flooding of the marsh habitat. The marsh floods gradually with water accumulating over periods of high tides and/or heavy rains resulting in a shallow water body suitable mainly for foraging for waterfowl. Protected birds such as Whooper swans and also a number of Red and Amber Listed birds have been recorded when the marsh is flooded for long periods during winter.

At present, the embankment and pathway run along the eastern side of the floodplain, with trees blocking the view in places. The proposed works, with a new embankment to the west of the flood plain, will result in the flood plain being completely enclosed by embankments, with public paths on top and easier public access to the marsh area. Increased public usage of pathways and easier access to flood plain will result in greater disturbance to wintering water birds during flood events. Potential impacts on the attributes of the designated features of River Shannon and River Fergus Estuaries SPA are listed in Table 7-4.

Table 7-4: Potential impacts on the attributes of the designated features of River Shannon and River Fergus Estuaries SPA

Qualifying Interest	Attribute	Measure	Potential Impacts
Wintering birds - as listed in Table 7-1	Distribution	Number and range of areas used by waterbirds	Disturbance of wintering birds from operation of new embankment on eastern side of island beside flood plain. Not all bird species listed appear to use King's Island but as a precautionary principle disturbance during operation phase could impact on success of those wintering birds that utilise the flood plain area

Atlantic Salmon

A new lighting scheme along the river will impact on fish such as Salmon. This section of river is part of a resting area for salmon and the light impinging on the water may attract fish and cause them to delay passing through the area. It may also lead to an increase in illegal fishing opportunities. Artificial light can impact on timing and path of migration (Stitch et al. 2015, Mueller and Simmons, 2008)

7.3.2 Do Nothing Impact

If the 'do-nothing' approach is adopted and the development of the King's Island FRS does not take place, flooding events will keep occurring within the residential and commercial areas of King's Island, resulting in reoccurring and long-term socio-economic pressures on the local community. This could result in the requirement for emergency works or ad-hoc remedial

measures in the future, such as the short length of sheet-piled wall at the north of the island, which may negatively affect Natura 2000 sites if they proceed without a coherent and rational approach of a flood relief scheme.

7.4 Significance of Cumulative and In-combination Impacts

The site of the proposed works is situated in an island location surrounded by watercourses and connected by bridges to Limerick city. Other projects within the city environs that could have a cumulative or in-combination impact are listed in Section 6 and none indicate significant cumulative impacts. Some of these projects have not yet gone to planning stage. The main project that could coincide with the present project is the proposed regeneration of the Opera Site. However, no significant cumulative impacts are indicated.

It is therefore expected that no likely significant cumulative impact is expected from these projects.

7.5 Mitigation to Avoid Impacts

This section describes the avoidance and mitigation measures required to prevent or reduce impacts on the Lower River Shannon SAC and River Shannon and River Fergus SPA that will be incorporated into the proposed King's Island FRS.

A site-specific Construction and Environment Management Plan (CEMP) will be written by the contractor prior to site works commencing. This CEMP will incorporate the mitigation measures listed here as well as those in the EIAR (JBA, 2019a). Measures to reduce siltation and pollution will be discussed with Inland Fisheries Ireland to ensure that they meet their required standards.

All of the works and mitigation measures will be monitored by a suitably qualified ecologist during the construction period, with findings reported to the competent authority. The ecologist should have at least 5 years' experience in riverine infrastructural works and should have a high-level knowledge of fisheries. This knowledge base and on-site construction experience is required given the sensitivity of the Lower River Shannon as an internationally important habitat for fish.

Consultation has been carried out with respect to specific mitigation measures in regard to marsh habitat (NPWS) and electrofishing of juvenile lamprey (NPWS and IFI). Pollution prevention measures will be implemented during the construction of FRS. As the receptor habitats and species will be impacted from the same source (spills/leaks), mitigation will be the same for all.

Mitigation measures listed below will be listed as part of tendering document and used during preparation and construction phases of the FRS.

7.5.1 Construction mitigation- Habitats and Species

Estuaries

In order to mitigate identified construction impacts on Estuaries habitat of the Lower River Shannon SAC, the following measures will be followed;

- The footprint of the construction works on the eastern embankment will be demarcated throughout the construction period by fencing to prevent encroachment into the Lower River Shannon SAC. the marsh habitat beyond the boundary of the proposed eastern embankment will be fenced off throughout the period of works
- Runoff from works on new eastern embankments will be controlled so that no water or sediment discharge reaches the marsh/floodplain habitat (see Section 7.5.2.2 Water Quality Controls).
- Runoff from works on embankments from excavation and removal of existing sandbags, footpath, and concrete plinth along embankments will be controlled so that no water or sediment discharge reaches the River Shannon or Abbey River (see Section 7.5.2.2 Water Quality Controls).
- Works on cutting sheet piling will take place from the embankment side only and will not take place inside the marsh habitat of the SAC
- Runoff from works on preparation of new reinforced concrete wall near creche will be controlled so that no water or sediment discharges to the River Shannon

- Excavation of marsh for outfall pipes from eastern embankment will be carried out prior to construction of embankment to limit access and impact on marsh. The boundary of excavation work will be pegged out prior to works and machinery will only track and excavate within designated boundary. Excavations will be minimised, and machinery will not track across marsh.

