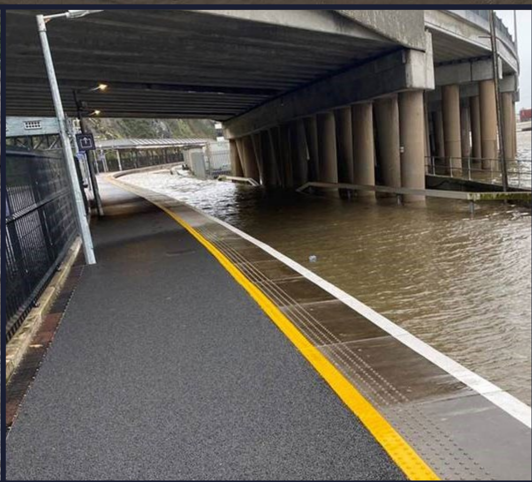

Waterford City Public Infrastructure Project
Flood Defences West

Environmental Impact Assessment Report
Volume 2 Main Text | October 2021

ROD ROUGHAN & O'DONOVAN

Comhairle Cathrach & Contae Phort Láirge
Waterford City & County Council

Údarás Náisiúnta Iompair
National Transport Authority

Iarnród Éireann
Irish Rail

Rialtas na hÉireann
Government of Ireland

Tionscadal Éireann
Project Ireland
2040

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Volume 3 Figures

Acknowledgements

This Environmental Impact Assessment Report (EIAR) has been prepared with inputs from the following team members:

Roughan & O'Donovan

Team Leaders, Report Authors and Scheme Designers

Waterford City and County Council

Overall Project Management

AWN Consulting Ltd

Air Quality and Climate, Noise and Vibration

Roughan & O'Donovan

Biodiversity, Soils and Geology, Hydrology, Hydrogeology, Population and Human Health, and Material Assets and Land

Murray and Associates

Landscape and Visual

IAC Archaeology

Archaeology, Architecture and Cultural Heritage

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1.0 Introduction

This Environmental Impact Assessment Report (EIAR) is prepared for the proposed Waterford City Public Infrastructure Project, Flood Defences West, hereafter referred to as the 'proposed development'. The EIAR has been prepared in accordance with the requirements of Annex IV of Directive 2011/92/EU (as amended by Directive 2014/52/EU), and comprises "A statement of the effects, if any, which the proposed development, if carried out, would have on the environment" (Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports, (EPA, 2017)).

This EIAR has been prepared by Roughan & O'Donovan Consulting Engineers and a team of specialist sub-consultants on behalf of the applicant Waterford City and County Council. This EIAR forms part of the application that will be submitted by Waterford City and County Council to An Bord Pleanála for their approval of the proposed development.

It should be noted that surveys, assessments and information that form the basis of this EIAR are based on the current design of the proposed development which has been developed to a stage that permits a fully informed EIA. While some developments and refinements of the current design may occur during the detailed design stage, any such iterations of the development, if approved, will not include any significant adverse impacts on the environment not dealt with within this EIAR.

1.1. Overview

Roughan & O'Donovan Consulting Engineers were appointed by Waterford City and County Council to lead the Waterford City Public Infrastructure Project. The Project is being carried out in order to improve the public infrastructure in Waterford's North Quay area to enable the redevelopment within a Strategic Development Zone (SDZ). The redevelopment of SDZ is outside the scope of this project.

The Waterford City Public Infrastructure Project consists of several separate parts, such as rock face stabilisation, access road infrastructure, new railway station and Transport Hub, River Suir Sustainable Transport Bridge which have all been granted separate planning permissions. The Waterford City Public Infrastructure Project also comprises the provision of flood protection measures to the west of Plunkett Station, the Waterford railway station. The proposed Flood Defences West will provide flood protection measures under the scope of Waterford City Public Infrastructure Project.

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, and the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City. The development extends approximately 1km to the west and 100m to the east of the Plunkett Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor which is bound to the north of the proposed development.

The development will provide protection for lands and the existing built assets in Waterford City from future flood events, such as the existing and future rail infrastructure in the vicinity of Plunkett Station and the Rice Bridge roundabout over its extents. It will also form a continuation of the flood protection measures proposed along the North Quays SDZ as part of the new Transport Hub development.

The design flood level of the proposed flood protection measures is +4.0m OD (metres above Ordnance Datum), with the top-of-the-wall flood protection measures of +4.30m OD.

A high-level description of the proposed development is provided below:

- Construction of c.365m of impermeable shallow underground trench (0.35m wide and up to 3m deep) within Iarnród Éireann's Plunkett Station car park.
- Construction of c.185m of overground flood defence measures for the R680 Rice Bridge roundabout and along the 3 roundabout arms; R448 Terminus St., R711 Dock Rd.
- Remedial works to c.75m section of existing quay wall by raising its height to between 0.6m and 1.2m.
- Construction of c.730m of sheet pile flood defence wall with the top-of-the wall level at +4.30mOD consisting of:
  - c.540m of sheet pile wall within the foreshore from the riverside, 1m from the front face of the existing quay wall.
  - c.190m of sheet pile wall will be installed on Iarnród Éireann land, 1m behind the existing quay wall. Construction of c.20m underground isolation structure comprising of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers to the structure should these be required to be implemented during a flood event.
  - Demolition of up to 3m of existing quay wall at transition point between the landside and riverside sheet pile wall.
- Drainage works will consist of:
  - Remedial works to the existing drainage outfalls to the River Suir.
  - Construction of new trackside drainage and groundwater drains to include 2 no. pumping stations and surface water outfalls to the River Suir.
  - Demolition of c. 540m of existing quay wall south of the railway corridor to approximately 800mm below the existing ground level. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level to facilitate the construction of a surface water pumping station.
- And all ancillary works.

Detailed description of the proposed development is provided in Chapter 4 Description of Proposed Development in EIAR Volume 2. The location of the proposed development is shown in Figure 1.1 in Volume 3 of this EIAR.

1.2. Requirement for an EIAR

The planning application for the development of the Flood Defences West project is being submitted under Section 175 and Section 226 of the Planning and Development Act 2000 (as amended).

Section 175 (1) and 175 (3) states:

"175 – (1) Where development belonging to a class of development, identified for the purpose of section 176 , is proposed to be carried out –

by a local authority that is a planning authority, whether in its capacity as a planning authority or in any other capacity, or

by some other person on behalf of, or jointly or in partnership with, such a local authority, pursuant to a contract entered into by that local authority whether in its capacity as a planning authority or in any other capacity.

175 – (3) *Where an environmental impact assessment report has been prepared pursuant to subsection (1), the local authority shall apply to the Board for approval."*

Section 226 (1) states the following:

"226.—(1) Where development is proposed to be carried out wholly or partly on the foreshore—

(a) by a local authority that is a planning authority, whether in its capacity as a planning authority or otherwise, or

(b) by some other person on behalf of, or jointly or in partnership with, a local authority that is a planning authority, pursuant to an agreement entered into by that local authority whether in its capacity as a planning authority or otherwise, (hereafter in this section referred to as "proposed development"), the local authority concerned shall apply to the Board for approval of the proposed development."

The proposed development is being carried out by Waterford City and County Council and will involve the construction of c. 1.1km of flood defence measures, parts of which will be developed within the foreshore, and therefore the application will be made to An Bord Pleanála for approval under Sections 175 and 226 of the Planning and Development Act 2000 (as amended).

2.0 Need for the Proposed Development

Over the past 15 years, there has been a sequence of flood events at, and in the vicinity of Plunkett Station as reported in news articles[1] and observed by the Iarnród Éireann (IÉ) Inspection Staff – the latest being in October of 2020 (see Plate 2.1 below). It has been found that large sections of the existing quay wall are of inadequate height and are below the design flood level, rendering it ineffective at protecting IÉ lands and associated rail infrastructure against flooding.

[1] www.journal.ie published an article on the 17th of Oct. 2012 entitled 'Waterford train station is flooded… very flooded".

www.theirishindependant.ie published an article on the 11th of March 2008 entitled "Escaping in the eye of the storm" and describes that rail services at the existing Plunkett train station were affected sue to flooding resulting in bus transfers to be put in place.

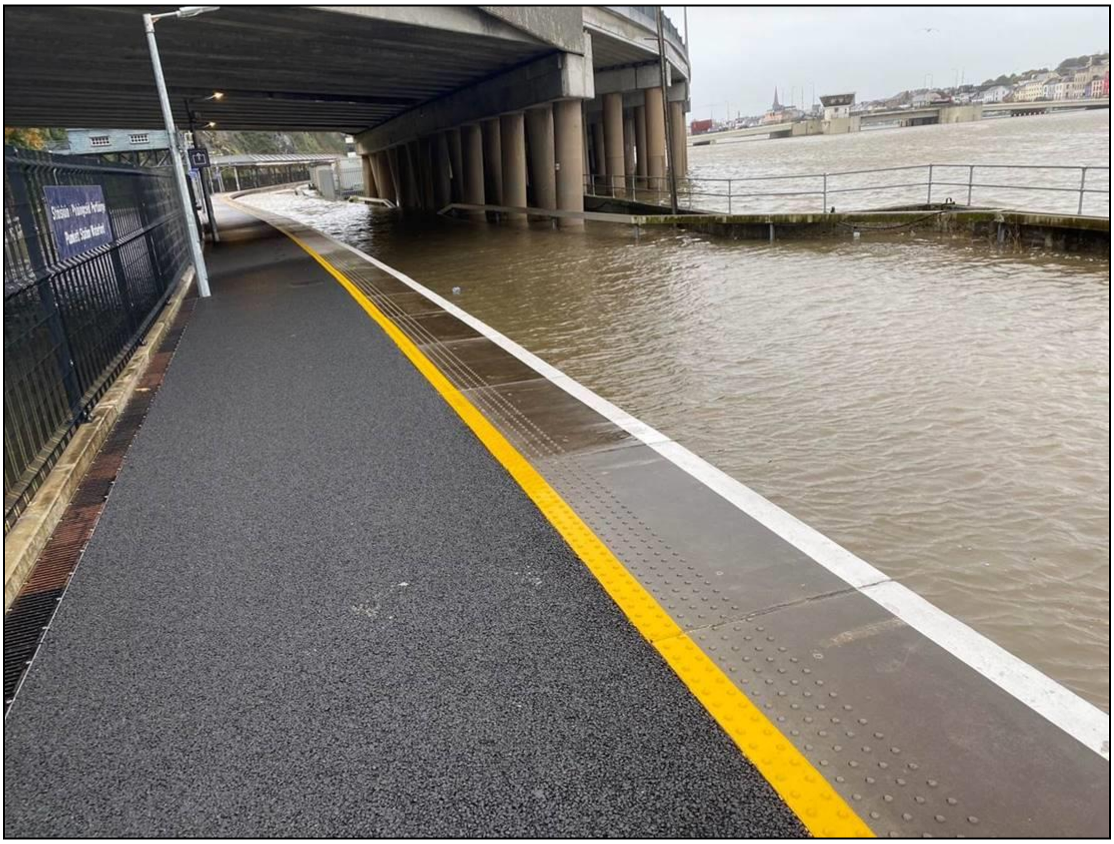

Plate 2.1 Flooding at Waterford (Plunkett) Station in October 2020

Flooding of the existing railway line at and to the west of Plunkett Station impedes on the operation of the railway service to and from Waterford City and has the potential to damage the rail infrastructure. The need for protection of the existing infrastructure and to build resilience against climate change induced flood events is outlined at national, regional, and local planning policy, specifically within the planning and guideline documents listed in Table 2.1. The development of flood defence measures will enable future development of the Waterford North Quays in a sustainable manner as well as preserving the existing rail infrastructure in proximity of Plunkett Station. The proposed development will also facilitate the upgrade of rail infrastructure proposed as part of the separately approved SDZ Transport Hub.

Table 2.1 Overview of Policy Documents which Support the Proposed Development

Policy Level	Policy Document
European	The EU Floods Directive
National	Project Ireland 2040, National Planning Framework and National Development Plan, 2018 – 2027;
	Investing in the Transition to a Low-Carbon and Climate-Resilient Society 2018-2027
	National Adaptation Framework: Planning for a Climate Resilient Ireland
Regional	Southern Regional Spatial and Economic Strategy (S-RSES)
Local	Waterford City Development Plan 2013-2019 (as extended)
	Kilkenny City and County Development Plan 2021 – 2027
	Ferrybank Belview Local Area Plan (LAP) 2017 – 2023

Policy Level	Policy Document
	Waterford North Quays SDZ Planning Scheme 2018
	Climate Change Adaptation Strategy 2019 – 2024

3.0 Alternatives Considered

3.1 Constraints

The main physical and environmental constraints within the study area include the existing railway line to the north, the River Suir and the existing quay wall to the south. The River Suir also forms part of the Lower River Suir Special Area of Conservation (SAC). The aforementioned constraints allowed for a limited number of options to be developed and considered as part of the assessment of alternatives. Two options, Option A and Option B were developed as part of the option selection process.

Table 3.1 provides the description of the two options considered, which both commence in front of the Plunkett Station and continue westwards in parallel to the alignment of the existing quay wall, see chainage (Ch.) reference points in Table 3.1. The design of the preferred option has been further developed since the options assessment stage, which is why the description of proposed works in Section 4 of this Report and in Chapter 4 of the EIAR is slightly different to either of the options presented below.

