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KING'S ISLAND
FLOOD RELIEF SCHEME

**King's Island Flood Relief Scheme
Environmental Impact Assessment Report
Volume 1 - Non Technical Summary**

Final Report

December 2019



Comhairle Cathrach
& Contae **Luimnigh**

Limerick City
& County Council



OPW

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This report describes work commissioned by Limerick City & County Council as part of the King's Island Flood Relief Scheme. Emily Rick and Bernadette O'Connell of JBA Consulting carried out this work.

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Abbreviations

ABP	An Bord Pleanála
CEMP	Construction Environmental Management Plan
DMP	Dust Management Plan
EIAR.....	Environmental Impact Assessment Report
EPA.....	Environmental Protection Agency
EU	European Union
FRS.....	Flood Relief Scheme
HEFS	High-End Future Scenario
HGV	Heavy Goods Vehicle
LCCC	Limerick City & County Council
MRFS.....	Mid-Range Future Scenario
NIAH	National Inventory of Archaeological Heritage
OPW	Office of Public Works
PID	Public Information Day
RMP	Record of Monuments and Places
SAC.....	Special Area of Conservation
WFD.....	Water Framework Directive

Non-Technical Summary

Introduction

This document provides a non-technical summary for the Environmental Impact Assessment Report (EIAR) which was prepared for the proposed King's Island Flood Relief Scheme (FRS).

There are five stages in the project:

- Stage I – Development of a number of flood defence options and the identification of a preferred Scheme;
- Stage II – Planning & Detailed Design;
- Stage III & IV – Tender & Construction; and
- Stage V – Project Close-Out (Handover to Client).

This Non- Technical Summary is produced as part of Stage II of the project. It follows on from work carried out to date including the Constraints Study¹, Options Assessment Report² and the EIAR Scoping Report³.

The EIAR comprises three volumes as follows:

- Volume 1: The Non-Technical Summary;
- Volume 2: The EIAR and Appendices;
- Volume 3: Figures; and
- Volume 4: Photomontages.

Site Description

King's Island is characterised by two distinct areas, the northern portion is known as St. Mary's Park, a residential development of two storey semi-detached dwellings and surrounded by large open fields that act as a natural buffer running along the river's edge. Embankments form part of the river walk around the northern boundary of the island and are viewed as part of the natural landscape. This predominantly residential quarter is identified as Flood Cell A for the purposes of this EIAR.

To the south is Englishtown, which runs along the south west of the island, and is regarded as the historic core of Limerick City, home to cultural buildings such as St. Mary's Cathedral and St. John's Castle and also includes restaurants, businesses and some residential dwellings built along the water's edge and is generally considered the more urban area of the island. Flood defence works are visible within the area, including lengths of both formal and informal flood defences in the form of quay walls. However, there are no defences in place at the Potato Market or civic buildings on Merchant's Quay. For the purposes of this report the southern commercial area has been identified as Flood Cell B.

Need for the Proposed Project

King's Island is surrounded by the River Abbey and River Shannon, both of which are influenced by the tide and therefore highly susceptible to tidal and fluvial flooding. 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. 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, the sandbags around the Island contained the tidal surge.

As the island is highly susceptible to flood events, major improvements to the existing temporary flood defences are required to reduce impacts and frequency of extreme events which inundate the island. JBA Consulting and Arup have been commissioned by Limerick City & County Council

¹ Constraints Study for Flood Relief Scheme at King's Island, Limerick. V1 December 2015, JBA Consulting and Arup for Limerick City and County Council

² Options Assessment Report for Flood Relief Scheme at King's Island, Limerick. V5 August 2018, JBA Consulting and Arup for Limerick City and County Council

³ EIAR Scoping Report for Flood Relief Scheme at King's Island, Limerick. V3 December 2018, JBA Consulting and Arup for Limerick City and County Council

(LCCC) to provide the engineering and environmental services subject of this EIAR and deliver the King's Island Flood Relief Scheme (FRS).

In the absence of the proposed development works, flooding will persist and possibly worsen over time. The residual impacts of continuous flooding will damage and devalue properties in the area and affect long term regeneration plans for King's Island and its environs.

It is intended the works will enhance and fortify the existing measures in place and be able to withstand the likely increased frequency and severity of future flooding events. The works have been designed and developed with a primary focus to protect the affected areas against fluvial and tidal flooding. The scheme proposed herein is designed to provide protection to properties in the study area from the 1 in 200 year tidal flood event.

Support for enhanced flood protect is encouraged under the National Planning Framework, regional and local objectives, and further supported under European Union Policy for flood risk assessment and management. These objectives and goals are set out below.

Legislation and Planning Policy

The requirement for flood protection is driven largely by the EU 'Floods' Directive (2007). The design of the King's Island FRS in response to this law, has triggered the need for an EIAR as part of the planning requirements set out by An Bord Pleanála and the Planning and Development Act 2000 (as amended), and the Planning and Development Regulations 2001, as amended. These key pieces of policy are described further below.

The scheme has been designed in accordance with the following legislation and policy documents:

- EU 'Floods' Directive 2007;
- The National Planning Framework;
- The Draft Regional Spatial and Economic Strategy for the Southern Region;
- The Planning System and Flood Risk Management 2009;
- Climate Change Sectoral Adaptation Plan for Flood Risk Management, 2015;
- Our Sustainable Future: Framework for Sustainable Development;
- National Climate Change Policy 2007-2012;
- Mid-West Area Strategic Plan (MWASP) 2012-2030;
- Shannon Catchment Flood Risk Assessment and Management Study (CFRAM); and
- Limerick City Council Development Plan (LCDP) 2010-2016 (as Extended).

It is concluded that the proposed development would be in compliance with national, regional and local planning policy.

EU 'Floods' Directive 2007

The EU 'Floods' Directive came into force in 2007 and works with the Water Framework Directive (WFD) for the protection of water quality. Under this Directive, each Member State is required to produce policies and plans that set out measures to reduce flood risk and protect the most at-risk communities from flooding.

King's Island is part of the Flood Risk Management Plan for the Shannon Upper and Lower River Basin. The plan manages flooding for the southwest region to meet Ireland's obligations under the 2007 EU 'Floods' Directive.

The Planning and Development Act 2000 (as amended), and the Planning and Development Regulations 2001, as amended

The Planning and Development Act 2000 (as amended) forms the basis of the Irish planning system, setting out the detail of for planning guidelines, obtaining planning permission and the process for Environmental Impact Assessment.

LCCC wishes to prepare a Planning Application to An Bord Pleanála (ABP), under Section 226(1) of the Act. Due to the scale and nature of the Scheme, the requirement for an Environmental Impact Assessment Report has been triggered, as listed under Section 5 Part 2.

The requirements for the preparation of an Environmental Impact Assessment are contained within the Planning Act, and have been followed closely in the preparation of the 3 Volumes of this EIAR.