Impacts on water quality will be mitigated by following pollution prevention measures as detailed in section 7.5.2.

Mudflats and Sandflats

Follow pollution prevention measures as detailed in section 7.5.2.

Alluvial forests [91E0]

Works will only take place within the site boundary. This will be demarcated by fencing on the western boundary to prevent access or potential damage to the alluvial woodland adjacent to the riverbank and north of the works on new western outfall. Mitigation will ensure location of new outfall is not located within Alluvial forest habitat.

As works will be undertaken inside the existing SAC boundary, an adequate buffer zone will be provided to ensure that the alluvial woodland and riparian zone is not degraded and there is no bankside erosion. The design should follow the guidance given in the Shannon Regional Fisheries Board's 'Planning for watercourses in the urban environment' (SHRFB, 2011).

Otter

A pre-construction survey for Otter will be carried out within 10 months prior to construction. This should be supplemented by inspection of development area immediately prior to site clearance to ensure no holts or couches have been created in the intervening period. If any holts are found appropriate steps will be taken and a derogation licence will be applied for from NPWS.

In order to mitigate identified construction impacts on Otter the following mitigation measures will be implemented:

- Trenching works shall not create confined areas where Otter may get trapped. However, if such areas are created, the area will be fitted with an escape ramp (no more than 45°) to allow trapped animals to escape when the area is not in operation. These areas must be made safe before leaving site each day;
- Design mitigation will ensure lighting will be minimised during hours of darkness and will not illuminate areas near the riverbank and the area of the flood plain, to ensure no adverse effects on Otter.

Juvenile Lamprey

Pre-construction targeted removal of juvenile lamprey (ammocoetes) will take place at Areas A9 and B3 under licence (Section 14 Authorisation Act, under the Fisheries Consolidation Act 1959, as substituted by section 4 of the Fisheries (Amendment) Act 1952) and using best practice guidelines. Electro-fishing is possible between July and September inclusive, and pending the conditions of the issued licence and low river flow levels.

Methodology and reasoning behind use of jack-up rigs

It is proposed that a jack-up barge be introduced into the Abbey River (north of Abbey Bridge) and the River Shannon (at the Court House) in order to carry out construction works to the parapet wall (taking down sections of the existing parapet wall and replacing it with a new wall and re-pointing of the existing Quay Wall in order to maintain the existing wall and protect its integrity into the future). The use of jack-up rigs reduces the impact on the riverbed to just the area beneath the 4 supporting legs.

The jack-up rig has 4 supporting legs, each with a 1.5m x 1.5m base plate, which is placed on the riverbed in order to provide support to the barge. The barge itself will be approximately 12m wide x 20m long. A netting apron will be suspended off the side of the barge, to catch any debris, in order to prevent debris falling into the river.

As the works progress the rig will be moved along the defence walls, requiring the legs to be repositioned. The lengths of walls affected are 37m at Area A9 and 300m at Area A3. Works at A9 on the Abbey River in front of the Absolute Hotel requires 2x setups with duration of works of 2-3 months, resulting in an approximate 18m² area of substrate being affected. Works at B3 on the Shannon River in front of the Court House requires 3x setups, with a duration of works of 5 to 6 months, resulting in an approximate 27m² total area of substrate affected.

No introduction of rock infill is required as part of the set-up or operation of the jack-up rig.

Areas to be electro-fished

Abbey River Area A9

It is proposed to carry out electro-fishing of the near bank platform feet areas in the Abbey River and exclude the outer areas by virtue of higher flows, lower aggradation rates (due to higher energy) and therefore low probability of lamprey presence in those areas. Areas of fine sediment are characteristically within the river margins and pool slacks and this is where invariably most lamprey ammocoetes are in large rivers. The jack-up rig feet positioning in the centre of the channel will therefore not encounter areas of soft sediment due to erosional forces 12m out in the Abbey River. The 9m² area of legs close to the walls at low tide would be electro-fished thereby removing any localised ammocoete populations. The area to be electro-fished is shown in Figure 7-1. The faster moving water and harder small boulder and cobble areas of more central areas of channel are of lower suitability for juvenile lamprey and will not be electro-fished.



Figure 7-1: Area A9 to be electro-fished (from left bank of image)

Shannon River Area B3

The area (27 m²) beneath proposed jack-up rig locations in Area B3 will be electro-fished.