Table 3.1 Description of Options Considered

Chainage (Ch.) see Note 1	**Option A**	**Option B**
0.000 to 0.270	No works are proposed at this location as part of Options A and B as the existing flood wall between Chainage 0.000 and 0.270 is of sufficient height (i.e., above the design (top-of-wall) level of +4.3mOD).	
0.270 to 0.370	**Remedial Works to Exiting Masonry Flood Wall** Raising of the existing masonry flood wall for c.100m to add between 0.7m and 1.3m in height is proposed as part of both options.	
0.370 to 0.520	**Riverside Sheet-Pile Flood Defence Wall** This section requires the construction of approximately 150m of new flood defence wall within the foreshore of the River Suir for both options. The sheet pile wall would be constructed approximately 1 metre in front of the existing quay wall (riverside) in the River Suir mudflats and the gap between the new wall and the existing quay wall would be backfilled with fill material. The reason for placing sheet piles in river in this section is due to requirements for minimum clear distance from rail tracks to the nearest structure that have to be respected according to Iarnród Éireann guidelines.	
0.520 to 0.950	**Landside Sheet-Pile Defence Wall (nightworks)** Construction of a sheet piled flood defence wall on land between the existing quay wall and the rail tracks, typically 1.0m behind the existing quay wall. The works will not encroach into the foreshore of the River Suir. As part of Option A, the works will be completed overnight (between 21.30 to 05.30	**Riverside Sheet-Pile Flood Defence Wall** Construction of a new flood defence wall located within the foreshore of the River Suir. This section of the driven sheet pile wall will be constructed from the riverside. The sheet pile wall would be constructed approximately 1.0m in front of the existing quay wall in the River Suir mudflats and the gap would

Chainage (Ch.) see Note 1	**Option A**	**Option B**
	hours) due to the requirement for possessions of the railway line. These reduced working hours will prolong the construction programme.	be backfilled with fill material. This would be a continuation of the sheet pile wall constructed between Chainages 0.370 and 0.520 section using the same method. Minimal night-works and rail possessions are required.
0.950 to 0.1090 and isolation structure	**Landside sheet piles** Construction of a sheet piled flood defence wall on land between the existing quay wall and the rail tracks for both options. The works will not encroach into the foreshore of the River Suir. The works are envisaged to be undertaken during the day with a temporary fence separating the works from the railway tracks and will therefore not affect IÉ rail traffic. The underground isolation structure across and under the rail-line will be constructed 950m from the Plunkett Station. The structure will be approximately 25m in length and will require nightworks and track possessions.	
0.000 to 0.1090	**Drainage.** Upgrade of drainage system and outfalls. Replacement/ provision of flap-valves on existing and proposed back-of-wall drainage. New drainage will be limited to the relief of any trapped groundwater behind the new wall. No alteration or addition to existing land drainage is proposed.	
Notes	Note 1: The design of the preferred option has been further developed since the options assessment stage, which is why the description of the proposed development in Section 4 of the NTS and in Chapter 4 of the EIAR Vol 2 has slightly different chainages to either of the options presented. Further design considerations implemented for the proposed development are summarised in Section 3.3 of the NTS and detailed in Chapter 3 of EIAR Volume 2.	

3.2 Multi-Analysis Criteria Applied

A methodology was developed for the assessment of the two flood defence options considered. Options A and B were assessed in accordance with the Common Appraisal Framework (CAF) criteria of Safety, Economy, Integration, Environment, Accessibility & Social Inclusion, having regard to the associated sub-criteria outlined in the Transport Infrastructure Ireland's (TII) *'Project Appraisal Guidelines for National Roads Unit 7.0 – Multi Criteria Analysis'*. The options considered were not assessed under the Physical Activity criteria as they are considered to be very similar, with the adjacent lands being either within Córas Iompair Éireann (CIÉ) ownership which are not accessible to the public, or mudflats which are unsafe for public access. As such, the proposed options will not impede on any existing cycling/walking infrastructure, nor will they provide any additional infrastructure to enhance physical activity in the area.

While the two options were found to be comparable for most of the MCA criteria, the main differences arose under the following sub- criteria:

- Under the heading of Economy:
  - Construction and Cost
  - Constructability
- Under the heading of Environment:
  - Noise and Vibration
  - Landscape and Visual
  - Biodiversity

- Soils and Geology

Taking into consideration the impact assessment of the proposed flood defence options under the MCA sub-criteria of land and cost, constructability noise and vibration, biodiversity and soils and geology, Option B was identified as the preferred option.

The larger extent of landside works proposed as part of Option A presented constraints both from economical, constructability and biodiversity perspectives when compared with Option B. In terms of biodiversity, the extended night-time works, and construction programme proposed as part of Option A is likely to cause disturbance to the Lower River Suir SAC over a longer period, and thus, will cause a slower recovery time. However, Option B will result in a greater habitat loss when compared with Option A.

Option A requires an installation of sheet piles from the landside over a larger area than Option B and will require longer night-time works that introduce greater complexity in terms of constructability, increased construction duration and health and safety risk. The longer night-time works required for construction of Option A are also likely to have a greater impact on noise sensitive receptors. Economically, the landside sheet piling installation over a longer distance proposed is more costly than driving sheet piles from a barge as proposed as part of Option B. Option B requires greater import of fill to backfill the gap between the new riverside sheet pile wall and the existing quay wall when compared to Option A. As such, Option A is preferred under the soils and geology sub-criteria, however the overall volumes of imported fill, and thus the significance of the impact, are very small to start with.

Option B is also seen as advantageous as it removes the risk of the existing quay wall, which is in poor condition, from collapsing into the River Suir, and avoiding any subsequent impacts to the Lower River Suir SAC over the design life of the proposed development.

Option B was therefore selected as the Preferred Option.

3.3 Further Design Considerations

As noted in Section 3.2, a number of design changes have been introduced to the design of the proposed development since Option B was determined as the preferred option in the option selection process. The main changes which have been made to Option B and which now form part of the design of the proposed development described in Section 4 of this NTS and in Chapter 4 Description of the Proposed Development (see, EIAR Volume 2) are as follows:

- Very minor changes in the alignment of the sheet pile wall have been introduced upon further review of the existing topography, quay wall geometry and condition and other obstacles.
- The extent of the concrete wall required to be remediated was reduced from 100m in length, to 75m.
- Inclusion of underground flood protection measures in a form of an impermeable trench in front of Plunkett Station. Measures to protect IÉ infrastructure and associated utilities from groundwater seepage were deemed necessary after reviewing further available groundwater monitoring data.
- Inclusion of overground flood protection measures for the Rice Bridge Roundabout in the form of glass flood barriers and demountable flood barriers.

- Drainage design and description is at a more advanced level compared to the options stage. However, no fundamentals were changed, and the drainage elements described as part of Options A and B have been retained. The vast majority of drainage works are the same for both options.

The design changes outlined above are stand-alone construction elements, and it is very likely that they would have been identical in Options A and B and as such, would not have affected the option selection process.

4.0 Description of the Proposed Development

Chapter 04 in Volume 2 of the EIAR provides a description of the proposed Waterford Flood Defences West which is summarised below.

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, and the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City, refer to Figure 1.1 in Volume 3 of this EIAR. The development extends for approximately 1km to the west and 100m to the east of the Waterford (Plunkett) Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor located to the north of the proposed development.

The proposed flood defence measures are for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval, eliminating the risk of flooding to the Transport Hub.

An overview of the structural elements of the proposed development is provided from east to west below, and should be read in conjunction with Figure 4.1 to Figure 4.6 in Volume 3 of this EIAR:

- Construction of c.365m of underground flood defences (an impermeable shallow trench approx. 0.35m in width and up to 3m in depth) from Ch.0.0 to Ch.365 to cut off the potential groundwater seepage during high tide events. It is possible that parts of these underground flood protection measures may be omitted during detailed design or may be implemented on a phased basis depending on the ongoing groundwater monitoring results.
- Total of c.185m of overground flood defences from Ch.0.40 to Ch.210 consisting of:
    - c.170m of glass flood barrier on the river side of the road edge vehicular parapets on Rice Bridge roundabout and along the 3 roundabout arms (R680 Rice Bridge, R448 Terminus St. and R711 Dock Rd).
    - c.15m of demountable flood barriers on the R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.
- Remedial works to the existing quay wall from Ch.285 to Ch.360 by raising its height by 0.6m to 1.2m to conform with the design top-of-wall level of +4.30m OD.
- Construction of a sheet pile flood defence wall from Ch.360 to Ch.1090, with the top of wall at +4.30 mOD, to protect against overground flooding and underground groundwater seepage:

  - From Ch.360 to Ch.900 the sheet pile wall will be installed within the foreshore from the riverside, 1m from the front face of the existing quay wall. The space between the sheet pile wall and the front face of the existing quay wall will be filled with clean imported granular fill. The intertidal zone of the sheet pile wall within the foreshore will be fitted with pre-cast concrete cladding material ("eco-seawall").
  - From Ch.900 to Ch.1090, the sheet pile wall will be installed on land from the landside, 1m behind the existing quay wall.
  - The demolition of minor localised section of existing quay wall (max length of 3m) will be required in order to connect the in-river sheet piles with the landside sheet pile walls at Ch.900.
- Construction of c.20m of underground isolation structure at Ch.1090, consisting of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event.

Drainage works will be carried out for the entire extents of the proposed flood defence measures i.e., from Ch.0.0 to Ch.1090 as shown in Figure 4.11 to Figure 4.20 in Volume 3 of this EIAR:

- Remedial measures to the existing drainage outfalls to the River Suir from Ch.0.0 to Ch.1090 by extending them to reach an outlet within the new sheet pile wall, or to be retrofitted to pass through the new sheet pile wall, into the River Suir.
- In the vicinity of Plunkett Station, from Ch.0.0 to Ch.470, new trackside drainage and groundwater drains are included in the upgraded drainage works, which will include a pumping station (at approx. Ch.380) and a new surface water outfall structure in the River Suir at Ch.390.
- From Ch.370 to Ch.1090, new drainage system will be installed for trackside drainage and also to allow groundwater cut -off behind the sheet pile wall to drain to the River Suir with 2 No. new outfalls to the River Suir terminating at the front face of the proposed flood defence sheet pile wall (at Ch 550 and Ch.900). The works will also include the construction of pumping stations at Ch.390 and Ch.550 respectively.
- Existing surface water outfalls at Ch.470 and Ch.490 which extend into the riverbed will be demolished to allow installation of the new flood defence wall; these will be replaced by new surface water outfall structures in the River Suir.
- Demolition of the existing quay wall to approximately 800mm below the existing ground level and removal of handrails from Ch.360 to Ch.900 where it is level with or above, the existing ground level. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level will be required in order to facilitate the construction of a surface water pumping station at Ch.390.
- All drainage outfalls (new and existing) will be fitted or retrofitted with non-return valves to prevent tidal water ingress.

Table 4.1 Overview of Proposed Flood Defences West

Chainage	Proposed Works
Ch.0.0 to Ch.365	Construction of an impermeable trench
Ch.0.40 to Ch.210	Construction of overground flood defences at Rice Bridge Roundabout.
Ch.285 to Ch.360	Remediation of existing quay wall
Ch.360 to Ch.1090	Construction of sheet pile flood defence wall
Ch.0.0 to Ch.1090	Drainage works

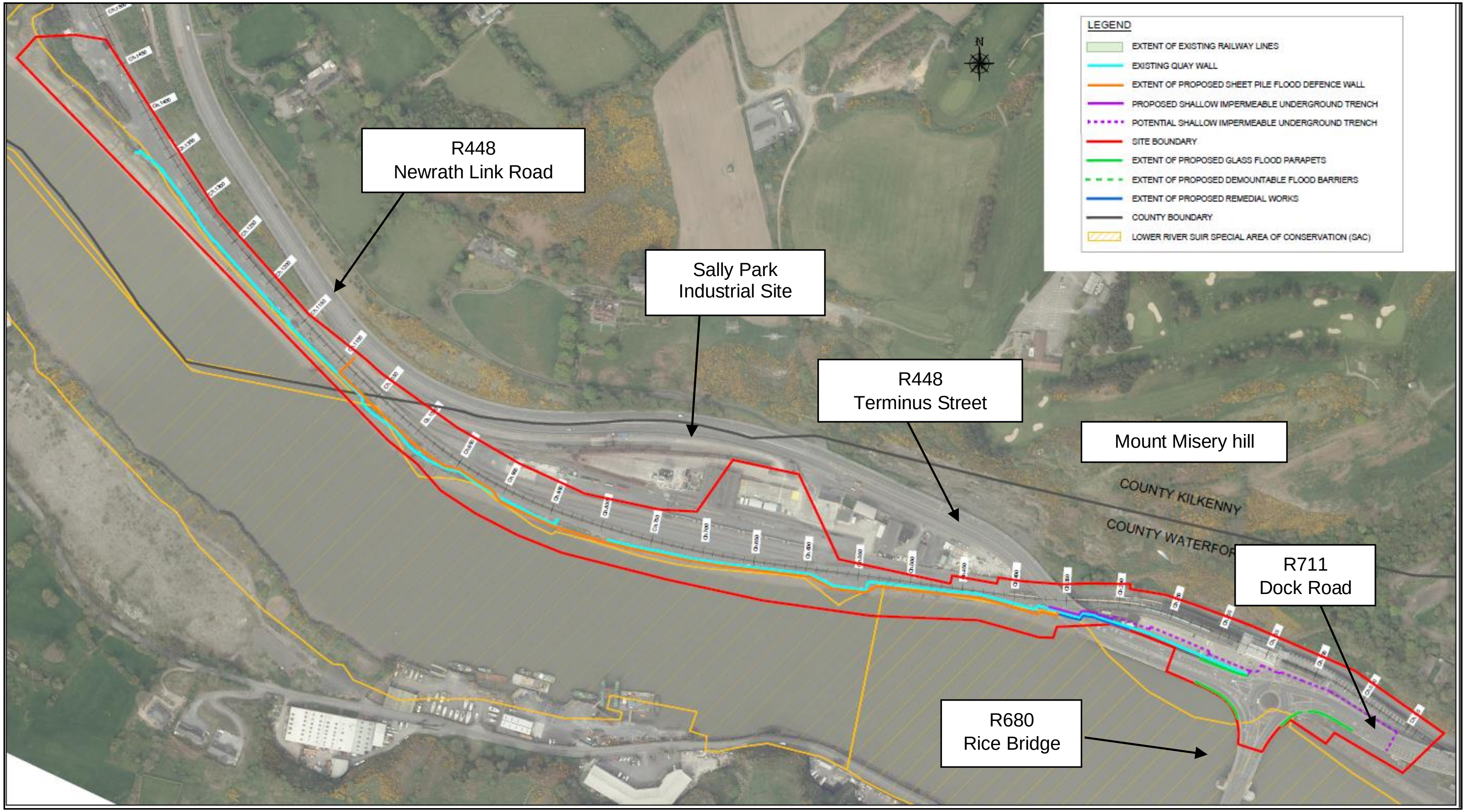

Plate 4.1 **Location of proposed Waterford City Public Infrastructure Project - Flood Defences West (Scale: 1:1400)**

The main temporary construction compound area is situated at Ch.1340, approximately 300 m northwest of the proposed development works, in a very wide cess area between River Suir and rail lines. The land is in Córas Impair Éireann (CIÉ) ownership and is operated by Iarnród Éireann (IÉ). A public level crossing is situated nearby which facilitates access to the works area.