Constraints, Alternatives Considered, Options, and Scoping Stages

Prior to the preparation of this EIAR, several studies were undertaken to inform the options, design, and scoping of this EIAR.

The Constraints Study was the first step in the determining the key environmental constraints and drivers which would inform the development of potential flood relief options and ultimately informed the preparation of this EIAR.

Alternative options were considered in the early phases of the development. This was completed as part of Stage I - Options Development, and the results are presented in the Options Assessment Report² completed by Arup and JBA in 2018. The Options Assessment included the following options, which were assessed for their applicability, economic feasibility, and their environmental, social, and cultural impact.

Structural Measures

- Upstream floodplain storage;
- Tidal barrier;
- Barrier on upstream and downstream limits of the Abbey River;
- Direct flood defences;
- Diversion channels or culverts;
- Relocation of property occupiers;
- Individual property protection;
- Pumping;
- Channel widening; and
- Bridge/weir modifications.

Non-Structural Measures

- Planning control;
- Building regulations;
- Flood forecasting and early warning system;
- Public awareness; and
- Land use management.

The Options Assessment Report presented the various structural and non-structural defences through screening all available alternatives considered, and from the screening process developed options specific to each flood cell, of which there are 14 on King's Island. The outcome included 2 options for Flood Cells A and B:

Table 1. Potential options for Flood Cells A and B

Flood Cell	Option	Description
A	1	Inner alignment at A4
	2	Outer alignment at A4
B	1	Direct defences at B3
	2	Road raising and IPP at B3

The merits of the alternative options were summarised on the basis of cost, Multi-Criteria Analysis (MCA) score, environmental and ecological impact, process and programme, and climate change adaptability. The emerging preferred option is A1-B1, Inner alignment in Area A4 and Direct Defences for Area B3. Such an option represents the combination which meets the council's brief for passive flood defences and will ensure the most sustainable, long-term use of the area around

Merchant's Quay. It also provides advantages through MCA, including significant benefits in avoiding works within the SAC boundary at the north of the island.

Following selection of an Emerging Preferred Option, a Scoping Report was developed, which was the first stage in the preparation of the EIAR. The Scoping Report introduced the proposed development, defined the location and extent of works, identified the key environmental issues and receptors in the vicinity, the potential impacts of the proposal, and identifies the likely environmental studies that are required to inform the full EIAR. The Scoping Report was distributed to statutory consultees as part of the consultation phase.

Description of Proposed Development

Each part of King's Island has different needs for flood protection, and so the outer edges of the island have been divided into fourteen (14) "sub-areas".

The emerging preferred option is direct defences along the outer alignment for areas A1-A3 and A5-B3, and along the inner alignment for area A4. Direct defences include either reinforced concrete flood walls or glass panelling, or earth embankments (shown in Figure 1-2, Figure 1-3, and Figure 1-4 overleaf), depending on the location and local constraints. A description of the works at each area are described further in Table 1.

Table 2. Design measures proposed for each sub-area

Area	Design Measures
A1 - Thomond Bridge to Verdant Place	Works were completed in 2017. The existing wall was raised, reinforced and capped with concrete coping. It is proposed to remove railings and paint the existing coping and new southern coping a darker shade of grey to blend in with the stone wall.
A2 - Verdant Place Steps and Crèche	Replace the old embankment and temporary concrete barriers with a new reinforced concrete wall.
A3 - North West Embankment	New embankment along 920m of the northwest perimeter of the island, set back on the inside of the existing embankments. A footpath and cycle path will follow along the top. Total width will range from 60 to 70m but will vary at different locations and is designed to blend into St. Mary's Park.
A4 - St Mary's Park / SAC	New embankment topped with foot path and cycle path is to be approximately 850m in length and is to run along the rear of the houses on St. Munchin's Street. Similar in dimensions to the north west embankments, but narrower due to space constraints. Tree planting will be implemented between the houses and the embankment to limit the views into the properties from the raised ground level.
A5 - Star Rovers to Athlunkard Boat Club	New embankment around the sports fields along the northern and eastern sides until the boundary with the boat club. The fields will be moved and reconstructed in order to build the embankments.
A6 - Athlunkard Boat Club	Walls along the western side of the club will be raised. A new sewer system for the boat club will be constructed to connect sewerage to the main Limerick sewer system.
A7 - Sir Harry's Mall	The existing wall will be raised to the flood defence level and strengthened. The footpath will be raised to maintain views to the river over the raised wall, and widened with accessibility ramps on either end. The road will be narrowed to one lane of traffic and one lane of parking.
A8 - Absolute Hotel Boardwalk	The access landings at either end of the boardwalk will be raised by 10cm.
A9 - South of Absolute Hotel Boardwalk	The parapet wall is to be replaced with a reinforced concrete wall.
A10 - Abbey Bridge to Baals Bridge	The entire length of the wall will be replaced with a new concrete wall with masonry cladding.
B1 - George's Quay East	The eastern stretch of the wall is to be raised to the required guarding height, by removing the coping, raising the wall with matching stone and then replacing the coping again.
B2 - George's Quay West	The remainder of the wall is to be replaced by a reinforced concrete wall. The wall is to be interspersed with stretches of glass flood defence panels.
B3 - Potato Market and Civic Buildings	The cantilevered opening in the Potato Market will be replaced with flood resistant glass panelling. An automatic and manual flood gate will be constructed at the entrance to the Curragower club. The road level of Bridge Street will be raised (between the Potato Market and the Locke Bar). Along the cantilevered boardwalk by the Court House, glass panelling and concrete backing is proposed. Beyond the Court House, further glass panelling is proposed until King John's Castle.
B4 - King John's Castle	Do nothing