Electro-fishing and efficiency of removal

The footprint of the platform feet overlapping soft sediment areas would be marked with posts. This would form the electro-fishing boundary area. A single anode Smith-Root LR24 backpack (12V DC input; 300V, 100W DC output) will be used to electro-fish soft sediment areas during base flow conditions. Settings for lamprey followed those recommended and used by Harvey & Cowx (2003), APEM (2004) and Niven & McAuley (2013). Using this approach, the anode is placed under the water surface, approx. 10–15 cm above the sediment, to prevent immobilising lamprey ammocoetes within the sediment. The anode will be energised with 100V of pulsed DC for 15-20 seconds and then turned off for approximately five seconds to allow ammocoetes to emerge from

their burrows. The anode will be switched on and off in this way for approximately two minutes. Immobilised ammocoetes will be collected using a fine-mesh hand net as they emerge from silt and sand and transferred to 100l oxygenated bankside water tanks. The process is repeated several times until all lamprey are drawn from the footprint of the platform feet. Electro-fishing efficiency can be established using a depletion curve. Efficiency of removal is typically extremely high and is unlikely that any ammocoetes would remain behind. Lamprey would be released into soft sediment areas upstream and away from the works areas following electro-fishing. These are very well distributed in at King's Island and numerous suitable receptor habitat areas exist.

Translocation

Lamprey ammocoetes from the Abbey River would be translocated near the confluence of the Park Canal where abundant soft sediment beds exist for larval lamprey settlement (ITM 0558168, 0657461). For the Shannon River ammocoetes a number of soft sediment littorals also exist locally between Thomond Bridge and the railway bridge upstream on the east bank of the River Shannon. Some areas are larger in size than others. One specific area includes the river adjoining Verdant Place (ITM 0557579, 0658115).

Regeneration of habitat

After winter flows which are typically significant in the lower River Shannon, un-compacted silt habitat will rapidly regenerate in the works areas. The footprint of the feet in the working platforms covers a small area and in the context of temporary impingement on soft sediment there will be no longer term changes to the structure and faunal composition of the bed. As such, the river substrata will, after removal of the working platforms, revert to a condition very close to that pre-works and availability of juvenile habitat will be restored

Launch of jack-up rigs

Ensure launch of jack-up rig will not entail disturbance to riverbank or riverbed substrate. Proposals for the jack-up rig launch locations are provided in Appendix G. Two cranage points are required to lift the jack-up rig into the river at two points, as well as separate boat access points. It is proposed to lift the jack-up rig into the Abbey River at the hatched location with the note "Area A9 launch location option 1 (preferred)". For craning the barge into the River Shannon, a location beside the Curragower Boat Club is proposed. In addition to a cranage point for the jack-up rig, two boat access locations are required. The contractor would be able to use the existing pontoon on George's Quay, or the slipway near O'Dwyer's Bridge.

Wintering birds

Works on the eastern embankment will take place outside of the wintering bird season (September to March) during the entire period of construction (i.e. during both years, and longer if construction is extended) to reduce potential disturbance to wintering birds.

7.5.2 Construction mitigation - Measures to avoid/mitigate pollution and water quality issues

Appropriate mitigation measures will be implemented prior to the construction phase to ensure that water quality of the Lower River Shannon SAC is not adversely affected through pollution incidents and silt mobilisation. This mitigation will include:

7.5.2.1 Site Compound

- The site compound shall be located within the site boundary
- The compound will be sited as far from any water course (>50m) as possible in order to minimise any potential impacts.
- Only plant and materials necessary for the construction of the works will be permitted to be stored at the compound location.
- Site establishment by the Contractor will include the following:
 - a. Office
 - b. Site facilities (canteen, toilets, drying rooms, etc.);
 - c. Office for construction management team;
 - d. Secure compound for the storage of all on-site machinery and materials;
 - e. Temporary car parking facilities;

- f. Temporary fencing;
- g. Site Security to restrict unauthorized entry;
- h. Bunded storage of fuels and refuelling area. Bunds shall be 110% capacity of the largest vessel contained within the bunded area;
- i. A separate container will be located in the Contractors compound to store absorbents used to contain spillages of hazardous materials. The container will be clearly labelled, and the contents of the container will be disposed of by a licenced waste contractor at a licenced site. Records will be maintained of material taken off site for disposal;
- j. A maintenance programme for the bunded areas will be managed by the site environmental manager. The removal of rainwater from the bunded areas will be their responsibility. Records will be maintained of materials taken off site for disposal;
- k. The site environmental manger will be responsible for maintaining all training records;
- l. The contents of any tank will be clearly marked on the tank, and a notice displayed requiring that valves and trigger guns be locked when not in use;
- m. Drainage collection system for washing area to prevent run-off into surface water system and
- n. All refuelling of vehicles will be carried out at the fuel stores within the main site compound and only ADR trained personnel will be permitted to operate fuel bowsers.