An ancillary site compound is proposed in the IÉ's Sally Park yard at Ch.640.

See Figure 4.21 in Volume 3 of this EIAR for locations of the temporary main and ancillary construction compounds.

No construction traffic will be permitted to enter the construction site via Waterford City Centre. Material and machinery for remedial works to the existing quay wall and impermeable trenching will be routed from the ancillary compound at Sally Park depot via R448 (Terminus Street) to the works area in front of the Plunkett station. It is envisaged that the loading of the pontoon with the steel sheet piles can be carried out by crane over the riverbank from the main construction compound area. From the main construction compound, the machinery can also track down the cess into the working area for the purpose of landside sheet piling and associated drainage works.

Environmental Management Plans have been drafted as part of this EIAR which will be finalised by the successful contractor prior to any demolition, excavation or construction phase to ensure commitments included in the statutory approvals are adhered to.

5.0 Traffic Analysis

The traffic assessment determines the additional traffic loading resulting from the construction stage of the proposed development and considers the potential impact on the surrounding road network and traffic conditions. Appropriate traffic management measures are then identified.

The proposed works will be carried out on both the riverside and the landside. With the exception of overground flood defence measures proposed for the Rice Bridge roundabout, the landside works will be carried out within the Iarnród Éireann (IÉ) lands.

Considering the anticipated construction phase sequences for the proposed works, the peak of the HGV traffic load is estimated to occur for a total of 7 weeks of the 30-35-week construction programme. The peak loads are associated with the coinciding construction timeframes for construction of the impermeable trench, the sheet pile wall, installation of cladding and drainage works which will result in an increase in the number of HGVs on the existing road network of between 26 and 32 HGV movements/day over 7 weeks. Lower construction traffic movements are expected during the remainder of the construction programme, ranging from 4 to 20 HGV movements per day.

At the peak of the construction stage, the proposed development will result in an 0.1% increase in total traffic movements and an increase of 1.2% in HGV movements over the course of a working day on the R448 Terminus Street. This is likely to have *negative, temporary, not significant* impacts on the existing road network.

There are no predicted impacts on traffic as a result of the operational stage. Periodic maintenance works will be required during the operation phase of the proposed development however these works are not likely to generate significant volumes of traffic. The proposed development will protect the existing rail and road infrastructure within the site boundary from future flood events, which will have a *positive, permanent* impact on transport.

6.0 Population and Human Health

The EIAR has considered and assessed the likely significant effects with regard to population and human health associated with both the construction and operational phases of the proposed Flood Defences West. The proposed development is located in two Electoral Divisions (EDs), Ferrybank and Kilculliheen. According to the 2016 census, the total combined population residing within these EDs was 6,104 persons. Together, both EDs comprise the Waterford City suburbs north of the River Suir. The land uses within the footprint of proposed development is mainly industrial, focused on rail infrastructure to include the Waterford rail corridor and Plunkett Station, with road infrastructure encompassing the Rice Bridge roundabout and approach roads at the eastern extents of the development.

The assessment has found that construction activities may impact on journey times during specific periods as part of construction works for both roads and navigational channel users. Temporary traffic management arrangements are to be implemented to facilitate ongoing access for road users throughout the works. The potential impacts are likely to have *negative, temporary, not significant* impacts on the existing road network. Access will be maintained on the navigational channel throughout the construction phase. All boat users including search and rescue organisations vessels will continue to have access as required, therefore *no significant* impact on marine journey times is likely.

Access will be maintained to Plunkett Station and properties throughout the construction phase therefore no severance is predicted. Pedestrians will experience *imperceptible, neutral, temporary* severance.

It is envisaged that that the proposed development is a sufficient distance away from the Waterford City Core economic area that impacts to amenity and journey characteristics will be limited during the construction phase. Impacts / disruptions resulting from temporary noise, and visual disruption may impact sensitive sites such as hotels and other commercial properties in the vicinity and are likely to have a *negative, slight to moderate temporary* impact on economic operators.

Emissions from the construction activities such as dust and risk of accidents were found to potentially have negative, temporary impacts. Noise emissions from construction activities such as plant and machinery on site is likely to have *negative, slight* to *moderate* impact on all sensitive receptors. However night-time piling works may cause a *negative, significant* and *temporary* impact on some residential properties (see Chapter 12 Noise and Vibration in EIAR Volume 2). Whilst the entire programme of works is expected to last approx. 7 months, individual activities such as piling will likely last for a smaller percentage of the entire programme (approximately 4 weeks of night-time piling is required) and as such, these exceedances will not be occurring continuously throughout the construction phase. The piling works are expected to take place at a range of distances from the sensitive receptors.

All construction stage impacts will be temporary in nature and reduced and managed by Construction Environmental Management Plan (CEMP) and associated Environmental Operating Plan (EOP) and Construction and Demolition Waste Management Plan (CDWMP) and the range of mitigation measures of this EIAR.

The operation of the proposed development is expected to have *positive, long-term* impacts on the population and human health of the City and South East region, by reducing flood risk. The proposed development supports the national, regional and local policies and is seeking to protect the existing built infrastructure, such as the existing Plunkett Station and the associated rail infrastructure from flood damage. The proposed development will also support the sustainable growth of Waterford City on the north side of River Suir by minimising future flood risk attributed to climate change.

The development will also benefit the adoption of sustainable transport for the population's journey characteristics, journey amenity and general amenity due to the improvement in transportation infrastructure's resilience to climate change.

7.0 Biodiversity

The natural environment in the Zone of Influence of the proposed development was examined through a combination of desk studies, consultations and field surveys. Eight ecological receptors of Local Importance (Higher Value) or above are likely to be impacted upon by the proposed development. These are:

- River Suir, including Annex I 'Estuaries'
- Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide'
- Shoreline Habitats, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)'
- Fish Species, including Annex II migratory species
- Otter
- Bat Species
- Invasive Alien Species
- Nationally Designated Sites

The potential impacts of the proposed development on the Key Ecological Receptors above were characterised and their significance was assessed. Where negative impacts were identified, mitigation measures have been proposed to avoid or minimise these impacts. Enhancement measures have been proposed to maximise the Biodiversity value of the proposed development, in accordance with national, regional and local policy, and ensure that there will be No Net Loss of Biodiversity.

Provided that the proposed development is constructed and operated in line with the mitigation described in Chapter 7 Biodiversity (see EIAR Volume 2), and the accompanying Natura Impact Statement, there will be no significant residual impacts on Key Ecological Receptors, either from the proposed development itself or in combination with other plans or projects. While there will be a loss of approximately 800m^2 of two European protected habitats, namely 'Estuaries' and 'Mudflats and sandflats not covered by seawater at low tide', there will be no effect on any European designated sites or the conservation status of these habitats nationally.

Based on the assessment of the pre- and post-mitigation impacts from the proposed development, including the ecological enhancements, the overall conclusion is that there will be No Net Loss of Biodiversity within the Zone of Influence as a result of the proposed development. Furthermore, the final specification for the eco-cladding ("eco-seawall") presents an opportunity to achieve an overall Net Gain for Biodiversity in relation to the Flood Defences West.

The Natura Impact Statement for the proposed development concluded, in view of best scientific knowledge and the Conservation Objectives of the relevant European designated sites, that the Flood Defences West, either individually or in combination with other plans or projects, will not adversely affect the integrity of the Lower River Suir SAC, the River Barrow and River Nore SAC, or any other European site.

8.0 Soils and Geology

This chapter describes the natural characteristics of the receiving environment, in terms of soils and geology. The likely significant impacts of the proposed development on these resources are assessed and where required, mitigating measures are put in place to avoid, reduce or minimise the impact of the proposed development.

The historical maps show that up to the 1850s, the landuse within the area of proposed development was a mix of unused and agricultural lands. With the introduction of the rail infrastructure in the second half of 19th century, the land use was changed into railway and the old shoreline was slightly extended and fortified with a quay wall.

The bedrock geology consists of slates, shales and siltstones of Ballylane Formation over the eastern two thirds of the proposed development area, and conglomerates and sandstones of Carrigmaclea Formation at the western third of the area. The bedrock is typically found in excess of 10m below ground level, except in front (to the south) of Plunkett station where it is shallower due to the proximity to Mount Misery Hill. The quaternary sediments typically consist of Made Ground (thickness increasing west to east) overlying thick layers of soft sandy and silty alluvium, overlying modest depths of glacial overburden, overlying bedrock.

The contamination testing uncovered no hazardous material, with some samples exceeding inert and increased Waste Acceptance Criteria (WAC) limits.

Relatively little excavation and fill importation is required for this project given its size, due to design relying on significant lengths of driven steel sheet piles. As a consequence, the impacts from excavation and importation of material are assessed as *non*-significant *permanent negative*, mostly due to need for imported backfill for the gap between the proposed riverside sheet pile walls and the existing quay wall and for suitable drainage material. This is further mitigated by the reuse of the excavated material, either as landscaping across the site, or reuse of excavated material when forming impermeable trenches.

Installation of the sheet pile wall will also create *slight permanent positive* impact by controlling the transport of sediment and contamination across the rail yard and into the River Suir and preventing further fouling of the mudflats from collapsing parts of the quay wall.

Mitigation measures are incorporated through the design of the proposed development, while further specific measures are proposed, including the preparation of a project-specific Construction Environmental Operating Plan (CEMP) by the Contractor to address potential construction related impacts.

Following mitigation measures, the residual impact on soils and geology will be negative, non-significant and permanent as a result of covering the soft silts in the mudflats with imported backfill. In addition, residual impacts will be positive, slight and permanent as a result of preventing the uncontrolled debris from further quay wall deterioration from reaching and fouling the mudflats.

9.0 Hydrogeology

The EIAR considers and assesses the likely significant effects with regard to Hydrogeology associated with both the construction and operational phases of the proposed Flood Defences West.

Excavation of made ground will take place during the construction of the proposed development for the construction of shallow underground impermeable trenches within the car park areas of Plunkett Station, and for the installation of two pumping stations within the live Waterford to Dublin railway corridor. The excavation of any localised areas of ground contamination for disposal off-site at suitably licensed facility will improve the quality of soils which will have a corresponding benefit to the underlying groundwater resources due to the removal of a potential source of contamination for percolating water. Therefore, the likely impact of excavation activities on hydrogeology is *positive, slight* and *permanent*.

There is a risk that the contaminants present in the made ground across the site may be brought to the surface during excavation works or driven down into underlying aquifer. The impact associated with driven piles is slight, as contaminated material will be dragged down into the underlying soil layers by shaft friction, however the displacement of these contaminants is not likely to be significant. The potential impact is *negative, slight* and *short-term*.

The Lower River Suir SAC is hydrologically linked to the proposed development as a section of the proposed flood defence measures is located within the mudflats of the SAC. Given that this SAC is predominantly a surface water system and is not sensitive in relation to groundwater flows, the main potential impact would relate to construction related contamination of the aquifer impacting the SAC water quality. The potential impact to the Lower River Suir SAC water quality from construction related groundwater contamination would be *negative, imperceptible* and *temporary*.

During the operation phase, the proposed steel sheet pile wall will be installed to a depth of up to 8.5m for landside and between 11 – 16m for the riverside sections and may act as a barrier for natural groundwater flow towards the River Suir during low tide and may locally impact groundwater levels. While the groundwater seepage into the river at a local level may be restricted, it will be of minimal significance given that the majority of the outfall into the river is from precipitation and surface run-off from stormwater conveyance systems. Groundwater flow and seepage behind the proposed sheet pile wall will be redirected to the east and west behind the sheet pile wall. Any localised groundwater conduit flow will be managed by the upgraded trackside drainage. The potential effect of proposed development on groundwater flow is likely to be *negative, localised, imperceptible to slight,* and *permanent*.

During extreme weather events, the proposed sheet pile walls and the underground impermeable trench will reduce the risk of groundwater seepage into the rail infrastructure. The inclusion of filter drainage pipes along with the extension of existing stormwater pipes to the River Suir as part of the proposed development will help prevent backflow of the groundwater in the study area and help to mitigate flooding while only minimally impacting local hydrogeology. The significance of this impact is considered *positive, slight,* and *permanent*.

During the operational phase, the area will be an urban environment covered in hard standing (Sheet piles on the water edge with hard standing on the landward side of the piles). There are therefore no perceived activities which pose a risk of contamination to the hydrogeological features of importance during the operational phase of the proposed development.

A project-specific Environmental Operating Plan (EOP) and a Construction Environmental Management Plan (OCEMP) have been prepared for the proposed development. The EOP will cover all potentially polluting activities and include an emergency response procedure. As a minimum, the EOP for the proposed development will be formulated in consideration of the standard best practice.

Once the relevant mitigation measures are implemented, the significance of all residual impacts during construction to be considered as *negative, imperceptible* and *temporary.* As there are no mitigation measures for the operation phase of the proposed development, the residual impacts remain as per the potential impacts outlined above.