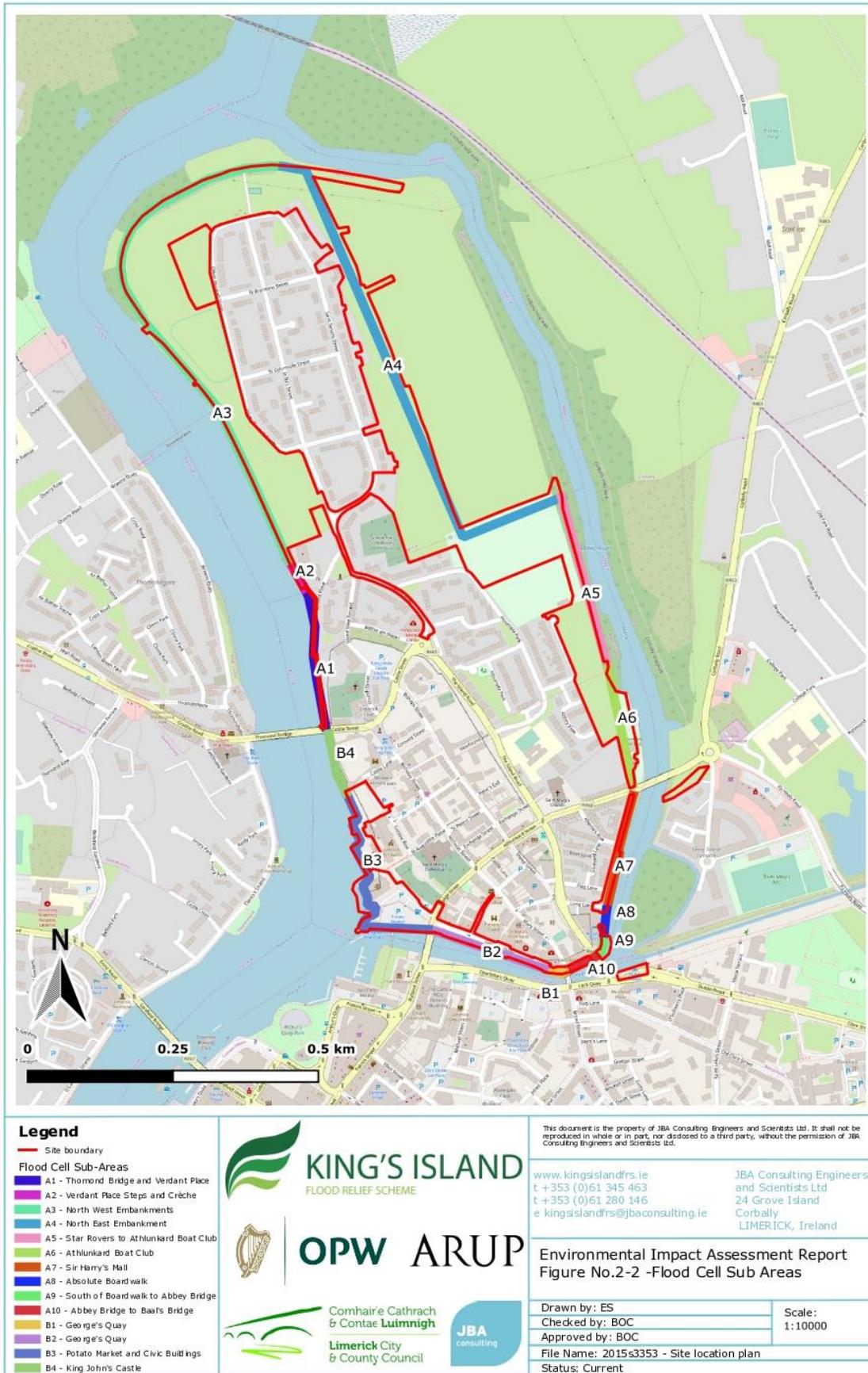


Figure 1-1. Location of the proposed defences and sub-areas



Figure 1-2. Reinforced glass panelling outside Limerick courthouse



Figure 1-3. Earth embankments in St. Mary's Park looking toward Thomond Park

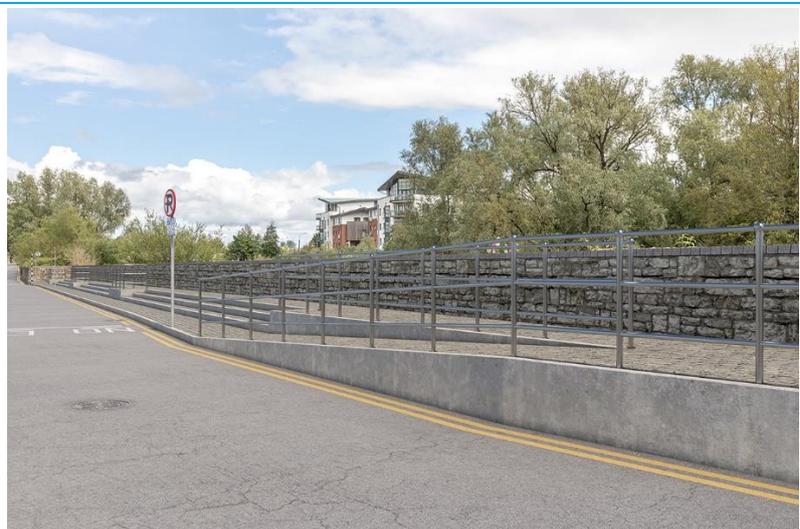


Figure 1-4. Flood defence walls at Sir Harry's Mall

Consultation

Public and statutory consultation are a requirement of projects undergoing EIAR. Statutory consultees include government bodies, regulatory bodies, non-governmental organisations and other who have an interest or responsibility in some respect to a part of the development. These consultees were identified in the Scoping stage of the EIAR. The second avenue is to consult with the public including local residents and business owners who may be impacted by the development or any member of the public who wants to provide input.

Statutory Consultation

Statutory Consultees were issued a letter and a copy of the Scoping Report by email on 21st December 2018 requesting that any comments, observations or submissions in relation to the scope and level of information to be included in the EIAR be made prior to submission. Non-statutory consultees, including NGOs, Local Authority, and local interest groups were also issued the report and were asked for feedback. Responses were received from the following:

- Coillte;
- Department of Agriculture, Fisheries, and Marine;
- Department of Culture, Heritage and the Gaeltacht (DCHG) Development Applications Unit (DAU) including National Parks and Wildlife Services (NPWS);
- Department of Transport, Tourism and Sport (DTTAS) Emergency Planning Unit;
- Electricity Supply Board (ESB);
- Fáilte Ireland;
- Geological Survey Ireland (GSI);
- Inland Fisheries Ireland (IFI);
- Institute of Geologists of Ireland;
- National Federation of Group Water Schemes (NFWGS); and
- Transport Infrastructure Ireland (TII).

Responses received from non-statutory consultees included

- LCCC Archaeology Section; and
- LCCC Planning and Environmental Services.

Responses were considered in the preparation of the EIAR and were passed onto the design team where amendments to the design were required.

Public Consultation

To date there have been four public information days (PID) on the King's Island FRS:

- Initial Public Information Day held on Wednesday 7th October 2015 in Limerick City and County Hall, with 40 people in attendance;
- Verdant Place Public Consultation Day on Tuesday 1st March 2016, held in the King's Island Community Centre which is adjacent to Verdant Place, with 36 people in attendance;
- Emerging Preferred Option Public Information Day on 20th December 2017, staged as a two-venue event, with displays in the City and County Hall during the day and continuing in the Community Centre in the evening, combined 89 people in attendance; and
- Public Information Day on 29th of August 2019, purpose of which was to explain the preferred scheme and to display the photomontage prepared to assist the Landscape and Visual Impact assessment for the project prior to submission of the planning application.

The feeling from most attendees was that a solution was needed, and whilst a particular option may not be the most appealing, for example in terms of visual impact, it is more important that flood protection is provided, and completed in a timely manner.