7.5.2.2 Water Quality controls

Relevant legislation and best practice guidance that have been considered includes the following:

Water Framework Directive (2000/60/EC);

European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009);

Local Government (Water Pollution) Acts 1977-1990;

CIRIA C532 *Control of water pollution from construction sites*. Guidance for consultants and contractors. (www.ciria.org);

CIRIA Guidance C741: *Environmental good practice on site guide* (Charles & Edwards, 2015);

CIRIA Guidance C750D: *Groundwater control: design and practice* (Preene *et al.*, 2016) (www.ciria.org);

Inland Fisheries Ireland 2016 *Guidance on Protection of Fisheries During Construction Works In and Adjacent to Waters*;

Shannon Regional Fisheries Board (SHRFB, 2011) - Planning for watercourses in the urban environment;

NRA (2005) Guidelines for the crossing of watercourses during the construction of National Road Schemes.

- Adoption of surface water controls including appropriate erosion and silt controls (e.g. trenches, settling ponds/tanks, silt fence, pumping and filtration units) to prevent any flow of surface water from the site into the SAC marsh, water courses within the site, or the Shannon or Abbey Rivers. Contents of any sediment tanks will be removed off site by a licenced waste contractor. The details of the control of site drainage will be shown in the developed CEMP.
- The delineation of trench works by a fence, outside of which no access shall be permitted.
- At no point should there be storage of material or vehicles/machinery at east of the site near the flood plain area within the SAC or near newly excavated channel at north of site.
- The excavation through embankments with open trench for connection of filter drain to Shannon river and to drains across flood plain will be carried out during a period of dry

weather. Rainfall needs to be monitored, and works carried out during consecutive dry days

- Storage of earth fill material for embankments will remain covered until required for construction
- Reseeding of embankments will take place immediately after construction
- Works on pilings and new concrete wall at Verdant Place to include appropriate erosion and silt controls to prevent surface water flow and accidental spillages onto riverbank and into Shannon River.
- Work on removal of sandbags, paths and concrete plinth along embankments will take place during a period of dry weather, and will include appropriate erosion and silt controls to prevent surface water flow and accidental spillages onto riverbank and into River Shannon and Abbey River.
- Cutting of sheet piling will take place from embankment side.
- Works on cutting of sheet piling and excavation and laying of new Bitmac path to north of sheet piling will take place during a period of dry weather. Rainfall needs to be monitored and works carried out during consecutive dry days. Appropriate erosion and silt controls will be required to prevent surface water flow, sediment mobilization and accidental spillages onto riverbank and into Abbey River.
- Oil booms and oil soakage pads that float on water should be maintained on-site to enable a rapid and effective response to any accidental spillage or discharge into surface water. These need to be secured to prevent them breaking free from the site of the spill and releasing the polluting material. These shall be disposed of correctly and records will be maintained by the Environmental Manager of the used booms and pads taken off site for disposal.
- Do not attempt to hose the spillage down or clean up with detergents or emulsifiers, as these will increase the risk of harming the environment.
- Fail-safe site drainage and bunding through drip trays on plant and machinery will be provided to prevent discharge of chemical spillage from the sites to surface water.
- Jack-up rig and plant are clean and are in good working order (no leaks) before entering the estuarine environment for work on defence walls in Area A9 and B3.
- All working platforms within or adjoining watercourses should have spill kits available to prevent egress of chemicals include concrete, lubricants, fuels, setting compounds or other from entering the River Shannon
- Launch of jack-up rig will be carried out by crane and will not disturb bank habitats or bottom sediment at launch sites
- Emergency repair tools and/or towing equipment is to be made available in case of damage to jack-up rig

7.5.2.3 Pollution Control and Spill Prevention

Spill kits containing absorbent pads, granules and booms will be stored in the site compound with easy access for delivery to site in the case of an emergency. A minimum stock of spill kits will be maintained at all times. Absorbent material will be used with pumps and generators at all times and used material disposed of in accordance with the Waste Management Plan. All used spill materials e.g. absorbent pads will be placed in a bunded container in the contractor's compound. The material will be disposed of by a licensed waste contractor at a licensed facility. Records will be maintained by the Environmental Manager.

Regular inspections and maintenance of plant and machinery checking for leaks, damage or vandalism will be made on all plant and equipment.

In the event of a spill, the Contractor will ensure that the following procedure are in place:

- Emergency response awareness training for all project personnel working on site.
- Appropriate and sufficient spill control materials will be installed at a strategic location within the site. Spills kits for immediate use will be kept in the cab of mobile equipment.