10.0 Hydrology

The headwaters of the River Suir are located on the eastern slopes of Benduff, North West of Templemore in Co. Tipperary. The Suir becomes tidal just before reaching Carrick-on-Suir and is joined by a number of rivers between this point and Waterford City including the Lingaun, Portlaw Clodiagh, Pil, and Kilmacow Blackwater. It then makes its way to the confluence with the Nore and Barrow Rivers, downstream and east of Waterford City. The Suir estuary then turns south, flowing out to sea through Waterford Harbour between Dunmore East and Hook Head.

The River Suir is tidal at the location of the proposed development. Surface water features located in the vicinity of the proposed development are located entirely within the South Eastern River Basin District. The proposed development is located within Hydrometric Area No.16 (Suir). This catchment includes the area drained by the River Suir and all streams entering tidal water between Drumdowney and Cheekpoint, Co. Waterford, draining a total area of 3,542km^2. The largest urban centre in the catchment is Waterford City.

The Flood Risk at the site of the proposed Flood Defences West has been assessed as part of this study. Previous flood studies have been undertaken as part of the PFRAMs, CFRAMS, Waterford Flood Alleviation Scheme and Waterford North Quays SDZ Planning Scheme.

Key hydrological receptors identified in the vicinity of the proposed flood defences include:

- The Lower River Suir SAC (European Designated Site);
- Ecologically sensitive surface water features and catchment systems; and,

- Flood Risk Areas.

The main potential for contaminants to enter into the hydrology environment arising from construction runoff include:

- Elevated silt/sediment loading in construction site runoff;
- Spillage of concrete, grout and other cement-based products;
- Accidental Spillage of hydrocarbons from construction plant and at storage depots / construction compounds; and
- Faecal contamination arising from inadequate treatment of on-site toilets and washing facilities.

In the absence of mitigation measures, the potential impact is *negative, temporary moderate to significant*.

There is potential for flood events to occur during the construction phase. The construction works will increase the number of people near a known source of flooding, thus increasing the potential for flood risk related impacts on human health. This has the potential to have a *negative, temporary, imperceptible to slight* impact.

During operation phase, hard flood defences, by design, cause permanent disturbance to river channels, floodplains and the flood regime. These structures can, if not appropriately designed, create an obstacle to flow, particularly under flood conditions resulting in increased flood risk and damage in the vicinity of the proposed structures. Such structures can locally alter channel morphology resulting in changes in flow velocity and water depth. These structures can also result in localised riverbed and riverbank erosion, resulting in long-term changes to the morphology of the river channel.

In relation to water quality, new surface water outfalls which collect surface water run-off from the railway area shall pass through a Class 1 by-pass separator prior to discharge to the River Suir. This will limit the potential for impacts to the water quality of receiving waterbody and has the potential to have a *positive, long term, slight to* moderate impact. Operational phase maintenance works could result in accidental spillage of paint which will be used in the periodic (approximately every 10 years) repainting of the exposed sections of the new sheet pile flood defence wall. In order to control this risk, the paint specified for this purpose shall not contain lead or tributyltin (TBT) or shall be otherwise approved for use near water. This has the potential to have a *negative, temporary, imperceptible to slight* impact.

A computational model (see Appendix 10.1 in EIAR Volume 2) was undertaken to assess the hydrodynamics of Suir Estuary and to assess the effects of the proposed development on the circulation patterns of the estuary. The conclusion reached from this analysis is that the computed velocity increases from the proposed vertical sheet piled wall are relatively small and of insufficient magnitude to produce sufficient shear stresses (i.e. generally <0.7Pa) that would result in any potential significant erosion of the permanent consolidated sediments on the channel bed and banks in the vicinity of the affected area. Fresher unconsolidated silts will be mobile under tidal ebb and flood conditions both for the proposed and existing cases and a slight reduction in silt deposition adjacent to the sheet piled wall is anticipated. This has the potential to have a *negative, long-term, imperceptible to slight* impact.

The proposed flood defences will defend lands to the north from flooding including sections of the rail line, the existing Plunkett Station and Rice Bridge roundabout. The overall predicted impact is therefore *positive, significant and long-term*.

As is normal practice with infrastructure projects, an Environmental Operating Plan (EOP) and Construction Environmental Management Plan will be finalised for the Flood Defences West. These will be developed by the selected contractor to suit the detailed construction methodology and allocate responsibilities to individuals in the construction team. In doing so, the measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the current drafts of the Plans is sufficient to allow an assessment of the anticipated impacts including residual impacts.

Following the implementation of the measures outlined in the Environmental Operation Plan, there will be a *negative, slight, temporary* residual impact on water quality during the construction of the Flood Defences West. Mitigation in place during the construction phase will limit flood risk and reduce the potential for pollution events. With the inclusion of mitigation during the construction phase, the proposed flood defences scheme will have a net *significant positive* impact.

11.0 Landscape and Visual

The landscape and visual assessment of the proposed Flood Defences West was carried out to assess the possible effects that the proposed development would have on the existing environment in terms of quality of the landscape of the area adjacent to the Suir River and what the changes to existing views are likely to be as a result of the project.

The site of the proposed Flood Defences West project is located on the north quays, approximately 0.7-1.5km northwest / west of Waterford City centre (Broad St./ Barrow St.). The proposed development is located on the northern edge of the River Suir, and stretches 100m to the east and c.1km to the west of Plunkett Station and Rice Bridge Roundabout. The site includes the existing quay wall, some of the rail lines along the quays and the area around the Plunkett Station and the Rice Bridge roundabout.

Existing views were identified through fieldwork and research, including Waterford City & County Council plans. The most important views are from residential dwellings and tourist areas, as well as those views listed in the Waterford North Quays Strategic Development Zone Planning Scheme 2018. The site is not visible from the city centre or South Quays due to R680 Rice Bridge screening the main areas of the site from view.

There are a number of visible elements in the proposed Flood Defence West that will change views of the river and landscape to some degree. The main change is the new flood defence wall along the river edge, which will be a little taller than the existing quay wall and of a different design – made out of steel with precast concrete cladding on the riverside sheet pile wall. Other visible elements of the proposed development include a system of low glass barriers and flood gates to be installed around the edges and existing railings of the Rice Bridge roundabout and repair works to the existing quay wall in specific places. The other proposed elements of the proposed development won't be visible. The Photomontages shown in Figures 11.1 to 11.12 in Volume 3 of this EIAR show computer-generated images of the new structures based on photographs of the existing landscape to show how the proposed flood defences will look if constructed.

During construction, *slight to moderate* landscape and visual impacts will occur due to the presence of the machinery required to construct the new wall and the other elements. This will include barges on the river, with construction machinery building from the river as well as the land side.

Following completion of the works, the new flood defence wall along the river edge will result in *slight negative* impacts on the existing landscape at the edge of the river. The proposed wall will be present at a level of 3.3-5.3m above the level of the existing mud flats at low tide, which is up to 2m higher than the existing quay wall and offset further into the river approximately 1m from the existing quay wall. Over time, the pre-cast concrete cladding ("eco-seawall") at the intertidal zone of the riverside sheet pile wall will become colonised with vegetation and take on more natural colouring and texture which will lessen the contrast between the new structure and the river. It should be borne in mind that the existing condition of the quay wall is poor, and the train tracks of the site are also poor-quality landscape, so this is considered slight impact.

The effect on views and visual landscape from the nearby roads, Rice Bridge and from Grattan Quay are all considered to be generally *slight, negative* and *permanent* due to the current poor quality of the existing quay wall and visual environment. It is proposed to develop the Bilberry to Waterford City Centre Greenway Link along the South Quays and Grattan Quay in the future, so allowing for this additional tourism-related use and greater sensitivity, the visual impact would be *moderate and negative* to the Greenway users.

Views from residential dwellings are somewhat more sensitive, the nearest being Bilberry Road Halting Site at approximately 180m to the south and which will experience *moderate negative* impacts on views from the entrance area to the site. Other residential receptors are further away, such as Water's Gate (300m west) and Bowefield (450m west) and have partial or indirect views of the proposed Flood Defences West so would have *slight negative* impacts on their views.

12.0 Noise and Vibration

A baseline environmental noise survey was conducted in the vicinity of the proposed development and within Waterford City in order to quantify the existing noise environment in the vicinity of the noise-sensitive locations that may be affected by the proposed development. The prevailing noise levels in the area are primarily attributed to road and rail traffic.

The noise impact assessment has focused on the potential outward impacts associated with the construction phase of the proposed development on its surrounding environment.

During the construction phase the assessment has predicted that construction noise emissions will temporarily exceed the threshold of significant effect at receptor R3 (R448 Residential Properties), when night works are undertaken for the underground isolation structure and the landside sheet pile wall (see Chapter 12 Noise and Vibration in EIAR Volume 2 for more details). This work is expected to occur for a period of 4 weeks, Monday to Friday. The resulting impact will be *negative, temporary* and *significant*. All other activities are expected to cause a *negative,* *temporary* and *not significant* impact at all receptors. A series of mitigation measures have been recommended in order to reduce the potential for impacts during the construction phase.

Due to the nature of the proposed development, there are no predicted noise emissions during the operational phase.

13.0 Air Quality and Climate

The existing air quality environment at the site of proposed development was determined using baseline monitoring data available from similar environments and indicates that levels of nitrogen dioxide, particulate matter less than 10 microns and less than 2.5 microns are generally well below the National and European Union (EU) ambient air quality standards.

The existing climate baseline was determined by reference to data from the EPA on Ireland's total greenhouse gas (GHG) emissions and compliance with European Union's Effort Sharing Decision "EU 2020 Strategy" (Decision 406/2009/EC). The EPA state that Ireland is predicted to have total GHG emissions of 59.9 Mt CO_2eq in 2019. This is 6.98Mt CO_2eq higher than Ireland's annual target for emissions in 2019. Emissions are predicted to continue to exceed the targets in future years.

Impacts to air quality and climate can occur during both the construction and operational phases of the proposed development. With regard to the construction phase, the greatest potential for air quality impacts is from fugitive dust emissions impacting nearby sensitive receptors. Impacts to climate can occur as a result of vehicle and machinery emissions. In terms of the operational phase, air quality and climate impacts are not predicted due to the nature of the proposed development. There will be no emissions to atmosphere once constructed.

The surrounding area was found to have a low sensitivity to dust soiling impacts and a low sensitivity to potential human health impacts as a result of dust emissions. As works will take place directly beside and within a section of the Lower River Suir SAC this is considered a high sensitivity area to potential dust related ecological impacts.

It was determined that there was a worst-case medium level risk of dust impacts associated with the proposed development in the absence of mitigation. Any potential dust impacts can be mitigated through the use of best practice minimisation measures which are outlined in Chapter 13 Air Quality and Climate in EIAR Volume 2. Therefore, dust impacts will be *temporary, negative, localised* and *imperceptible* at all nearby sensitive receptors. It is not predicted that significant impacts to climate will occur during the construction stage due to the nature and scale of the development and the low volume of vehicles and machinery predicted.

As the National and EU standards for air quality are based on the protection of human health, and concentrations of pollutants are predicted to be significantly below these standards, the impact to human health is predicted to be *long-term, neutral and imperceptible*.

To conclude, no significant impacts to either air quality or climate are predicted during the construction or operational phases of the proposed development.

14.0 Archaeology and Cultural Heritage

Waterford has a rich cultural heritage associated with the River Suir, with the foundation of Waterford as a city dating back to the Viking Age and the earliest date for the city itself being generally accepted around AD 912-33. Waterford began as a defended Viking longphort or ship-fortress and became Ireland's second city after Dublin.

The proposed Flood Defences West is located along the northern bank of the River Suir, to the west of the Edmund Rice Bridge, within the townlands of Newrath, within County Kilkenny and County Waterford and Mountmisery, County Waterford. There are no recorded monuments within the proposed development boundary.

Cartographic sources depict the proposed development area as occupied by the railway lines and associated infrastructure from the mid-19th century onwards. The development of the railway is clearly visible in the historic mapping. The current quay wall within the development area is directly associated with the railway and is contemporary with the construction of the expanded railway infrastructure during the late 19th century. It is likely that the quay wall was constructed in order to facilitate the stability of the railway tracks and also the loading and unloading of cargo from shipping. A total of eight post medieval landing stages protruding into the River Suir were identified within study area of proposed development in varying states of preservation. These timber structures facilitated the transfer of goods from shipping to the railway.

The proposed main construction compound at the western site boundary of the proposed Flood Defences West, currently contains a section of the iron railway bridge, the remaining sections of which are in-situ across the river, c.700m to the northwest and is listed as a protected structure (RPS WA731015).

No direct or indirect impacts will occur on the recorded archaeological resource, either during the construction or operation of the proposed development.

For the purposes of this assessment, the existing quay wall and riverine features are included in the archaeological impact assessment. The c.545m section of the existing quay wall will be demolished to approximately 800mm below the existing ground level as part of the proposed development. Approximately 28m of this section of the wall will be demolished above and below ground; c.25m will be demolished to facilitate the construction of a pumping station and up to 3m will be demolished to connect landside and riverside sections of the new sheet pile wall. The quay wall is not a recorded monument or a protected structure.

The demolition of sections of the quay wall, including the landing stage abutment, but not including the wall associated with landing stage 7, will result in a *direct, negative, significant,* impact on the archaeological resource. No direct impacts are predicted upon the remains of the timber landing stages that have been identified as part of this assessment.

It also remains possible that ground disturbances associated with the proposed development may have a *direct, negative, impact* on archaeological features or deposits that have the potential to survive behind the quay walls proposed for demolition or during any other associated ground works. In terms of cultural heritage, it is possible that works associated with the proposed compound may result in a direct negative impact on the section of iron railway bridge that currently occupies the site.