Assessment of Effects

Population and Human Health

This chapter assessed impacts to population and human health including 886 dwellings and 2167 people living on King's Island, as well as a number of businesses, 4 schools/colleges, 2 childcare facilities, 6 medical facilities, 2 social and 4 community facilities. Tourism and recreation amenities which would have the potential to be impacted by various phases of the development were also discussed, including King John's Castle, the Medieval Quarter, the existing walking/cycling pathways, two boat clubs, and private boat users.

The proposed development is expected to have the greatest impact to population and human health during the construction phase of the project. These impacts are predicted to be secondary impacts as a result of disruptions to traffic, noise, air quality, water quality, and landscape/visual amenity. These impacts are addressed in their respective chapters of this EIAR. There will be temporary minor impact to residential and visual amenity lasting only the duration of the construction phase (18 months approximately). The footpath around the island will be closed until the embankments and new footpath are completed, which will have an impact on recreation and tourism for the duration of the construction phase. The users of the Star Rovers FC will be affected during the construction phase, due to the temporary disruption to the sports fields. To mitigate this impact, construction will aim to take place in the off-season for the club, though it is unlikely to be completed during this time. There will be a positive impact to population and economy through the employment of construction personnel. There is also a risk to personnel employed on the site, as with any construction site, however procedures will be put in place by the contractor to mitigate for this. Mitigation measures will include a Construction Environmental Management Plan (CEMP), which will limit the effects on human beings with regards to traffic, noise, air, dust, access, landscape and visual impact, and amenity. The residual impact of the construction phase is predicted to be Slight/Temporary.

When the site is operational, the land use and zoning will be consistent with the existing land use, as these works are considered an upgrade to the existing flood defences. One part of the scheme, the embankments along the inner alignment of Area A4, have the potential to change the residential amenity and privacy in this area due to the close proximity of embankments to the rear of houses on St. Munchin's Street.

The upgrade will, however, improve the recreational and tourism opportunities on the island through the provision of a 3m wide cycle and foot path on the perimeter of St. Mary's Park. Additional positive mitigation included as part of the design include access and egress points for boat users at the north end of the island. A guarding height of 1.1m will be provided along all quay walls to ensure safety around the flood defences. The visual impact has been addressed through extensive mitigation measures as outlined in Chapter 13 of the EIAR. There will be no significant impacts to residential amenity, recreation or community facilities. Overall, the proposed development has the potential to make King's Island more desirable as a residential and business area due to the reduced risk of flooding and the new amenities. The development will also protect important tourist destinations from flooding, which are culturally and economically significant to Limerick City. No significant negative impacts are predicted during the operation phase.

Material Assets

Traffic

With a development of this nature, the only traffic impacts will occur during the construction phase, which is anticipated to be of 18 months' duration. The development will be unmanned during operation, with infrequent traffic movements to and from the site primarily for maintenance and environmental monitoring.

The results of the analysis show that the surrounding road network generally performs within capacity during the construction period of the proposed development. A number of junctions experience localised capacity issues; however, the impact on the performance of these junctions due to the proposed development is relatively small when compared to the baseline traffic flows.

Peak traffic volumes are anticipated to occur during the first year of construction, in 2021, with peak delivery and removal of material and numbers of site staff present decreasing thereafter.

Throughout the construction phase, traffic will be generated by the following activities

- Heavy Goods Vehicles (HGVs) importing construction materials;
- HGVs exporting waste/spoil materials;
- HGVs delivering plant and fuel; and
- Workforce traffic.

HGVs will travel to and from the site from the east, via the R445 and Island Road. Construction staff trips are more widely dispersed as they will not have a single point of origin. HGV traffic will generally seek to avoid peak hours, both for efficient operation of the site and to reduce the impact on the surrounding network.

The links and junctions in the network generally continue to operate within capacity during the morning and evening peak periods with the addition of this traffic. Three junctions on the network will experience capacity issues, however these are relatively small. The impact of this element of the works was therefore considered very slight and temporary in nature.

A number of mitigation measures are included to minimise the impact of the development on the local road network. These include a range of construction mitigation measures to be implemented by the contractor such as preparation of a CEMP to include a Construction Traffic Management Plan (CTMP), appointment of a traffic management coordinator, staff mobility management and a clear signage system.

In summary, the proposed development is likely to incur a slight temporary negative impact on localised sections of the road network during construction and will have no permanent impacts on the road or transport network in the vicinity of the site.

Utilities

There are five areas where disruption to services will be experienced during construction:

- In Area A6 (Athlunkard Boat Club) minor diversion of telecoms and power will be required as well as routing of the existing combined sewer through the RC flood wall at one location. There will be a provision of a new connection from the Boat Club through the RC flood wall which can be picked up by the Limerick Main Drainage Scheme, therefore a temporary disruption to the sewer network will be required.
- In Area A7 (Sir Harry's Mall) some of the exiting road gullies will be re-located.
- In Area A10 (Abbey Bridge to Baal's Bridge) diversion of street lighting ducts and underground electricity and telecom service is required, causing temporary disruption to utilities. The existing 150 mm outfall will be replaced with a 225 mm diameter pipe with a WaStop installed.
- Area B1/B2 (George's Quay), diversion of the water main and power lines is required at various points along the length of the proposed wall. The existing 150mm diameter pipes will be replaced with larger pipes. It is not expected that diversion of the concrete sewer will be required.
- Area B3 (Potato Market), it is proposed to raise the road levels at Merchant's Quay (the Potato market), other existing manholes, chambers and chamber lids relating to water, sewer, storm, telecoms and electrical services will also be raised to match the proposed road levels. Existing road gullies will be raised. The existing outfall to the south-west of the civic building will be increased in size with a WaSTOP or similar approved non-return valve installed. The existing outfall to the rear of the City Hall will be increased in size with a WaSTOP or similar approved non-return valve installed. Inter-tidal storage for existing paved areas behind the new glass panel and the wider contributing area will be provided adjacent the outfall such that flooding on the surface does not occur during high tide conditions in the Shannon.

There will be no disruptions to services when the scheme is operational.

Waste Management

There will be primarily two types of waste material as a result of this development:

- Concrete and stone material from the reconstruction of the flood walls; and

- Soil, potentially some non-hazardous and some hazardous during the implementation of the embankments.

Concrete and stone materials should be minimized in terms of materials taken offsite. This will be achieved through crushing and screening of the materials, and re-use for alternative purposes such as site access tracks. Any material that is not re-used will be brought offsite and disposed of at a licensed waste facility, as agreed with Limerick County Council and as written in the Contractor's Waste Management Plan.

Soil materials will be reused where possible in the construction of the embankments, and any material brought offsite will be required to undergo waste characterisation prior to removal. Uncontaminated soil materials can be brought to a soil recovery facility. Any materials exceeding soil trigger levels of the EPA Guidelines will be disposed of at a hazardous landfill site.