- Spill kits will be stored in the site compound with easy access for delivery to site in the case of an emergency. A minimum stock of spill kits will be maintained at all times and site vehicles will carry spill kits at all times. Spill kits must include suitable spill control materials to deal with the type of spillage that may occur and where it may occur. Typical contents of an on-site spill kit will include the following as a minimum;
- Absorbent granules;
 - Absorbent mats/cushions;
 - Absorbent booms.
- Spill kits will contain gloves to handle contaminated materials and sealable disposal sacks.
- Track mats and geotextile material.
- All potentially polluting substances such as oils and chemicals used during construction will be stored in containers clearly labelled and stored with suitable precautionary measures such as bunding within the site compound.
- All tank and drum storage areas on the site will, as a minimum, be bunded to a volume not less than the following;
 - 110% of the capacity of the largest tank or drum within the bunded area, or
 - 25% of the total volume of substances which could be stored within the bunded area.
- The site compound fuel storage areas and cleaning areas will be rendered impervious and will be constructed to ensure no discharges will cause pollution to surface or ground waters.
- Designated locations for refuelling are within Site Compound. Where practicable, refuelling of vehicles and machinery will be carried out on an impermeable surface in one designated area well away from any watercourse or drainage (at least 10m).
- Potentially contaminated run off from plant and machinery maintenance areas will be managed within the site compound surface water collection system.
- Damaged or leaking containers will be removed from use and replaced immediately.

These are standard best-practice measures that are regularly used on construction sites in and adjacent to water and are proven to be effective.

7.5.3 Measures to prevent the spread of non-native invasive species

In order to mitigate the potential spread of non-native invasive listed in the Third Schedule (Part 1) of the European Communities (Birds and Natural Habitats) Regulations 2011 the mitigation measures listed in Section 4 of the King's Island Invasives Species Management Plan (JBA, 2019b) will be implemented during construction.

7.5.4 Operation mitigation

Otter

Any new lighting required as part of the project will be of as low a wattage as possible and will be directed away from river bankside, flood plain and the surface of the water (see Section 2.4.3 Lighting Design).

Wintering Waterbirds

Planting: The steepness (1:3) of the embankment in the northern third of the new eastern embankment and the southern embankment area north of Star Rovers should discourage public access to the floodplain in these areas. Planting a natural barrier using whips of low-growing native species such as Hawthorn/willow at the base of eastern embankment where it is less steep and where there is space between SAC boundary and base of embankment should also discourage access to the flood plain. Allow minimal meadow grassland management (e.g. one cut / year) on the embankment, with unmanaged areas where scrub and natural succession are allowed. Any vegetation on the embankment itself will be maintained and restricted to shallow rooted vegetation only, to avoid the risk of damage to the embankment core. Public access of the paths and use of marsh is likely to be less during the winter months.

Public Participation: A local awareness campaign could highlight the biodiversity of King's island. Bird counts by local nature groups could potentially monitor wintering bird numbers and rates of disturbance from public use of new pathways. As an example, Booterstown Marsh in Dublin has a train line and a main road close by. Wintering birds appear undisturbed by human activity and it is a regular location for bird watching (Dún Laoghaire-Rathdown County Council, 2013). However, there is little direct access by the public onto Booterstown Marsh, unlike King's Island.

Salmon

Any new lighting required as part of the project will be of as low a wattage as possible and will be directed away from river bankside, flood plain and the water surface. This should be as per the requirements of and in consultation with Inland Fisheries Ireland. Illumination should be "cowled" or designed to ensure that the pool of light falls only on the footpath and not on the water (see Appendix B Section 2.4.3 Lighting Design).

Water quality

Regular operation and review of drainage maintenance requirements. Maintenance procedures will follow those recommended in CIRIA SUDS Manual (2015), Part E C753, Chapter 32 Operation and Maintenance.

7.5.5 Contingency Plans

Should an accidental spill or leak occur, appropriate containment and clean-up plans will be implemented accordingly. The EPA and NPWS will be contacted in the case of spills into any waterbodies within King's Island and/or estuarine environment.

7.5.6 Confidence in Assessment and Precautionary Interpretation

The mitigation proposed for the potential impacts on Estuaries consist of proven and effective measures and will be able to eliminate impacts that would adversely affect site integrity.

7.6 Impact Evaluation Summary

Table 7-5 below presents the screened in Natura 2000 site and the potential impacts as discussed in Section 7.2 and 7.3. Where potentially significant adverse impacts are identified, avoidance and mitigation measures are proposed to offset these impacts (Section 7.5).

Residual Impacts are those that occur after mitigation measures have taken place. It is considered that if the proposed mitigation measures are correctly employed during the proposed works, then no residual impacts of significant adverse effect are foreseen on the habitats and species of Lower River Shannon SAC and of River Shannon and River Fergus Estuaries SPA.