The eastern section of the proposed development area is characterised by the existing train station and modern car park. Excavations associated with drainage and services will be required in this area as part of the development. Although the area has been disturbed, it remains possible that that ground disturbances associated with the proposed development may have a *direct, negative,* impact on archaeological features or deposits that have the potential to survive below the existing ground level. Impacts, prior to the application of mitigation, may range from *negative, moderate to very significant* in scale.

As part of the development, it is proposed to demolish and replace two existing outfalls and to construct a new outfall within the riverbed of the River Suir. It is possible that that ground disturbances associated with the construction of the outfalls may have a *direct, negative,* impact on archaeological features or deposits that have the potential to survive behind the riverbed. Impacts, prior to the application of mitigation, may range from negative, *moderate to very significant* in scale.

In order to ameliorate any negative impacts upon the archaeological resource, a full intertidal and wade/dive survey will be carried out along the sections of the existing quay wall to be directly impacted by the works and at the location of the upgraded and proposed outfalls. The survey will include a photogrammetry survey of the wall to be demolished, along with the mapping and recording of the former landing stages. All timber landing stages will be avoided during the course of works. The survey will also include a metal detecting survey and all works will be carried out by a suitably qualified underwater archaeologist, under licence to the National Monuments Service of the DoHLGH.

All ground disturbances associated with the proposed development will be monitored by a suitably qualified underwater archaeologist. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).

All ground disturbances associated with excavations within the car park associated with the existing train station will be monitored by a suitably qualified archaeologist. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).

The section of the iron railway bridge that currently occupies the works compound will be left in-situ and undisturbed by contractors.

15.0 Architectural Heritage

The proposed development is located along the northern bank of the River Suir, in the townlands of Newrath, County Kilkenny and Mountmisery, County Waterford. Due to a slight change in the county boundary in the late 19th century, a small section of Newrath townland is now located in County Waterford. There are five recorded built heritage sites within the boundary of the proposed development, four relating to the railway; the Railway Station (NIAH 22500032), Signal Box (RPS 571, NIAH 22500027), Platform (RPS 709, NIAH 22500033 and post box (RPS 1036). The fifth built heritage site is the Edmund Rice Bridge (NIAH 22500075) across the River Suir, which is only partially within the development boundary. There are two additional built heritage sites within a 200m radius of the proposed development. The modest former demesne of Mountmisery Lodge (RPS C672), later known as Knockane Villa, is also located to the immediate northeast of the development, with the demesne associated with Newrath House (RPS C671) located to the north and northeast.

It is proposed to erect glass flood barriers along the three roundabout arms, at the Edmund Rice Bridge roundabout, to the immediate north of the bridge and south of the railway station. Demountable flood barriers are also proposed on the R680 Edmund Rice Bridge for the section leading to the North Quays Strategic Development Zone. Ground works associated with required drainage and the impermeable underground trench will also be carried out within the car park associated with the existing train station. The glass and the demountable flood barriers, and ground disturbances, which are proposed will not result in any negative direct or indirect impacts, either during construction or the operation of the development, on the bridge, station and post box. This is due to the developed nature of the existing suburban environment and the minimal changes proposed by the proposed development.

The post medieval signal box, which is located to the northwest of the proposed flood development works, will not be negatively impacted by the works, as no changes are proposed to the structure or its setting.

16.0 Material Assets and Land

Waterford City is the largest urban area in the South East of Ireland and is an important tourism centre with good transport linkages for both public and private transport. The construction of the proposed Flood Defences West will protect and prevent damage from flooding of existing rail infrastructure such as Plunkett Station and road infrastructure, particularly the Rice Bridge roundabout.

The permanent footprint of the proposed development is largely located within the railway corridor which is in the ownership of Córas Iompair Éireann (CIÉ) and operated by Iarnród Éireann, with whom the project team have been in consultation throughout the development of the project to agree consent to site access. CIÉ have consented to the proposed development and support the use of their lands for construction of the proposed flood protection measures.

The permanent footprint of the proposed development is also located within areas of the foreshore and on lands not in the ownership of either WCCC or CIÉ. These lands and areas of the foreshore will be obtained by WCCC through the Compulsory Purchase Order (CPO) process. WCCC or CIÉ will also pursue title to the unregistered lands within the permanent footprint of the proposed development for the purpose of this planning application.

A temporary works area for the proposed development is located within the foreshore. An application for Foreshore Licence consent will be made to the Marine Planning and Foreshore Section of the Department of Housing, Local Government and Heritage for the temporary works area.

Commercial/industrial facilities within the Sally Park industrial estate may be subject to indirect impacts during construction as a result of noise and vibration increases from activity of machinery and transport vehicles. There are no other commercial or community facilities in vicinity of the proposed works.

The construction works at the site may cause annoyance or nuisance to maritime recreational users of the River Suir over the duration of the construction phase, specifically during day-time piling activities which are estimated to occur intermittently throughout the day over approx. 3 months. As such, the construction phase has the potential for *negative, slight to moderate, temporary* effects on maritime recreational users.

The proposed development will permanently reduce a small section of the River Suir channel through the installation of the riverside sheet piles in front of the existing quay wall. However, this change to the width of the river channel is very minor in nature, and will not have any impacts on the maritime commercial and recreational activities within the River Suir.

The operation of the development will provide many significant positive impacts to the city. Specific significant positive impacts relating to the operational phase of the proposal include:

- Protecting the existing rail and road infrastructure such as Plunkett Station and the Rice bridge roundabout from existing and future flood risk.
- Upgrading the existing drainage network within the extents of the proposed development by increasing its capacity to account for extreme weather events induced by climate change
- Eliminating costs associated with flood damage on built assets, particularly the rail infrastructure at, and to the west of Plunkett Station and the road infrastructure, specifically Rice Bridge roundabout.

17.0 Interactions and Cumulative Impacts

Interactions

In addition to the assessment of impacts on individual environmental topics, the potential interactions between these factors have also been considered. Table 17.1 shows the principal interactions / interrelationships identified for the proposed development. The nature and magnitude of all identified interactions / interrelationships was assessed, and it was concluded that, provided the proposed mitigation measures are fully implemented, no significant adverse effects will arise as a result of interactions / interrelationships between the various environmental topics considered, either during construction or operation.

Table 17.1 Interactions Matrix

Receptor / Activity	Traffic Analysis	Population and Human Health	Biodiversity	Soils and Geology	Hydrogeology	Hydrology	The Landscape	Noise and Vibration	Air Quality and Climate	Archaeological and Cultural Heritage	Architectural Heritage	Material Assets and Land
Traffic Analysis		✓	✓					✓	✓			
Population and Human Health	✓											
Biodiversity								✓				
Soils and Geology	✓	✓	✓		✓	✓	✓	✓	✓	✓		
Hydrogeology		✓				✓						✓
Hydrology		✓	✓	✓								✓
The Landscape		✓										
Noise and Vibration		✓	✓				✓					✓
Air Quality and Climate		✓	✓									✓
Archaeological and Cultural Heritage												
Architectural Heritage												
Material Assets and Land		✓			✓	✓						

Cumulative Impacts

It is considered that the scale of the works and implementation of effective environmental control measures will avoid all likely significant effects on environmental parameters. There is no potential for cumulative impacts arising in combination with any other plans or projects and therefore no potential for in-combination effects on environmental parameters.

Based on the above, it can be objectively concluded, in view of best scientific knowledge, on the basis of objective information and provided effective mitigation is in place, that the Project, individually or in combination with other plans and projects, will not have a significant adverse effect on the receiving environment.

18.0 Major Accidents and Disasters

There are no "Seveso" sites (establishments within the meaning of the Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2015) in close proximity to the proposed development. The closest establishment is at least 1.5km east of the proposed development. The design of the proposed development has taken account of the potential for flooding. The proposed development will prevent flooding of lands along the northern bank of Waterford City. In relation to accidents resulting in a spillage of polluting material, the risk of these occurring will be significantly reduced and if a spillage should occur the proposed development incorporates drainage to allow the spilled material to be contained and treated prior to discharge.

19.0 Further Information & What Happens Next

The Environmental Impact Assessment Report (EIAR) and the Natura Impact Statement (NIS) may be inspected free of charge, or purchased at a reasonable fee (which shall not exceed the reasonable cost of making a copy) by appointment only due to current Covid -19 restrictions at the following locations and as detailed in the published newspaper notices:

- Waterford City and County Council, Customer Care Desk, Baileys New Street, Waterford X91 XH42;
- Waterford City and County Council, Civic Offices, Davitts Quay, Dungarvan, Co. Waterford X35 Y326;
- Kilkenny County Council, County Hall, John Street, Kilkenny R95 A39T; and,
- Kilkenny County Council, Ferrybank Area Office, Abbeylands, County Kilkenny X91 DE42.

The application including the EIAR, NIS and plans and particulars of the proposed development may also be viewed and downloaded online on the Waterford City and County Council website via the following link:
http://waterfordcouncil.ie/projects/public-consultations/index.htm

Submissions or observations may be made in writing only to **An Bord Pleanála, 64 Marlborough Street, Dublin 1, D01 V902** in relation to:

- The implications of the proposed development, if carried out, on the proper planning and sustainable development of the area;
- The likely effects of the proposed development, if carried out, on the environment; and
- The likely effects the proposed development, if carried out, on a designated European Site.

An Oral Hearing may be held, should the statutory requirements for one be met. Written submissions, together with any representations made at any oral hearing, will be considered by An Bord Pleanála in making its decision on whether or not to approve the Flood Defences West with or without modifications.

An Bord Pleanála's decision will be published in one or more newspapers circulating in the area, including where appropriate, particulars of any modifications to the Flood Defences West.

Chapter 1
Introduction

Chapter 1 Introduction

1.1 Introduction to this Document

This Environmental Impact Assessment Report (EIAR) is prepared for the proposed Waterford City Public Infrastructure Project, Flood Defences West, hereafter referred to as the 'proposed development'. The EIAR has been prepared in accordance with the requirements of Annex IV of Directive 2011/92/EU (as amended by Directive 2014/52/EU), and comprises "A *statement of the effects, if any, which the proposed development, if carried out, would have on the environment*" (Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports, (EPA, 2017)).

This EIAR has been prepared by Roughan & O'Donovan Consulting Engineers and a team of specialist sub-consultants on behalf of the applicant Waterford City and County Council (WCCC). This EIAR forms part of the application that will be submitted by Waterford City and County Council to An Bord Pleanála for their approval of the proposed development.

This EIAR for the proposed development is presented in three volumes. Volume 1 provides a Non-Technical Summary of the EIAR. Volume 2 contains the main text of the EIAR, and Volume 3 contains the associated figures including the proposed development drawings. The Volume and Chapter layout is presented below.

Volume 1: Non – Technical Summary

Volume 2: EIAR - Main Text

Non – Technical Summary
Chapter 1: Introduction
Chapter 2: Need for the Proposed Development
Chapter 3: Alternatives Considered
Chapter 4: Description of the Proposed Development
Chapter 5: Traffic Analysis
Chapter 6: Population and Human Health
Chapter 7: Biodiversity
Chapter 8: Soils and Geology
Chapter 9: Hydrogeology
Chapter 10: Hydrology
Chapter 11: The Landscape
Chapter 12: Noise and Vibration
Chapter 13: Air Quality and Climate
Chapter 14: Archaeology and Cultural Heritage
Chapter 15: Architectural Heritage
Chapter 16: Material Assets and Land
Chapter 17: Interactions and Cumulative Impacts
Chapter 18: Major Accidents and Disasters
Chapter 19: Mitigation Measures

Volume 3: Figures

1.1.1 Natura Impact Statement

A Natura Impact Statement (NIS) has also been prepared and is provided as a separate document accompanying the application. The NIS contains an examination of the implications of the proposed development, on its own or in combination with other plans or projects, for Natura 2000 sites. The NIS has also been prepared in accordance with the provisions of Part XAB of the Planning and Development Act 2000 to facilitate the carrying out of an Appropriate Assessment by An Bord Pleanála.

1.2 Background and Context

1.2.1 Background to the Proposed Development

Roughan & O'Donovan Consulting Engineers were appointed by Waterford City and County Council to lead the Waterford City Public Infrastructure Project. The Project is being carried out in order to improve the public infrastructure in Waterford's North Quay area to enable the redevelopment within a Strategic Development Zone (SDZ). The redevelopment of SDZ is outside the scope of this project.

The Waterford City Public Infrastructure Project consists of several separate parts, such as rock face stabilisation, access road infrastructure, new railway station and Transport Hub, and River Suir Sustainable Transport Bridge, which have all received planning approval. The Waterford City Public Infrastructure Project also comprises the provision of flood protection measures in front of, and to the west of Plunkett Station, the railway station servicing Waterford City. The proposed Flood Defences West will provide flood protection measures under the scope of Waterford City Public Infrastructure Project.

Over the past 15 years, there has been a sequence of flood events at, and in the vicinity of Plunkett Station as reported in news articles[1] and observed by the Iarnród Éireann (IÉ) Inspection Staff – the latest being in October of 2020. It has been found that large sections of the existing quay wall are of inadequate height and are below the design flood level, rendering it ineffective at protecting IÉ lands and associated rail infrastructure against flooding. For much of the length, the existing quay wall is also in very poor condition. The deficiencies in height and the condition of the existing quay wall are described further and are shown in a number of photographs in Chapter 2 of the EIAR, Need for the Proposed Development.

Flooding of the existing railway line at, and to the west of the Plunkett Station currently impedes the operation of the railway service to and from Waterford City and has the potential to damage the rail infrastructure. The need for protection of the existing infrastructure and to build resilience against climate change induced flood events is outlined at national, regional, and local planning policy. The development of flood defence measures will enable the planned development of the Waterford North Quays in a sustainable manner as well as preserving the existing rail infrastructure in front and to the west of Plunkett Station.

[1] www.journal.ie published an article on the 17th of Oct. 2012 entitled 'Waterford train station is flooded… very flooded".
www.theirishindependant.ie published an article on the 11th of March 2008 entitled "Escaping in the eye of the storm" and describes that rail services at the existing Plunkett train station were affected sue to flooding resulting in bus transfers to be put in place.