Biodiversity

The chapter concerning biodiversity assessed impacts to potential sensitive receptors on King's Island. The proposed works are located directly adjacent to the Lower River Shannon SAC and upstream of the River Shannon and River Fergus Estuaries SPA. The qualifying interests for Lower River Shannon SAC within the zone of influence are the following habitats: Estuaries [1130], Mudflats and sandflats [1140], Alluvial forests [91E0], and the following species: 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. These qualifying interests have been discussed further in the Natura Impact Statement. Other habitats and species that could be impacted include water quality, marsh habitat, ditches, treelines, wet grassland, bats, Badger, breeding birds, mining bees and the protected species Opposite-leaved Pondweed (*Groenlandia densa*).

Significant impacts at an international level are posed during construction and relate to potential disturbance on the Annex 1 habitats and species:

- Juvenile Lamprey species could be impacted during construction of flood defence walls at Areas A9 and B3 due to disruption of the river bed.
- Annex 1 water dependent habitats and species of the SAC could be impacted by potential pollution of surface waters caused by runoff from excavated soil and accidental spillage of diesel and oil.
- 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 disturbance.
- Otter and Salmon could be disturbed by a new lighting scheme along the embankment paths.
- Marsh habitat, acting as a support habitat for Annex 1 habitat Estuaries, could be disturbed by construction of eastern embankment.

Impacts at a national and local level include:

- Removal of treelines/scrub, ditches and wet grassland habitat. The removal of one of the ditches impacts at a national level on the protected species Opposite-leaved Pondweed. Breeding birds will be impacted by removal of treelines/scrub.
- Badger by closure of an outlier sett.
- Bats will be disturbed by a new lighting scheme along the embankment paths.
- Removal of sandbags along the embankments will have a temporary short-term impact on mining bees.

Mitigation measures have been proposed for the protection of juvenile lamprey (pre-construction electro-fishing and translocation), for the non-disturbance of Alluvial forest, Otter and wintering birds and for pollution control measures to be included during the construction and operation phases. Mitigation for Opposite-leaved Pondweed includes translocation into a new ditch, with equivalent hydrological conditions. Permanent closure of the outlier Badger sett will mitigate against

disturbance during construction. Planting of native trees and plants, under a vegetation management plan, and provision of replacement habitat for bees will increase nesting bird and pollinator habitat and improve overall biodiversity. It will also mitigate against disturbance to wintering birds by reducing public access to the flood plain. The lighting plan includes mitigation for Otter, bats and Salmon during construction and operation.

Operational impacts relate to water quality and success of translocation of Opposite-leaved Pondweed. These will be mitigated by vegetation and drainage maintenance and regular monitoring of the new ditch, as well as translocation/enhancement of two other sites with Opposite-leaved Pondweed in or as near to King's Island as possible, as per NPWS instructions under licence.

In conclusion the proposed King's Island FRS will not have a significant effect on the integrity of the above Natura 2000 sites and habitats and species of national and local importance.

Surface and Ground Water

This chapter is primarily concerned with impacts to the River Shannon and the Abbey River, which are influenced by the tides and make up the Limerick Docks Transitional Waterbody. Additional surface water bodies discussed included the open drains within St. Mary's Park, which are within the Lower River Shannon SAC, as well as upstream tributaries to the Shannon such as the North Ballycannon River.

King's island overlies the Limerick City North and Limerick City East groundwater bodies. Both are classified as locally important aquifers. A site investigation was completed in 2016 which determined that groundwater in the limestone beneath the island is locally confined beneath a layer of clay, and highest in the centre of the island. The available data indicates that groundwater flow is likely to be from the centre outwards and rises close to the river reflecting the tidal cycles. There are no known groundwater extractions (wells, etc.) on King's Island.

The main risks to the surface water environment during the construction phase is the potential runoff of suspended solids (such as soil and silt) and hydrocarbons to the rivers. In relation to the underlying groundwater body, the main risk is the release of contaminants from the existing soils (if contamination exists) and contamination from spills from construction machinery.

To minimise the potential impacts, mitigation measures have been proposed which recommend best practices for earthworks and concrete works in and around water. Suspended solids in runoff will be managed through consolidating earth works near banks, and through use of settlement ponds or tanks, and by conducting the large part of earthworks during periods of dry weather. Accidents will be prevented through use of spill kits on all machinery, appropriate storage of hazardous materials. Jack up rigs/ in-river works will be carefully managed through minimisation of barge movements, and through the use of netting to catch any debris falling from quay walls.

The risk of contamination as a result of a flood occurring during the construction phase will be managed through close monitoring of tide levels. Existing flood defences will be left in place until the new defences are built. It is recommended that a site-specific CEMP should be developed by the contractor to manage the construction activities. A CEMP will include protective measures, such as surface water management, material storage and hydrocarbon management, consolidation of imported soil, use of settling tanks, and ensuring that when possible that earth works are completed in periods of dry weather. Risks of spills and leaks from machinery will be mitigated through best practices and will be outlined in a CEMP.

During the operational phase, the proposed works will reduce the risk of contamination to the underlying groundwater body and surround surface waterbodies following the removal of contaminated soils within King's Island and import of clean soils. No change to the groundwater environment is predicted following completion of the proposed works.

An assessment was made to determine the impact on water levels during flood events as a result of the reduction in the floodplain. The modelling results show no net increase in water level in the river during operation of the scheme. It was found that as flooding on King's Island is primarily influenced by tides, that the scheme will not have an impact on water levels of the River Shannon.

Mitigation measures were included in the design to protect the surface and groundwater environment during the operation phase including the provision of filter drains to allow settlement of contaminants prior to discharging surface water runoff into the Abbey and Shannon Rivers. Erosion mitigation measures are proposed in area A4 around sheet piling works to prevent further erosion

of the bank. Further design adaptations include setting back embankments from the river's edge to limit erosion and long-term impacts on hydromorphology.

Soils and Geology

The soils and geology environments on King's Island are heavily influenced by the River Shannon and Abbey River. The soils are marine/estuarine silts to the east and northwest, poorly drained mineral soils and peaty mineral soils further inland to the northwest on the site, and made ground everywhere else. There is an unlicensed landfill to the east of St Mary's Park (which was removed by LCCC in recent years) around which the soils are partially contaminated.

Site investigations completed in the area revealed that the made ground was made up of silty clay and clayey sand with loose ash, red brick, gravel, shells and occasional glass and wood. The thickness of the made ground on the site varies between 1.0m to 5.5m thick in places.

The overburden geology is primarily limestone derived till to the north and northwest of the Island and made ground everywhere else. The overburden thickness varies across the Site from 3.0m and 11.0m, generally increasing in a south west to north east direction.