Table 7-5: Potential impacts on the attributes of the designated features of the Natura 2000 sites

Qualifying Interest	Attributes	Potential Source of Impact	Pathway	Impact on target prior to Avoidance/Mitigation	Avoidance/Mitigation Measures	Residual Impact
Estuaries [1130]	Habitat area	Construction of embankment	Land and air	Reduction of flood plain area on King's Island	<p>The footprint of the construction works on the eastern embankment will be minimised and fenced off to limit encroachment into the floodplain area of the SAC</p> <p>Runoff from works will be controlled so that no water or sediment discharge reaches the marsh/floodplain habitat.</p> <p>Works on cutting sheet piling will take place from the embankment only and will not take place inside the marsh.</p>	No adverse effects
	Community distribution	<p>Construction of embankment</p> <p>Excavation of topsoil for drainage works, path works, piling etc.</p> <p>Pollution from hydrocarbon spills, concrete dust and surface water runoff</p>	Surface water	Impact on water and sediment quality and community types	<p>Management of surface water runoff from site</p> <p>Pollution control and spill prevention</p> <p>Emergency procedures for broken down machinery</p>	No adverse effects
Mudflats and	Habitat area	N/A	N/A	Impact from	N/A	N/A

Qualifying Interest	Attributes	Potential Source of Impact	Pathway	Impact on target prior to Avoidance/Mitigation	Avoidance/Mitigation Measures	Residual Impact
sandflats not covered by seawater at low tide [1140]				potential pollutants will not affect the extent of area of mudflats and sandflats		
	Community distribution	Construction of embankment Excavation of topsoil for drainage works, path works, piling etc. Pollution from hydrocarbon spills, concrete dust and surface water runoff	Surface water	Pollution from hydrocarbon spills, concrete dust and silt runoff could impact water quality and community types	Management of surface water runoff from site Pollution control and spill prevention Emergency procedures for broken down machinery	No adverse effects
Alluvial forest [91E0]	Habitat area	Excavation and physical damage to alluvial woodland during construction of outflow drain to Shannon river and during removal of sandbags and concrete plinths along embankments Invasive species	Land and air	Destruction of trees and reduction in area of alluvial forest Impact on Vegetative composition of habitat	The footprint of the construction works will not encroach within the boundaries of the SAC. Fencing/signage will be used to demarcate SAC boundary. Location of new outfall on western riverbank will not be located within Alluvial forest habitat. CEMP to include Invasive Species Management Plan and biosecurity measures	No adverse effects

Qualifying Interest	Attributes	Potential Source of Impact	Pathway	Impact on target prior to Avoidance/Mitigation	Avoidance/Mitigation Measures	Residual Impact
River Lamprey <i>Lampetra fluviatilis</i> Sea Lamprey <i>Petromyzon marinus</i>	Distribution: extent of anadromy	NA No barriers to fish migration	NA	NA	NA	NA
Brook Lamprey (<i>Lampetra planeri</i>) [1096], River Lamprey River Lamprey (<i>Lampetra fluviatilis</i>) [1099], Sea Lamprey (<i>Petromyzon marinus</i>) [1095]	Population structure of juveniles	Disturbance from launch of jack up rig Disturbance from pads of jack-up rig at Area A9 and B3 on bottom substrate Impacts on water quality from accidental spillage or from surface water runoff	Physical disturbance of bottom substrate in river	Compaction of substrate containing juvenile lamprey. Reduced water quality	Electro-fishing and translocation of juvenile Lampreys in pre-construction phase (August - October inclusive) Launch of rigs by cranes	No adverse effects
	Juvenile density in fine sediment	Disturbance from pads of jack-up rig at Area A9 and B3 on bottom substrate and Impacts on water quality from accidental spillage or from surface water runoff	Physical disturbance of bottom substrate in river	Compaction of substrate containing juvenile lamprey. Reduced water quality	Electro-fishing and translocation of juvenile Lampreys in pre-construction phase (August - October inclusive)	No adverse effects
	Extent and distribution of spawning habitat	NA- spawning habitat further upstream	N/A	N/A	N/A	N/A
	Availability of juvenile habitat	Disturbance from pads of jack-up rig at Area A9 and B3 on bottom substrate and Impacts on water quality from accidental spillage or from surface water runoff	Physical disturbance of bottom substrate in river	Compaction of substrate containing juvenile lamprey Reduced water quality	Electro-fishing and translocation of juvenile Lampreys in pre-construction phase (August - October inclusive). Compaction effect will be temporary and habitat will quickly regenerate after winter river flow events	No adverse effects
Atlantic salmon	Distribution: extent of	Lighting	Land and air	Light will attract fish	Suitable lighting plan	No adverse effects