1.2.2 General Overview of the Proposed Development

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, and the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City. The development extends approximately 1km to the west and 100m to the east of the Plunkett Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor which is bound to the north of the proposed development.

The development will provide protection for lands and the existing built assets in Waterford City from future flood events, such as the existing and future rail infrastructure in the vicinity of Plunkett Station and the Rice Bridge roundabout over its extents. It will also form a continuation of the flood protection measures proposed along the North Quays SDZ as part of the new Transport Hub development.

The design flood level of the proposed flood protection measures is +4.0m OD (metres above Ordnance Datum), with the top-of-the-wall flood protection measures of +4.30m OD.

A high-level description of the proposed development is provided below:

- Construction of c.365m of impermeable shallow underground trench (0.35m wide and up to 3m deep) within Iarnród Éireann's Plunkett Station car park.
- Total of c.185m of overground flood defence measures for the R680 Rice Bridge roundabout and along the 3 roundabout arms; R448 Terminus St., R711 Dock Rd.
- Remedial works to c.75m section of existing quay wall by raising its height to between 0.6m and 1.2m to conform with the top-of-wall flood protection measures of +4.30m OD.
- Construction of c.730m of sheet pile flood defence wall with the top-of-the wall level at +4.30mOD consisting of:
  - c.540m of sheet pile wall within the foreshore from the riverside, 1m from the front face of the existing quay wall.
  - c.190m of sheet pile wall will be installed on Iarnród Éireann land, 1m behind the existing quay wall. Construction of c.20m underground isolation structure comprising of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers to the structure should these be required to be implemented during a flood event.
  - Demolition of up to 3m of existing quay wall at transition point between the landside and riverside sheet pile wall.
- Drainage works will consist of:
  - Remedial works to the existing drainage outfalls to the River Suir.
  - Construction of new trackside drainage and groundwater drains to include 2 no. pumping stations and surface water outfalls to the River Suir.
  - Demolition of c. 540m of existing quay wall south of the railway corridor to approximately 800mm below the existing ground level. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level to facilitate the construction of a surface water pumping station.

- And all ancillary works.

Detailed description of the proposed development is provided in Chapter 4 Description of Proposed Development of this EIAR. The location of the proposed development is shown in Plate 1.1 below. See also, Figure 1.1 in Volume 3 of the EIAR.

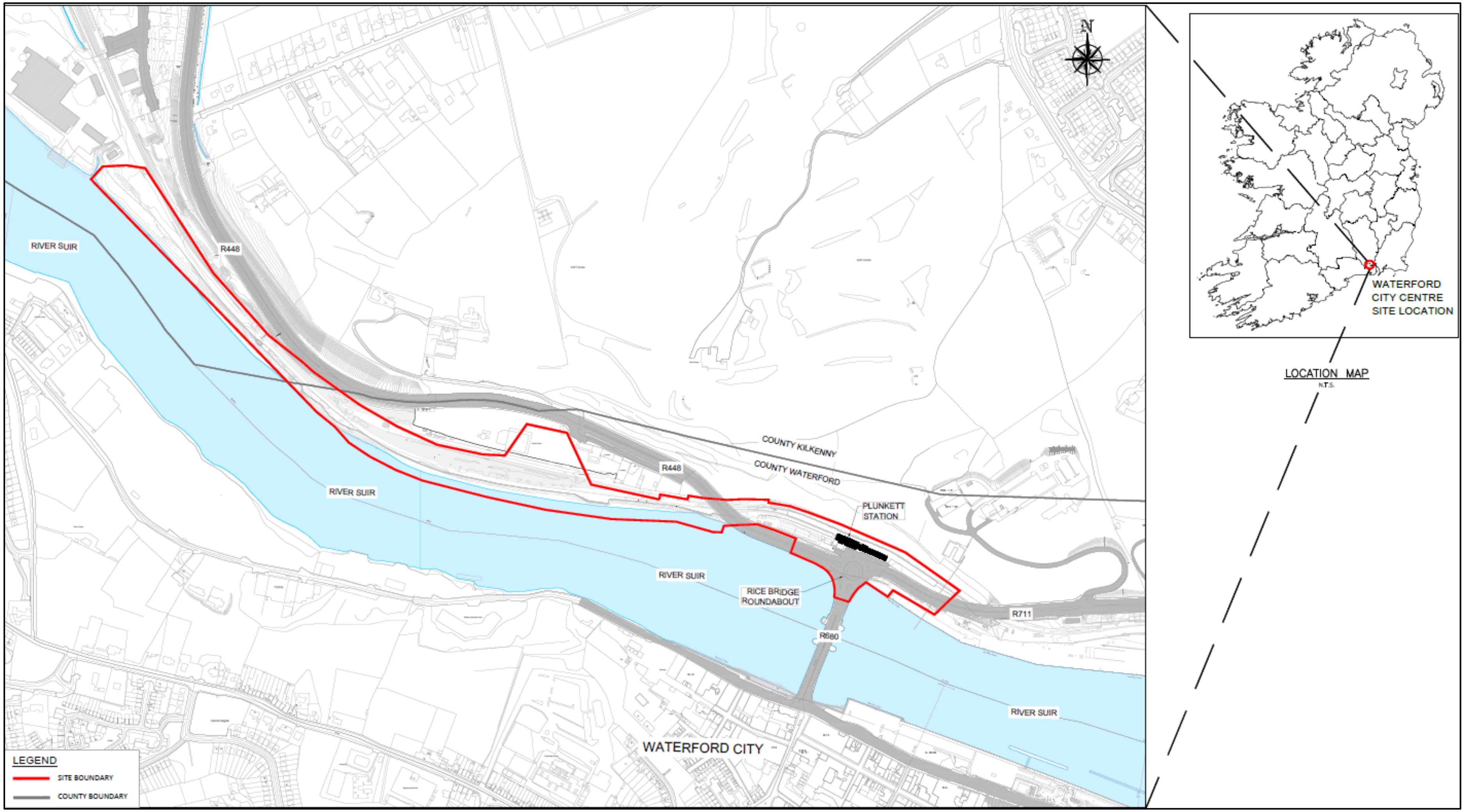

Plate 1.1 Location of the Proposed Flood Defences West

1.3 EIA Legislation

1.3.1 Introduction

Environmental Impact Assessment (EIA) is defined in Article 1 of Directive 2011/92/EU, as amended by Directive 2014/52/EU, as follows:

"Environmental Impact Assessment means a process consisting of:

(i) the preparation of an environmental impact assessment report by the developer, as referred to in Article 5(1) and (2);

(ii) the carrying out of consultations as referred to in Article 6 and, where relevant, Article 7;

(iii) the examination by the competent authority of the information presented in the environmental impact assessment report and any supplementary information provided, where necessary, by the developer in accordance with Article 5(3), and any relevant information received through the consultations under Articles 6 and 7;

(iv) the reasoned conclusion by the competent authority on the significant effects of the project on the environment, taking into account the results of the examination referred to in point (iii) and, where appropriate, its own supplementary examination; and

(v) the integration of the competent authority's reasoned conclusion into any of the decisions referred to in Article 8a."

An Bord Pleanála is the competent authority for the purpose of carrying out an environmental impact assessment of the proposed development.

1.3.2 Environmental Impact Assessment

The requirement for environmental impact assessment is imposed by Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (as amended by Directive 2014/52/EU) (the EIA Directive).

The requirements of these directives have been transposed into Irish law through the Planning and Development Acts 2000 (as amended), the Regulations made under the European Communities Act (1972) including the European Communities (Environmental Impact Assessment) Regulations 1989 – 2006, the European Union (Environmental Impact Assessment and Habitats) Regulations 2011 and the European Communities (Birds and Natural Habitats Regulations) 2011. Directive 2014/52/EU of the European Parliament has recently been transposed into Irish law through the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018).

1.3.3 Requirement for EIA

The planning application for the development of the Flood Defences West project is being submitted under Section 175 and Section 226 of the Planning and Development Act 2000 (as amended).

Section 175 (1) and 175 (3) states:

"175 – (1) Where development belonging to a class of development, identified for the purpose of section 176 , is proposed to be carried out –
by a local authority that is a planning authority, whether in its capacity as a planning authority or in any other capacity, or

by some other person on behalf of, or jointly or in partnership with, such a local authority, pursuant to a contract entered into by that local authority whether in its capacity as a planning authority or in any other capacity.

175 – (3) Where an environmental impact assessment report has been prepared pursuant to subsection (1), the local authority shall apply to the Board for approval."

Section 226 (1) states the following:

"226.—(1) Where development is proposed to be carried out wholly or partly on the foreshore—

(a) by a local authority that is a planning authority, whether in its capacity as a planning authority or otherwise, or

(b) by some other person on behalf of, or jointly or in partnership with, a local authority that is a planning authority, pursuant to an agreement entered into by that local authority whether in its capacity as a planning authority or otherwise, (hereafter in this section referred to as "proposed development"), the local authority concerned shall apply to the Board for approval of the proposed development."

The proposed development is being carried out by Waterford City and County Council and will involve the construction of c. 1.1km of flood defence measures, parts of which will be developed within the foreshore, and therefore the application will be made to An Bord Pleanála for approval under Sections 175 and 226 of the Planning and Development Act 2000 (as amended).

1.4 EIAR Methodology

Article 3 of the 2014 EIA Directive states that "*an environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project*" on stated factors.

This EIAR has been prepared using the "grouped" format structure as detailed in the 2017 EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, *"where the discussion of the characteristics of the environment in the EIAR are grouped under the headings which correspond to these factors or closely related headings*", refer to Section 1.1 for Chapter headings. In light of this, description of the receiving environment, the potential impacts, mitigation measures and residual impacts are grouped in each chapter of the EIAR. The group format makes it easy to review topics of interest and cross-reference between specialists' studies as appropriate.

1.4.1 Environmental Impact Assessment Guidelines

The preparation of the EIAR has been informed by relevant national EIA guidelines prepared by the EPA, the DHPLG and TII including:

- Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports, EPA, August 2017;
- Draft Advice Notes for Preparing Environmental Impact Statements, EPA, September 2015;
- Guidelines on the Information to be contained in Environmental Impact Statements, EPA, 2002;

- Advice notes on Current Practice (in the preparation of Environmental Impact Statements), EPA, 2003
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, DHPLG, August, 2018; and

  Environmental Impact Assessment of National Road Schemes - A Practical Guide, Revision 1, 20 November 2008.

Other guidelines from TII and other bodies have been taken into account in the relevant technical assessment chapters of this EIAR and are referenced in those chapters.

The following guidelines by the European Commission have also been consulted in the preparation of this EIAR:

- Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report, European Commission, 2017.

1.4.2 Transport Infrastructure Ireland (TII) / National Roads Authority (NRA) Guidelines

The Transport Infrastructure Ireland (TII) was established through an amalgamation of the National Roads Authority (NRA) and the Railway Procurement Agency (RPA) under the Roads Act (as amended) in 2015. Prior to the merger, the NRA published construction and planning guidelines that have been followed during the design and environmental assessment processes for the proposed development. For the purposes of this EIAR, the NRA guidelines will be referred to as TII guidelines throughout the EIAR where appropriate.

1.4.3 EIAR Contributors

The EIA Directive requires the developer to ensure that the EIAR is prepared by competent experts. Roughan & O'Donovan has led the preparation of this EIAR with the assistance of several specialists. Table 1.1 outlines the name of the authors of each EIAR chapters, their qualifications and experience. Waterford City and County Council has evaluated the technical competence of each of the consultants and specialists through the tendering process and during the project and is satisfied that they each are sufficiently qualified, experienced, expert, and competent in their fields.

Table 1.1 EIAR Authors Qualifications and Competency

Topic	Specialist Contributors	Company	Qualifications	Experience (years)
Chapters 1 – 3 Introduction, Need for the Proposed Development Alternatives Considered	Barry Corrigan	ROD	BSc (Hons), Dip EIA & SEA, MIEMA, CEnv	21
	Karlo Martinovic	ROD	BE (Civil) M.Sc., Ph.D., C.Eng. M.I.E.I.	10
	Yana Bersunukayeva	ROD	BA Env Sci, MSc Global Change, Ecosystem Science & Policy	2
Chapter 4	Karlo Martinovic	ROD	BE (Civil) M.Sc., Ph.D., C.Eng. M.I.E.I.	10

Topic	Specialist Contributors	Company	Qualifications	Experience (years)
Description of Proposed Development	Yana Bersunukayeva	ROD	BA Env Sci, MSc Global Change, Ecosystem Science & Policy	2
	Barry Corrigan	ROD	BSc (Hons), Dip EIA & SEA, MIEMA, CEnv	21
	Claire Dempsey	ROD	B.E. (Hons), M. Eng. Sc.	20
Chapter 5 Traffic Analysis	John Bell	ROD	BEng, MIEI CEng	19
	Enrica Calandro	ROD	B.Eng, M.Eng	2
Chapter 6 Population and Human Health	Claire Cable	ROD	Postgrad Dip., B.S.c. MCIWEM	15
	Warren Vokes	ROD	B.A., M.Sc, MCIWEM	5
Chapter 7 Biodiversity	Owen O'Keefe	ROD	BSc (Hons) MCIEEM	5
	Kalvin Townsend-Smith	ROD	BSc.	2
Chapter 8 Soils and Geology	Karlo Martinovic	ROD	BE (Civil) M.Sc., Ph.D., C.Eng. M.I.E.I.	10
Chapter 9 Hydrogeology	Brian Dugan	ROD	BSc, MSc	15
Chapter 10 Hydrology	Warren Vokes	ROD	B.A., M.Sc, MCIWEM	5
	Claire Dempsey	ROD	B.E. (Hons), M. Eng. Sc.	20
	Tony Cawley	Hydro Environmental	BE, MScEng	30
Chapter 11 Landscape and Visual Analysis	Mark Boyle	Murray and Associates	BA, MSc, MILI, Grad. Dip. Project Management	23
Chapter 12 Noise and Vibration	Jennifer Harmon	AWN Consulting	BSc, PGDip, MIAOA	20
	Alistair Maclaurin	AWN Consulting	BSc, PGDip, MIAOA	8
Chapter 13 Air Quality and Climate	Dr. Edward Porter	AWN Consulting	BSc, PhD, C Chem MRSC	23
	Ciara Nolan	AWN Consulting	BSc, MSc, MIAQM	3
Chapter 14 Archaeological and Cultural Heritage	Faith Bailey	IAC	MA BA (Hons), MCIfA	15
Chapter 15 Architectural Heritage	Faith Bailey	IAC	MA BA (Hons), MCIfA	15
Chapter 16	Yana Bersunukayeva	ROD	BA Env Sci, MSc Global Change, Ecosystem Science & Policy	2