The bedrock geology is Visean Limestone (undifferentiated) and was found to be locally slightly weathered and strong to very strong. The depths to bedrock were varied across the site from depths of 3.4m bgl to 14.9m bgl. Moderately weak to strong limestone was encountered. There are no karst features on King's Island, nor are there geological heritage sites.

The scheme will require significant infilling around the border of King's Island, resulting in the import of 143,600m³ of fill material, of which it is estimated that 93,900 m³ of embankment fill will be imported. Some excavations will also be required for the construction of the wall foundations.

During the construction phase, the main potential impact is the increased risk of contamination to the soils and geological environment. Excavations will also increase the risk of suspended solid and hydrocarbon contamination. Import of fill material has the potential to impact on soil compaction due to frequent truck movements.

To minimise the risk to the soils/geological environments a CEMP will be developed by the contractor that will incorporate mitigation measures to manage contamination risks. Measures will include the management of construction material, and hydrocarbons and machinery during the construction phase. The contractor will be required to prepare a Soil Management Programme, ensure imported soils are sourced from a reputable facility, and ensure contaminated soils are sent to a waste licensed soil facility.

During the operational phase, there will be no change to the bedrock vulnerability resulting from the development. The overall soil quality will be improved and the risk of contamination to the underlying bedrock following the removal of historic contamination onsite. No mitigation measures are required during the operation phase.

Noise and Vibration

An assessment was carried out of the noise and vibration effects arising from the construction of the proposed scheme. The baseline noise environment was determined by conducting surveys at sensitive locations in the vicinity of the proposed scheme. The results of these surveys indicate that the current noise levels are dominated by traffic, pedestrians and birdsong.

The noise and vibration assessment examined multiple phases during construction including embankment construction, concrete wall / barrier construction, and associated construction traffic. This assessment showed that appropriate noise levels will be achieved if mitigation measures are closely followed. The traffic data indicates that there will be no significant noise impacts generated during the construction or operational phases.

There are no operational noise sources as part of the proposed scheme, therefore, no impact assessment was required.

During construction, the contractor will take specific noise abatement measures and comply with the recommendations set out in appropriate codes of practice. Specific measures which will be prescribed in the site-specific Construction Environmental Management Plan will be implemented during construction include the following:

- Selection of plant machinery with low potential for noise and/or vibration. All construction plant and equipment will be modern equipment and will comply with the relevant legislation and regulations.
- Regular maintenance of plant will be carried out in order to minimise noise produced by on-site operations. Silencers and engine covers will be maintained in good and effective working order.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the construction phase.
- Any compressors used on-site will be of the 'sound reduced' models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machines that are used intermittently will be shut down or throttled back to a minimum during those periods when they are not in use.
- Any plant, such as generators or pumps, which are required to work outside of normal working hours, will be surrounded by an acoustic enclosure.
- Drivers will be properly trained to ensure smooth operation, and to minimise unnecessary noise generation.
- A barrier shall be provided around construction works for certain concrete wall/barrier construction.
- A maximum speed limit of 30 km/hr will be imposed for HGVs and drivers will be instructed to maintain as far as possible the distances between vehicles.

In addition to mitigation measures, monitoring will be undertaken during the construction phase to ensure that noise is in compliance with agreed upon limits. Given the nature of the works required and the proximity of receptors to the construction works site, there may be instances where on employing all mitigation measures outlined, these noise limits may be exceeded. If and when the noise limits are likely to be exceeded as a result of the proposed works, an agreement will be made between the Contractor, Limerick City and County Council and affected residents/businesses which will allow the required works to proceed at a time which will minimise noise nuisance or disturbance of the affected residents/business.

To mitigate vibration impacts, vibration measurements shall be taken at the base of buildings, on the side facing the source of vibration. Where feasible, the measurement should be taken on a hard surface on the ground outside the building. A pre-condition survey will also be undertaken of all properties potentially affected by the works. Crack monitoring will be installed on such affected properties and monitored throughout the works.

Air and Climate

Air Quality- The background air quality in the area of the development is of very good quality and the site is located in 'Zone C' as denoted by the EPA; classified relative to the size of city and relative air quality challenges.

A construction dust assessment has been undertaken to determine whether air quality impacts are likely to arise from the construction of the proposed development. The risk of impacts from earthworks, construction and trackout was determined. Subsequently, appropriate mitigation measures have been outlined to reduce the risk of dust soiling, and impact on human health and ecological receptors.

The suggested mitigation measures include the development of a Dust Management Plan (DMP). The DMP may include monitoring of dust deposition, dust flux, real-time PM10, continuous monitoring and/or visual inspections.

Appropriate dust deposition limits during the Construction Phase have been recommended;

- Dust Deposition Rate limit = 350 mg/m²/day.
- Dust Deposition Rate limit affecting sensitive ecological receptors = 1,000 mg/m²/day

Given the nature of the proposed development, it is expected that there will be no air quality and dust impact during the Operation Phase.

Climate- Regional Climate Modelling (RCM) simulations for Ireland have predicted a number of changes to the climate by 2050 and beyond, notably:

- Significant projected decrease in precipitation. The projected decreases are largest for summer, with reductions ranging from 0% to 20%. Heavy rainfall events will increase in winter and autumn;
- Storms affecting Ireland will decrease in frequency, but increase in intensity;
- Increased incidences of high and low flow periods in rivers and lakes;
- Sea level rise by 0.5m in the OPW's Medium Range Future Scenario (MRFS) and 1m in the High End Future Scenario (HEFS);
- Fluvial floods are projected to increase by 20% to 30%; and
- Decrease in frost days by over 50%.

When options were initially developed for this scheme, each was assessed for its vulnerability to the effects of climate change. The result of the assessment recommended a managed adaptive approach which would provide flood containment measures (including the flood wall and embankment options) with built-in foundations that would allow defences to be raised in the future to allow for climate change in the MRFS.

The results of the vulnerability assessment showed that both the embankments and the RC flood walls are at a high vulnerability to the effects of climate change (primarily, sea level rise and frequent storms). However, there were measures taken at the design stage to account for the sensitivity and adaptability of the flood defence features, notably that foundations will be provided which will allow raising of the defences by up to 0.5m in the future. The embankments have also been set back from the riverbank to reduce their exposure to frequent wetting.

There are two areas of the scheme that have not been designed to be adaptable to climate change: George's Quay, and the Absolute Hotel Boardwalk. At George's Quay, the scheme defence level is already high enough to account for sea level rise in the MRFS, so no additional foundations will be provided. The Absolute Hotel Boardwalk is a small localised area, and the current scheme will not hinder future policy decisions from raising the level in this area, compromise its structural integrity, nor will it compromise the other defences.

In terms of long-term future adaptability, the installation of the proposed scheme will not structurally impact or hinder future options which may be required under the High End Future Scenario, or sea level rise of up to 1 meter. It will be possible in the future, to remove or replace the scheme, however this would be at a significant future cost, and potentially significant change to infrastructure within King's Island.