Qualifying Interest	Attributes	Potential Source of Impact	Pathway	Impact on target prior to Avoidance/Mitigation	Avoidance/Mitigation Measures	Residual Impact
<i>Salmo salar</i> (only in fresh water)	anadromy			and cause them to delay passing through the area	with no light falling on surface of water	
	Adult spawning fish	Lighting	Land and air	Light will attract fish and cause them to delay passing through the area	Suitable lighting plan with no light falling on surface of water	No adverse effects
	Salmon fry abundance	NA	NA	NA	NA	NA
	Out-migrating smolt abundance	Lighting	Land and air	Light will attract fish and cause them to delay passing through the area	Suitable lighting plan with no light falling on surface of water	No adverse effects
	Number and distribution of redds	NA	NA	NA	NA	NA
	Water quality	Construction of embankment Excavation of topsoil for drainage works, path works, piling etc. Pollution from accidental hydrocarbon spills, concrete dust and surface water runoff	Surface water	Pollution from hydrocarbon spills, concrete dust and silt runoff could impact water quality	Management of surface water runoff from site Pollution control and spill prevention Emergency procedures for broken down machinery	No adverse effects
Otter (<i>Lutra lutra</i>) [1355]	Extent of terrestrial habitat	Lighting	Land and air	Avoidance of habitat for commuting/foraging	Lighting will be minimised during hours of darkness and will not illuminate areas near riverbank, flood plain or surface of water	N/A
	Extent of marine habitat	N/A	N/A	N/A	N/A	N/A
	Extent of freshwater (river) habitat	Lighting	Land and air	Avoidance of habitat for	Lighting will be minimised during hours of darkness	NA

Qualifying Interest	Attributes	Potential Source of Impact	Pathway	Impact on target prior to Avoidance/Mitigation	Avoidance/Mitigation Measures	Residual Impact
				commuting/foraging	and will not illuminate areas near riverbank, flood plain or surface of water	
	Extent of freshwater (lake) habitat	N/A	N/A	N/A	N/A	N/A
	Couching sites and holts	Precautionary principle: Disturbance from new lighting plan on riverbank habitat	Land and air	Avoidance of habitat for commuting/foraging/resting	Pre-construction survey for holts and resting places. Lighting will be minimised during hours of darkness and will not illuminate areas near riverbank, flood plain or surface of water	No adverse effects
	Fish biomass available	Impacts on water quality from discharges and impacts from jack-up rigs at Area A9 and B3 have the potential to impact on populations of fish and juvenile lamprey	Surface water pollution	Impact the availability of prey items for Otter	Management of surface water runoff from site compound Pollution control and spill prevention Emergency procedures for broken down machinery Mitigation re lamprey juveniles	No adverse effects
Wintering birds	Distribution	Disturbance of birds from construction and operation of new embankment on eastern side of island beside flood plain	Land and air	Not all bird species listed use King's Island but as a precautionary principle disturbance from construction work could impact on success of those	Construction work takes place outside of wintering bird season (September -March) Planting of native vegetation at base of	No adverse effects

Qualifying Interest	Attributes	Potential Source of Impact	Pathway	Impact on target prior to Avoidance/Mitigation	Avoidance/Mitigation Measures	Residual Impact
				wintering birds that utilise the flood plain area at the north east of King's Island	eastern embankment to act as natural barrier to reduce access by public to flood plain in winter months.	

8 Conclusion

This Natura Impact Statement provides information for the competent authority to undertake the Stage 2 Appropriate Assessment of the proposed King's Island Flood Relief Scheme and in particular to examine the potential direct and indirect impacts on the following Natura 2000 sites:

- Lower River Shannon SAC
- River Shannon and River Fergus Estuaries SPA.

A phase 1 Screening for Appropriate Assessment (see Section 4) concluded that the potential for significant effects is likely in relation to the above sites. This screening exercise followed a methodology which examines three source > pathway > receptor chains; surface water, land and air, and groundwater pathways.

The FRS at King's Island is critical for the protection of King's Island from flood events in the future. The proposed works are located directly adjacent to the Lower River Shannon SAC and upstream of River Shannon and River Fergus Estuaries SPA. The qualifying interests for Lower River Shannon SAC within the zone of influence are Estuaries [1130], Mudflats and sandflats [1140], Alluvial forests [91E0], Brook Lamprey (*Lampetra planeri*) [1096], River Lamprey (*Lampetra fluviatilis*) [1099], Sea Lamprey (*Petromyzon marinus*) [1095], Atlantic Salmon (*Salmo salar*) [1106] and Otter (*Lutra lutra*) [1355]. Qualifying interests for the River Shannon and River Fergus Estuaries SPA include wintering birds, that may use the flood plain to the north east of the island.

Where potentially significant adverse impacts were identified, a range of mitigation and avoidance measures have been recommended. These will be implemented to offset any impacts identified.

Potential Impacts

The potential impact from the proposed project is posed during construction and relates to potential pollution of surface waters caused by runoff from excavated soil and accidental spillage of diesel and oil, which could impact on the Annex 1 water dependent habitats and species of the SAC. Wintering birds from River Shannon and River Fergus Estuaries SPA could be disturbed by construction and operational activities near the flood plain to the north east of the island. Alluvial forest could be impacted by physical disturbance. Potential disturbance to juvenile lamprey species and their habitat could occur during temporary operation of jack-up rigs used during upgrading of flood defence walls at Areas A9 and B3. Otter and Salmon could be impacted by new lighting design.