Topic	Specialist Contributors	Company	Qualifications	Experience (years)
Material Assets and Land	Claire Dempsey	ROD	B.E. (Hons), M. Eng. Sc.	20
Chapter 17 Interactions and Cumulative Impacts	Barry Corrigan	ROD	BSc (Hons), Dip EIA & SEA, MIEMA, CEnv	21
	Yana Bersunukayeva	ROD	BA Env Sci, MSc Global Change, Ecosystem Science & Policy	2
Chapter 18 Major Accidents and Disasters	Yana Bersunukayeva	ROD	BA Env Sci, MSc Global Change, Ecosystem Science & Policy	2
	Barry Corrigan	ROD	BSc (Hons), Dip EIA & SEA, MIEMA, CEnv	21
Chapter 19 Mitigation Measures	Barry Corrigan	ROD	BSc (Hons), Dip EIA & SEA, MIEMA, CEnv	21
	Yana Bersunukayeva	ROD	BA Env Sci, MSc Global Change, Ecosystem Science & Policy	2

1.5 Consultation

1.5.1 Scope of the EIAR

As stated in the EPA Guidelines (2017, p. 23), *"'Scoping' is a process of deciding what information should be contained in an EIAR and what methods should be used to gather and assess the information"*. An Informal EIA Scoping Report was issued to an extensive list of bodies in February 2021, which set out the preliminary scope for the EIA of the proposed development, providing an outline of significant aspects of the development and sensitivities identified in the receiving environment, which would help the consultees provide useful feedback. The document was issued to the following Statutory Consultees, who were invited to submit comments over a four-week period, identifying any concerns or issues they may have in respect of the proposed development:

- An Chomhairle Ealaíon (The Arts Council)
- Fáilte Ireland
- An Taisce
- Development Applications Unit (DAU) of the Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media (i.e., National Parks & Wildlife Service)
- Minister for Tourism, Culture, Arts, Gaeltacht, Sport and Media
- The Heritage Council
- Waterford City and County Council
- Kilkenny County Council
- Southern Regional Assembly
- Inland Fisheries Ireland (IFI)
- Córas Iompair Éireann
- Health Service Executive

- Minister for the Environment, Climate and Communications
- Railway Safety Commission (Commission for Railway Regulation)
- Iarnród Éireann
- The Office of Public Works
- Waterways Ireland
- Bord Iascaigh Mhara (BIM)
- Geological Survey of Ireland
- Irish Water
- Minister for Agriculture, Food and Marine
- Health and Safety Authority
- Commission for Regulation of Utilities (CRU)
- Marine Institute
- Sea Fisheries Protection Authority
- Waterways Ireland
- Environmental Protection Agency
- Minster for Transport
- Minister for Housing, Local Government and Heritage
- Transport Infrastructure Ireland (TII)
- Irish Aviation Authority
- Údarás na Gaeltachta
- Waterford City River Rescue (CRBI)
- Waterford Marine Search and Rescue

Responses were received from 13 of the above-stated prescribed bodies, 4 of which contained comments in relation to the proposed development. Due consideration has been given to the responses received in determining the scope of the EIA for the proposed development. Details of responses are discussed, where appropriate, in the relevant specialist chapters of the EIAR.

1.6 Design of the Proposed Development and the EIA Process

It should be noted that the information which forms the basis of this EIAR is based on the design of the proposed development as it is detailed in Chapter 4 'Description of the Proposed Development'. This design has been developed to a stage that permits completion of a fully informed EIA. While some refinements of the current design may occur during the detailed design stage (i.e., after the completion of the EIA), any such iterations of the proposed development, will not be such that they give rise to any impacts which are more significant than those already identified and assessed in this EIAR.

1.7 Difficulties Encountered

No difficulties have been encountered in compiling the required information to complete this EIAR.

Chapter 2
Need for the Proposed Development

Chapter 2 Need for the Proposed Development

2.1 Introduction

This chapter sets out the need for the proposed Flood Defences West and provides an overview of the planning and development policy context under which the proposed development is being progressed. The existing flood defence measures are described under the heading of background and context along with an assessment of their effectiveness. The objectives of the proposed development are also identified in this chapter, which have formed the basis of the design development.

2.2 Background and Context

The proposed development is located within the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny along the north bank of the River Suir in Waterford City, Co. Waterford. The R680 Rice Memorial Bridge and the Waterford railway station, Plunkett Station are located at the easternmost extent of the site of proposed development, while the Iarnród Éireann (IÉ) rail corridor and the Sallypark industrial site bound the development to the north. The River Suir and the existing quay wall run along the south of the site. The lands within the extent of the proposed development are zoned for 'Opportunity Sites' and 'Mixed Use' by the Waterford City Development Plan 2013 – 2019 (as extended).

The site is characterised by a historically heavy industrial usage however it is currently used for rail freight traffic running from Dublin to Waterford. Commuter rail services also operate within the rail corridor. The existing flood protection measures afforded to this section of the north quays consist of a quay wall along the banks of the River Suir. As outlined in the following paragraphs and the remaining sections of this chapter, the existing flood protection measures are no longer effective in protecting the infrastructure on the northern bank of Waterford City from flood events.

2.2.1 Existing Masonry Quay Wall

The existing quay wall within the development site, is a masonry structure over most of its length, which originated in late 19th century and has been subject to numerous upgrades, including sections of mass concrete. The structure of the existing masonry quay wall is described in the following paragraphs with reference to chainages shown in Figures 4.1 to 4.6 (Volume 3 of the EIAR).

From Ch.0.0 to Ch.340, the old masonry quay wall is no longer visible, with any potential remnants covered with current infrastructure. The available as-builts drawings from the 1980's and 1990's, created during the design and construction of the current R448 Terminus Street Bridge and Rice Bridge roundabout, indicate the lower parts of old masonry wall to be present below the base of the new structures, i.e. below the west car park boundary wall built in the 1990's as shown in Plate 2.1 below. This could not be confirmed by visual observations.

Plate 2.1 Typical condition of the wall/shoreline between Ch.0.0 and Ch.340 (photo taken at approx. Ch.200)

From Ch.340 to Ch.1090, the front face of the quay wall, facing the river, is visible as shown in Plate 2.2. The wall is typically made of masonry or blockwork, with frequent concrete additions, mostly in the upper part where a concrete capping beam forms the top of the wall. Gabions and shotcrete are also encountered locally. The heterogeneity of materials used implies that the current wall was built and upgraded in numerous stages. Between chainages Ch.790 to Ch.840, the riverbank is exposed with no remnants of the exiting quay wall visible at this location. The base of the wall from Ch.340 to Ch.1090 is beneath the existing mudline and therefore, the exact shape of the wall cross-section is currently unknown. Numerous drainage outlets also protrude through the wall face.

Plate 2.2 Typical condition of the wall/shoreline between Ch.340 and Ch.1090 (Photo taken at approx. Ch.650)

A visual inspection of the existing masonry quay wall carried out in August 2018 by Roughan & O'Donovan, revealed that large sections of the existing quay wall are of inadequate height and condition and are below the design flood level of 4.0mOD, rendering it ineffective at protecting IÉ lands and associated rail infrastructure, against flooding. The deficiencies of the height and condition of the existing quay wall are described and presented in photographs below.

Wall height

The main cause of flooding within the development lands was observed to be the overtopping of the existing wall at the low points, with the flood waters then running gravitationally eastwards along the ballast towards the low point at Plunkett station. The locations of low points along the existing quay wall where the River Suir has been observed to be overtopping (by Iarnród Éireann staff) on several flood occasions include chainage Ch.370, between chainages Ch.540 and Ch.590 and between chainages Ch.900 and Ch.1050 (see Figures 4.1 to 4.6 in Volume 3 of this EIAR for chainage reference points).

A survey of the levels along the top of the wall was undertaken on 16th of May 2018. Plate 2.3 below shows the wall levels plotted on the graph along with a variety of flood levels including, the design flood level of +4.00 mOD. It is evident that the wall is of inadequate height to protect the site, even against frequent 1-in-2 years combined tidal/fluvial flood events in some places and is entirely inadequate to protect against the design flood level.

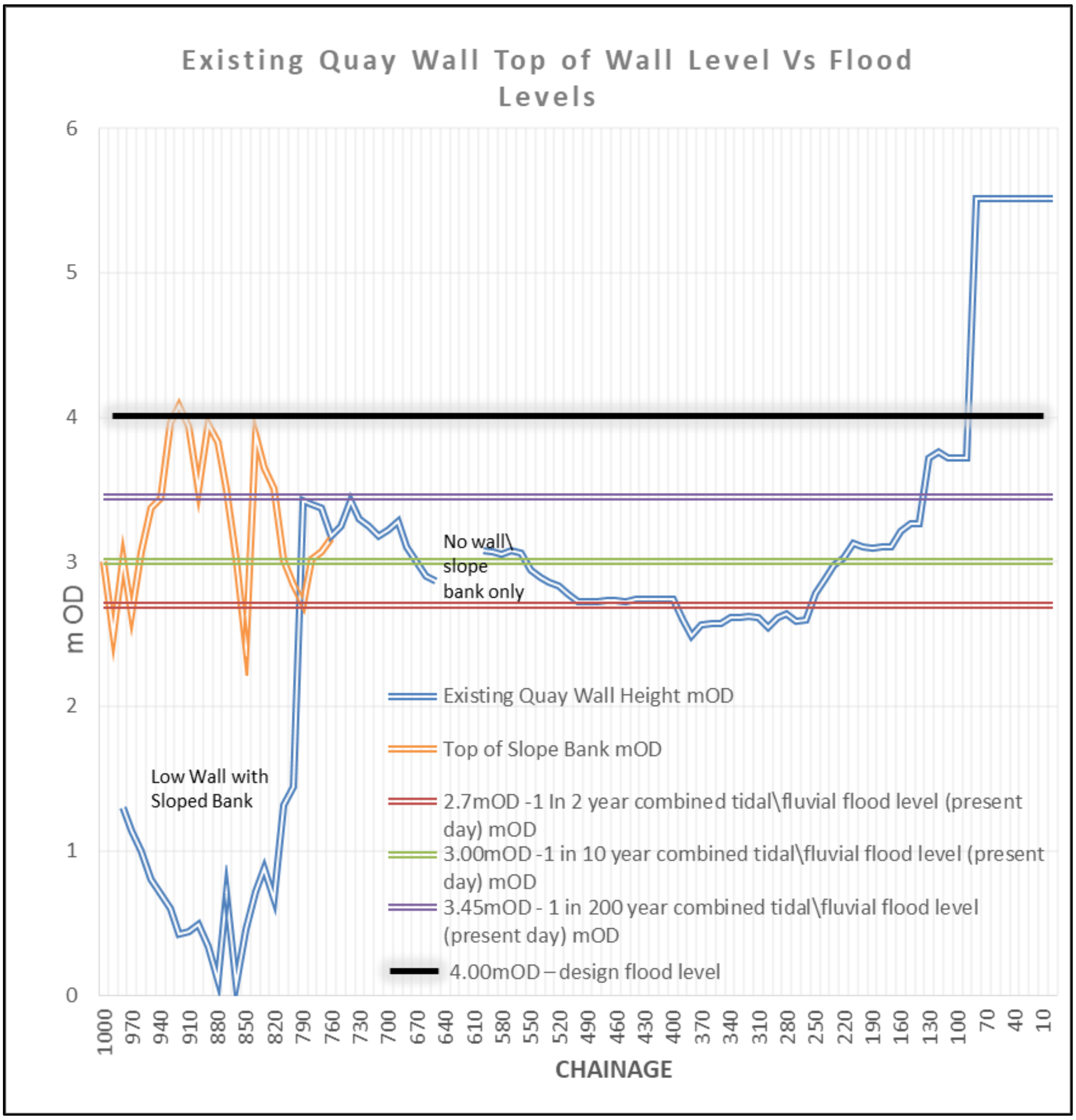

Plate 2.3 Existing quay wall height (note: chainage in the figure is a local chainage done for the purpose of Flood Scoping report in 2019 and 2020. Add 190 to get the chainage shown on the Volume 3 Figures of this EIAR. Example: chainage 100 in above graph equates to Ch.290 in Figure 4.2 in Volume 3 of the EIAR)

The OPW Catchment Flood Risk Assessment and Management (CFRAM) floodmaps (available at www.floodinfo.ie) have modelled the 1% Fluvial AEP with 0.5% Tidal AEP and the 0.1% Fluvial and Tidal AEP flood extents, as illustrated in the extract from the River Suir CFRAM map below. As illustrated in Plate 2.4, the lands behind the north bank of the River Suir are currently prone to flooding and are not protected by the existing quay walls.