Appropriate mitigation in the form of regular monitoring, maintenance, and adaptability features can reduce this vulnerability, and properly inform the timing of climate adaptability.

The residual impact to climate vulnerability during the operation of the scheme is Not Significant in the Long Term (i.e., the appraisal period of approximately 50 year), and Adaptable to climate change. Beyond the Long Term (past the appraisal period of 50 years), the scheme is considered to be Moderately Vulnerable, and Slightly Adaptable to the effects of climate change if mitigation measures and monitoring are implemented.

Landscape and Visual

The potential landscape and visual impacts were considered for the proposed flood defence scheme.

The overall impact on the landscape character is determined through combining the sensitivity of the landscape and the magnitude of the development. In terms of sensitivity, the study area includes many elements of landscape and visual value mentioned in the LCDP i.e. open space around St Mary's Park including the river edge walkway, the sports pitches and boat clubs plus the two river corridors, the many commercial, educational, ecclesiastical, and tourism buildings to the south including the Potato Market, the Court House, and King John's Castle. The study area also includes visually sensitive receptors including residential properties in St Mary's Park overlooking the open space and resident, workers and tourists who enjoy the scenic views along the Shannon and Abbey River corridors and the views towards the prominent historical and cultural buildings. The presence of residential properties and valued landscape features in the detailed study area including visual

corridors along rivers and view towards prominent buildings gives the area a 'High' visual sensitivity rating.

In terms of the magnitude (scale, extent or degree) the construction phase is due to last for 18 months and will be carried out in phases. The temporary closure of the river edge walkway on the western side of St Mary's residential estate, the setting up of the construction compound in the northwest corner of the Island (and associated construction traffic) and the temporary closure of the Star Rovers football pitches will all impinge on the landscape amenity and tranquil character of the area for a short period of time.

In the southern part of the detailed study area the upgrading of the drainage infrastructure including the installation of proposed intertidal storage tanks, the construction to the existing river edge flood walls including the raising, cleaning, reinforcing and recladding of the walls and installation of plinth and transparent panels along St George's Quay, the Court House and Council offices will be localised and limited to the river edge terms of scale of impact. The removal of vegetation will be minimal, no bankside vegetation will be removed except for two immature trees at Athlunkard boat club, two poorly formed trees between Abbey Bridge and Baal's bridge and up to six immature trees on the western side of the Council offices. This will be short term and not have a significant effect on the character of the river corridors or the streetscape quality along St. George's Quay.

The principal elements of the proposed development which are likely to cause a permanent significant impact to the landscape character during operational phase are the proposed earth embankment within the open space which is approximately 2.0-2.5m above existing ground level with a 3m wide footpath (bitmac) and lighting (columns 6m in height), the proposed night time lighting on the embankments and the proposed increased flood defence 1.1-1.4m in height above adjacent footpath.

In terms of visual impact, no residents, recreational users or tourists within the detailed study area will experience the highest levels of adverse visual impact i.e. Profound, Very significant or Significant.

A total of 107No. residential properties will experience Moderate Adverse visual impacts before mitigation as a result of the proposed embankment, footpath and night-time lighting. A total of 167No. residential properties will have Slight Adverse visual impacts from the proposed flood defences before mitigation.

In order to mitigate visual impacts on the residential amenity in the north of the Island and on the urban landscape character in the south, certain mitigation measures were incorporated into the design as described below.

Painting the light-coloured coping in Area A1 (Thomond Bridge and Verdant Place) a darker shade of grey to reduce the levels of visual intrusion.

Raising the existing ground level in Area A2 (Verdant Place Steps and Crèche) to maintain a wall height of 1.2m above ground level to allow river edge views and painting the coping a darker shade of grey to reduce its visual intrusion.

Profiling of the embankment around St Mary's Park in Areas A3-A6 to remove the engineered appearance and give a more natural landform. The surface of the embankment will be seeded with meadow grass to ensure the appearance is as natural as possible and to match the existing ground level in the open space.

Directional lighting (Areas A3-A6 around St. Mary's Park) will be implemented along the top of the embankment with the lighting columns on the outside of the footpath to direct the light away from the adjacent SAC (in the River Shannon and between St. Munchin's Street and the Abbey River). Semi mature trees (Area A4) will be planted at the base of the embankment parallel to St. Munchin's Street and Assumpta Park to filter visibility into the rear of properties (refer to the Landscape Strategy Document). Stone finishes to existing flood wall raised in height in Areas A6 to A10 (Athlunkard Boat club to Baal's Bridge).

Along George's Quay in areas B1 and B2 the new concrete flood wall will have a flamed finish stone facing and rounded stone coping to resemble the existing small section of stone. Section of stone wall will be replaced with transparent panels to allow connectivity with the Abbey River for pedestrian and vehicular users.

Along the cantilevered boardwalk by the Court House area B3, glass flood defence panelling is also proposed. This will sit on top of a new shorter RC cantilever element which will replace the existing

cantilevered walkway. Beyond the Court House, further glazed flood defence panelling is proposed as far as the location of the existing fountain to the west of the Civil Offices. The glazed panelling will tie into high ground just south of St. John's Castle but without any direct connection to the Castle structure itself, thus avoiding any direct impact on the National Monument.

Eleven photomontages were produced for the project. They illustrate the visual effect from the eastern and western sides of the development within public locations (roads). The photomontage demonstrated that the mitigation softens the edge of the flood defences and screens their operations resulting in no reduction in the residential amenity of the properties.

After planting and mitigation measures have established within 10 years, the moderate visual impacts will be gradually and increasingly mitigated. Monitoring of the growth of the tree planting around the site boundary will be carried out during the 18-month Defects Liability Period and the subsequent establishment period to ensure any planting which has failed to establish is replaced in the next planting season.

Cultural Heritage

The proposed FRS is located partly within the historic walled town of Limerick, close to a number of archaeological monuments and protected structures including King John's Castle (a National Monument). Background research and mapping identified 111 archaeological sites within Kings Island. The planned works are taking place at the location or close to 16 of the archaeological sites. The southern half of the works are located in the historic town area of Limerick city, where there are 14 Protected Structures, 2 NIAH Sites and 3 other buildings of architectural/historical interest within or in the immediate vicinity of the proposed works area. In the north of King's Island, outside the historic town area, works are planned on greenfield areas. There are direct impacts predicted on five protected structures: Thomond Bridge, King John's Castle, the County Court House, the Potato Market and Baal's Bridge. There are visual impacts only on a further two protected structures: Mathew Bridge and Thomond Bridge Toll House. There are also direct physical and visual impacts predicted on the quay walls, which are of historical interest, but which are not protected structures. A pre-construction underwater archaeology survey will be completed outside area B3 to ensure that any previously undiscovered artefacts are dealt with in accordance with best practices.