Cumulative Impacts

No likely significant cumulative impact on the two Natura 2000 sites is expected from the following schemes; Killaloe Bypass/Shannon Bridge Crossing and R494 Improvement Scheme, Castleconnell Flood Relief Scheme (FRS), Opera Site, Limerick City, Limerick Urban Centre Revitalisation - O'Connell Street and International Rugby Experience Building, O'Connell Street.

As Limerick City and Environs Flood Relief Scheme (FRS), Mungret Local Infrastructure Housing development Scheme Corbally Housing Development and Orchard housing development are at design or planning stage no detailed assessment of likely cumulative impacts can be assessed as part of this NIS. These projects will need to consider the present project in their cumulative assessments.

Mitigation Measures

Mitigation measures have been proposed for and for pollution control measures to be included during the construction and operation phases. None disturbance of wintering birds (construction outside of wintering bird season) and the protection of juvenile lamprey (pre-construction electro-fishing and translocation) and the non-disturbance of Salmon and Otter (appropriate lighting design., This will reduce any potential impacts to **No adverse effects** in relation surface and groundwater pollution, wintering birds, lamprey species Salmon to Otter.

Summary

Following a comprehensive evaluation of the potential direct, indirect and cumulative impacts on the qualifying interests and conservation objectives for the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA and ensuring that avoidance and mitigation measures

are implemented as proposed, it has been concluded by the authors of this report that the proposed King's Island Flood Relief Scheme will have **No adverse effects** on the integrity of the above Natura 2000 sites.

To confirm this conclusion, the following checklist, taken from DoEHLG (2009) has been completed.

Table 8-1: Integrity of Site Checklist (from DoEHLG, 2009)

Conservation objectives: does the project or plan have the potential to:	Y/N
Cause delays in progress towards achieving the conservation objectives of the sites?	N - Following mitigation, no significant adverse residual impacts have been identified that will prevent achievement of the conservation objectives of the assessed sites.
Interrupt progress towards achieving the conservation objectives of the sites?	N - Following mitigation, no significant adverse residual impacts have been identified that will prevent achievement of the conservation objectives of the assessed site.
Disrupt those factors that help to maintain the favourable conditions of the site?	N - Potential adverse impacts via surface water; land and air; and groundwater pathways identified during the screening and AA process can be mitigated against.
Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?	N - Potential adverse impacts on the habitats and species of the SAC and SPAs are not expected as impacts can be avoided by implementing the mitigation and avoidance measures detailed. Disturbance to Otter, juvenile lamprey and wintering birds have been mitigated against
Other objectives: does the project or plan have the potential to:	Y/N
Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?	N - Potential adverse impacts from potential pollutants are not expected as measures will be included within working protocols to ensure potential impacts are effectively mitigated.
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	N- Any works that are taking place within the SAC are temporary and affected habitats will quickly revert to previous conditions a) area of marsh where drainage channel is deepened and widened, b) river substrate where disturbed by jack-up rig and c) vegetated area surrounding storm water outfall and fisherman's path
Interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	N- Potential adverse impacts on the habitats of Lower River Shannon SAC and River Fergus Estuaries SPA are not expected given the mitigation measures that have been detailed.
Reduce the area of key habitats?	N- Potential adverse impacts on the habitats of Lower River Shannon SAC and River Fergus Estuaries SPA are not expected given the mitigation measures that have been detailed.

Other objectives: does the project or plan have the potential to:	Y/N
	Any works that are taking place within the SAC are temporary and affected habitats will quickly revert to previous conditions a) area of marsh (supporting flood plain habitat to estuaries) where drainage channel is deepened and widened, b) river substrate (juvenile lamprey habitat) where disturbed by jack up rig
Reduce the population of key species?	N- Potential adverse impacts on the habitats of Lower River Shannon SAC are not expected given the mitigation measures that have been detailed. Disturbance to juvenile lamprey will be mitigated against by electro-fishing and translocation prior to construction phase. Rapid regeneration of silt habitat in works area after winter flows will allow reversion to conditions pre-works. Potential impacts to the wintering bird species for which the Shannon and River Fergus Estuaries SPA are designated, are mitigated against by working outside the wintering bird season for the duration of the project
Change the balance between key species?	N - Potential impacts to the species for which Lower River Shannon SAC and River Fergus Estuaries SPA are designated, are not expected as impacts can be avoided by implementing the mitigation measures detailed.
Reduce diversity of the site?	N - The identified mitigation measures to protect designated habitats and species will ensure that the current diversity of the sites is maintained.
Result in disturbance that could affect population size or density or the balance between key species?	N- Disturbance to Otter, juvenile lamprey and wintering birds have been mitigated against
Result in fragmentation	N - The proposed works will be undertaken along existing roads and infrastructure and therefore no fragmentation of habitats will occur.
Result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding etc.)?	N - Potential adverse impacts on Lower River Shannon SAC and River Fergus Estuaries SPA habitats are not expected, as they can be avoided by implementing the mitigation measures detailed. No loss or reduction of key features is thus anticipated.

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Appendices

A Project location

A.1 Site Location