The following mitigation measures are proposed to preserve the cultural heritage of the site:

- It is recommended to carry out archaeological testing in advance of construction at selected locations under licence to the National Monuments Section at the Department of Culture, Heritage and the Gaeltacht. Where archaeological features are encountered during the construction phase, alterations will be considered to the detailed design of the flood defences. This is recommended specifically in the following areas:
 - Area B3: Construction details are required regarding installation of the glass panels, the proposed ramp at the Potato Market and proposed new coping, and how this will interface with the historic fabric. It is recommended that the interaction should be non-intrusive, i.e., deep excavations into the historic stone should be avoided.
 - Area A10: The existing wall along the northern side of the Abbey River between Abbey Bridge and Baal's Bridge has high archaeological potential, and should be recorded (i.e., measured and photographed by an expert and nominated to be put in the Record of Monument and Places).
- During construction, full-time archaeological monitoring is required where ground disturbance occurs within the RMP Zone of Notification and in areas of archaeological potential. This includes:
 - The southern parts of the FRS
 - Within the historic town, and
 - Areas of greenfield where there is the potential to encounter archaeological features (in the vicinity of National Monuments this must be conducted under Ministerial Consent, i.e. King John's Castle and the town walls).

Interactions between Environmental Effects

The interactions between environmental effects which are expected to occur are outlined here:

Population/Human Health and Traffic

The impact on the traffic network will be highest closest to the proposed site compound at the north east of St Mary's Park. Residents in this area will be affected for the 18 months of construction and temporary traffic measures will be implemented to ensure access to their property.

Population/Human Health and Noise/Vibration

There will be increases in noise from construction plant, particularly close to the construction compound and to the embankments and walls. Residents in these areas will experience an increase in noise levels. Mitigation during construction will comprise be in the form of a screen/hoarding of 2.4m high adjacent to Areas A2, A6, A7, A9, A10, B1 & B2, B3).

Population/Human Health and Air Quality/Dust

Increase in dust and emissions during the construction phase have the potential to influence human health. To address the impacts on air quality and dust to human beings, site management will involve recording all dust and air quality complaints, taking appropriate measures to reduce emissions in a timely manner, and recording the measures taken.

Population/Human Health and Visual Amenity

There will likely be some impact on visual amenity for residents living close to the scheme particularly those in St. Mary's Park with views towards the embankment and close to the site compound in Area A3 close to Oliver Plunkett Street, and in Area A4 for residents backing onto St. Munchin's Street. In the operation phase street lighting has been directed away from the residential properties and tree planting has been included to the rear of St Munchin's street to filter views in to rear garden.

Surface/Groundwater and Biodiversity

The waterbodies surrounding King's Island are part of the Lower Shannon SAC, which is valuable habitat for a number of significant and protected species. Impacts on the waterbodies will have associated impacts with fish, mammals, and vegetation within the rivers. Mitigation measures have been recommended to reduce these impacts.

Surface/Groundwater and Soils/Geology

Groundwater and aquifer characteristics and activity are largely dictated by geology and overlying soils. Impacts such as soil compaction, water infiltration into soil, and groundwater flow are directly related to both soil and geology, and surface and groundwater.

Surface/Groundwater and Climate Change

Surface water bodies around King's Island will be directly affected by climate change through sea level rise and changes to precipitation patterns, which is projected to cause increased water levels, and higher frequency of intense storms. Sea level rise as a result of climate change has the potential to affect the scheme through frequent wetting of the defences. This was considered at the design stage.

Traffic/Transport and Noise/Vibration

It was considered whether movement of HGVs along the construction delivery route to the site compound at St. Mary's Park would cause noise and vibration impacts to nearby buildings. An assessment of the impacts from the construction and operational phase of the proposed development shows that the increases in traffic during both phases will not give rise to significant impacts. To ensure that these impacts do not arise, monitoring will be implemented during the construction phase.

Air Quality/Dust and Biodiversity

A portion of Kings Island is designated within the Lower River Shannon Special Area of Conservation (SAC). The proposed construction works will take place within the SAC in Area A4. Therefore, the sensitivity of the Area to Ecological Impacts is High. Appropriate construction phase

mitigation measures have been outlined to ensure that the potential impacts of dust on the SAC will be negligible.

Biodiversity and Landscape/Visual

Interaction with the fauna and flora was required due to the presence of the SAC protected fauna (bats, badgers and nesting birds) adjacent to the embankment on the western and eastern side it was necessary to ensure that the 6m high lighting columns were directional.

Cultural Heritage and Landscape/Visual

In the preparation of the chapter on Cultural Heritage there was interaction with Landscape and Visual. Changes to cultural heritage sites are assessed against the potential change to the landscape setting which contributes to the quality and integrity of the environment. Additionally, the style and finishes of the flood walls affects the character of the historic setting of Kings Island. Proposed treatment of the flood walls as reported in the Landscape Strategy document for the proposed scheme, was developed in consultation with heritage officers and visual impact specialist to ensure the finish blended with the historic landscape setting.

Landscape/Visual and Climate Change

The approach to climate change taken in the options appraisal phase of this development included consideration of a precautionary approach which assessed building defences that were high enough to account for the most extreme events in climate change scenarios. However, the visual and landscape impact of the precautionary approach of building to the MRFS level was considered significant, and so the managed adaptive approach was taken instead to allow for defences to be raised at some point in the future when it is deemed appropriate and acceptable.

Cumulative Effects

Cumulative Impacts are effects that result from incremental changes caused by other past, present or reasonably foreseeable developments together with the proposed development. In some cases, the identified developments are in such an early stage that there is not enough information to accurately predict the cumulative impacts, however these projects were still considered.

The following projects were considered when assessing the potential for cumulative impacts:

- Killaloe Bypass / Shannon Bridge Crossing and R494 Improvement Scheme;
- Limerick Northern Distributor Road;
- Limerick City and Environs Flood Relief Scheme;
- Castleconnell Flood Relief Scheme;
- Springfield Flood Relief Scheme;
- Opera Site, Limerick City;
- Limerick Urban Centre Revitalisation - O'Connell Street;
- Mungret Local Infrastructure Housing;
- International Rugby Experience Building, O'Connell Street;
- Corbally Housing Development, Corbally Road; and
- Orchard Site Housing Development, King's Island.

There is a potential for cumulative impacts on traffic, noise, landscape/ visual and population/human health as a result of the following:

- Opera Site, Limerick City; and
- Limerick Urban Centre Revitalisation - O'Connell Street

And a potential for cumulative impacts on surface water quality (if the construction phases are to overlap) as a result of:

- Limerick City and Environs FRS; and
- Castleconnell FRS

Mitigation measures as described in respective chapters of this EIA will be sufficient to manage the possibility of cumulative impacts arising during the construction phase.



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