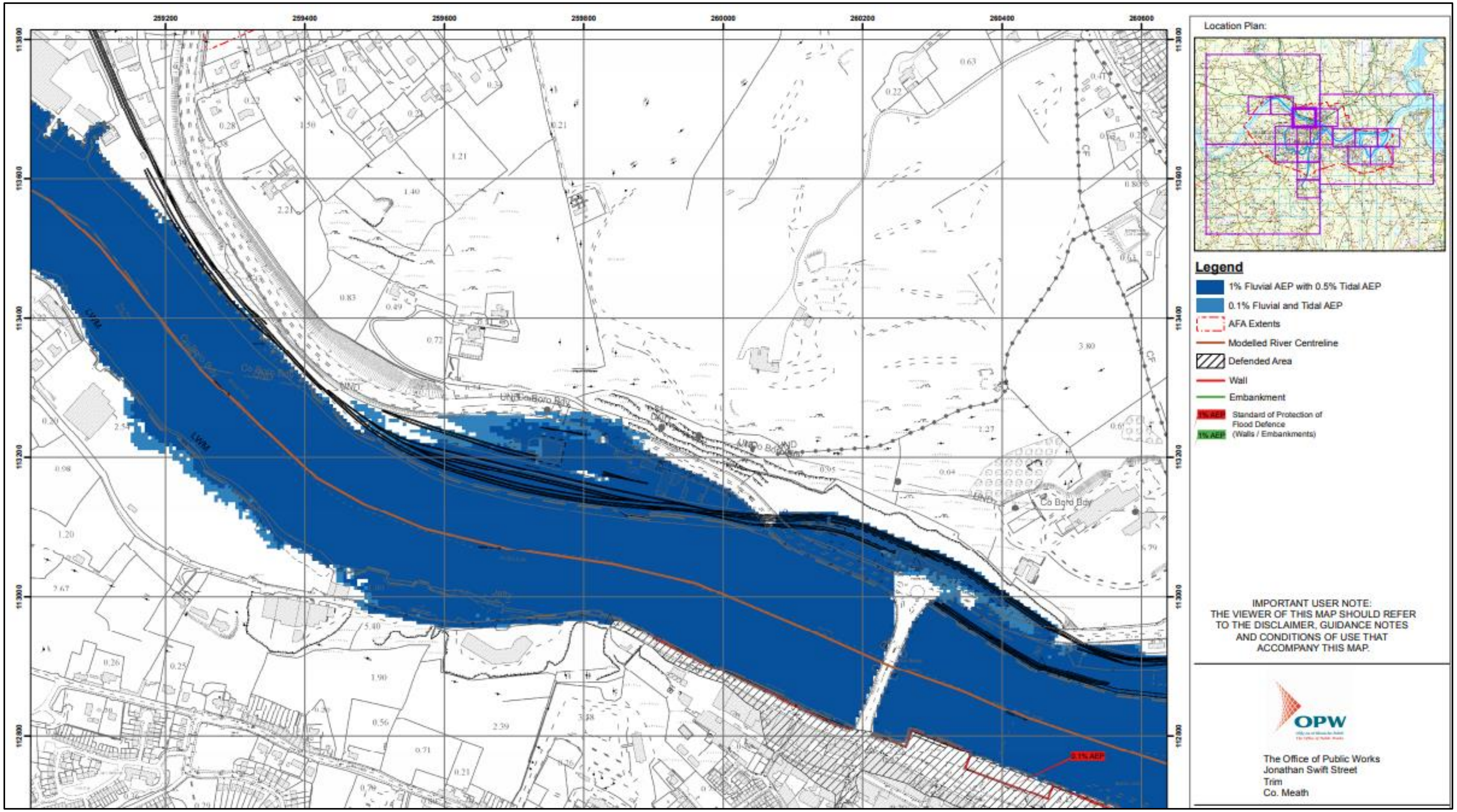

Plate 2.4 **OPW River Suir CFRAM Map extract**

Wall condition

A structural inspection of the full length of the existing quay wall, was undertaken both from landside and riverside on 17th of August 2018. The riverside inspections were carried out from a boat within a 3-5m distance of the existing quay wall, both at low tide and high tide.

The existing wall between chainages Ch.160 and Ch.300 (see Figure 4.2 in Volume 3 of the EIAR for chainage reference points) was built in the 1990s and doubles as a boundary wall to the Plunkett Station west car parking area. The wall is reinforced concrete, and no defects were found during inspections.

The remaining sections of the wall, composed of masonry / blockwork with mass concrete additions, are in poor condition. The dislodgement of blocks, horizontal and vertical displacement, settlement, cracking, and other defects are ubiquitous throughout the wall length. Evidence of dislodged blocks in the mudflats are plentiful. Particularly large displacement / rotation of the wall has been observed between chainages Ch.540 and Ch.580. At chainage Ch.790, approximately 5.5m length of capping beam was noted to have broken off the wall and fallen onto the bank. From this chainage (Ch.790) to Ch.840, there was no visible wall present.

Plates 2.5, 2.6 and 2.7 below provide an indication of common defects observed along the existing masonry wall.

Plate 2.5 Defects on the existing quay wall – cracking of the wall and dislodgement of masonry blocks (Ch. 370)

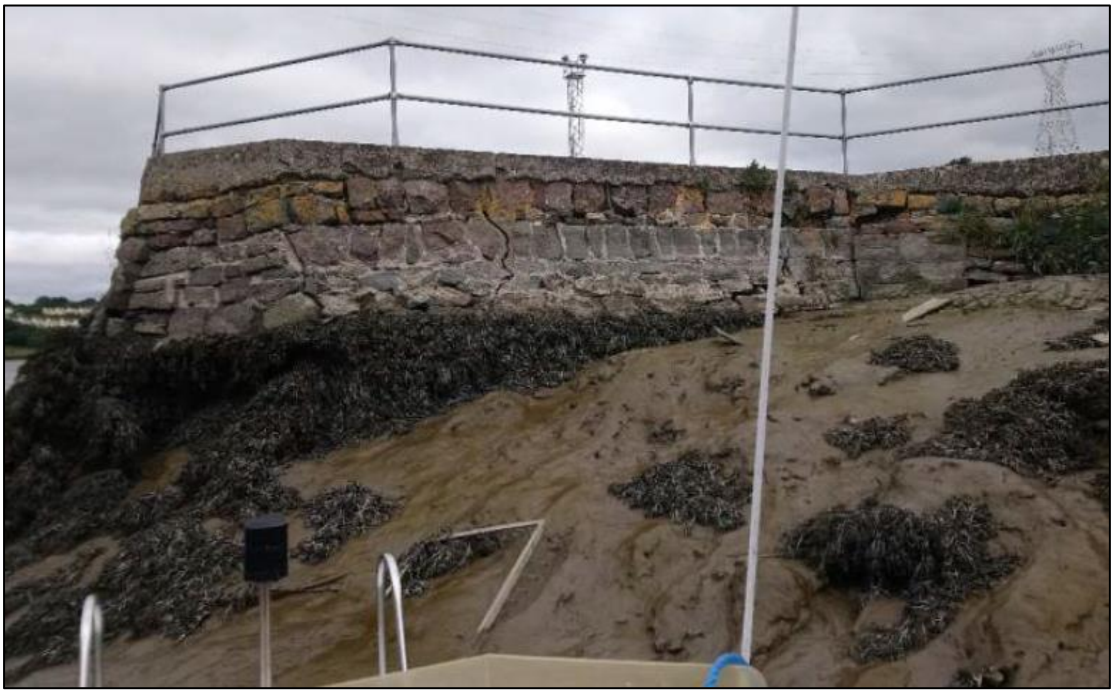

Plate 2.6 **Defects on the existing quay wall – large displacement and rotation of the wall (Ch. 540)**

Plate 2.7 **Defects on the existing quay wall – Dislodgement of blocks, mortar washout, several phases of wall upgrades (Ch. 550)**

It is considered likely that the flood events are related to high tide levels in the River Suir and are often compounded by strong south easterly winds pushing water back up the river. They are not particularly driven by high rainfall, however this may have occurred concurrently. The flood waters frequently enter into Iarnród Éireann lands and affect the railway infrastructure with subsequent impacts on both rail freight and commuter services. Plate 2.8 illustrates the extent of flooding within the Plunkett Station during the October 2020 flood event. This shows the passenger rail line completely flooded almost to platform level (height of 0.915m).

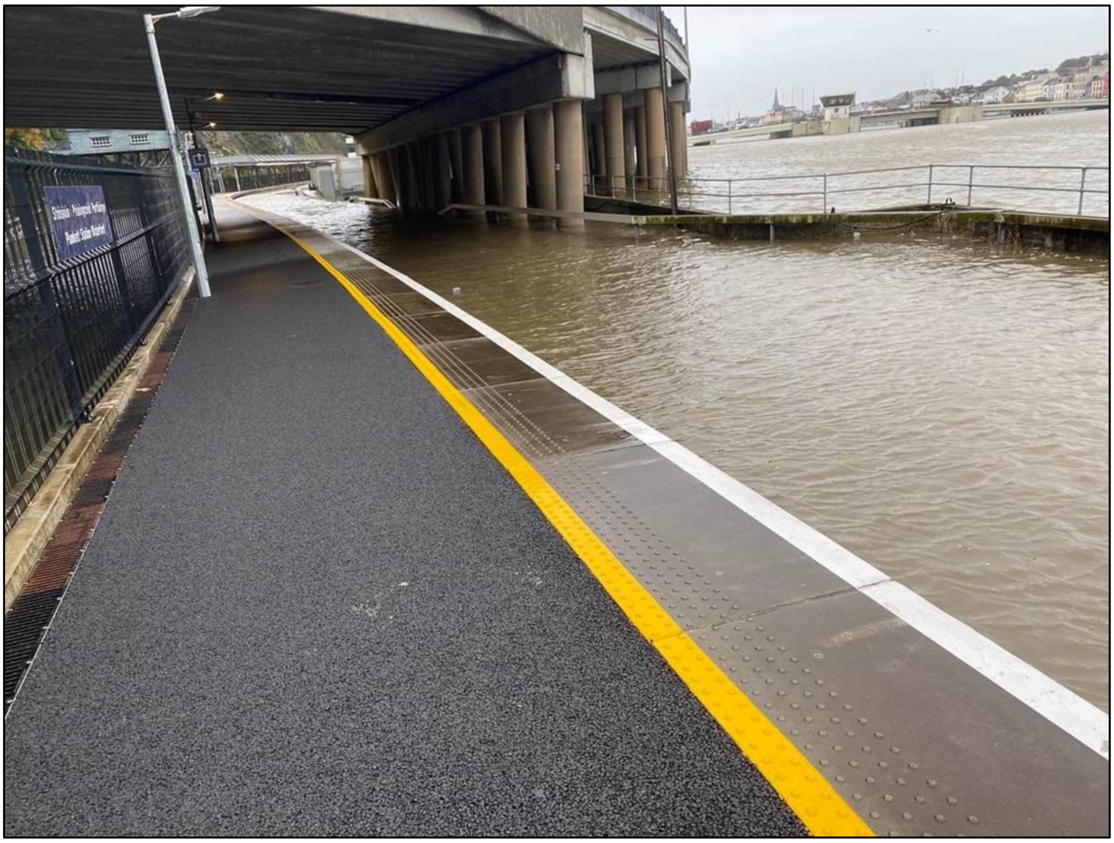

Plate 2.8 Flooding at Waterford (Plunkett) Station in October 2020

The OPWs "The Planning System and Flood Risk Management - Guidelines for Planning Authorities" (2009) states that new "*essential infrastructure, such as primary transport"* (e.g., railways) are classified as 'highly vulnerable developments'. The Guidelines further state that 'highly vulnerable developments' should be protected in the 1 in 1,000-year flood event, including an allowance for climate change. Plunkett Station, the future SDZ Transportation Hub and the railway line between these points can be considered as "essential infrastructure" and can be classified as a "highly vulnerable development". Therefore, it is essential that this infrastructure is protected into the future against extreme flood events (1 in 1,000-year flood event), while also future proofing against increases in flood levels due to climate change.

2.3 Overview of the Need for the Proposed Development

As outlined in the above section, flooding of the existing railway line at and to the west of Plunkett Station impedes on the operation of the railway service to and from Waterford City and has the potential to damage the rail infrastructure. The need for protection of the existing infrastructure and to build resilience against climate change induced flood events is outlined at national, regional, and local planning policy. The development of flood defence measures will enable future development of the Waterford North Quays in a sustainable manner as well as preserving the existing rail infrastructure in proximity of Plunkett Station. The proposed development will also facilitate the upgrade of rail infrastructure proposed as part of the separately approved SDZ Transport Hub.

2.3.1 Objectives of the Proposed Development

The objectives of the Flood Defences West are as follows:

- To protect the existing and future rail infrastructure in the vicinity of Plunkett Station and the proposed Transport Hub from fluvial and tidal flooding.
- To future proof rail commuter services arriving to and departing from Waterford City and maintaining Intercity sustainable public transport links.
- To prevent disruption to traffic in the vicinity of Rice Bridge from future flood events.
- To support the growth of Waterford City in a sustainable manner by protecting lands on the northern bank of the River Suir from flood related impacts.
- To support Waterford City in building its resilience against flooding induced by climate change.

2.4 Supporting Studies

2.4.1 Flood Defences West – Site Specific Flood Risk Assessment

Waterford City and County Council commissioned ROD to complete a Site – Specific Flood Risk Assessment (SSFRA) for the proposed development as part of the design process. The SSFRA identified the proposed Flood Defences West as falling under a category of developments classified as flood control infrastructure as per '*The Planning System and Flood Risk Management Guidelines for Planning Authorities'* (OPW, 2009) and that it is a water-compatible development, signifying that it's not vulnerable to flooding. The primary sources of flood risk identified as part of the assessment for the site of proposed development are from combination of tidal/fluvial events emanating from the River Suir. The SSFRA (see Appendix 10.1 of this EIAR) concluded that the proposed development will serve existing and future development within Waterford City and environs. The proposed project shall reinforce the transportation network, which will assist in achieving strategic planning objectives in the immediate vicinity and County Waterford as a whole.

2.4.2 Flood Protection West of Plunkett Station – Scoping Report

ROD undertook a scoping exercise to determine the likely cause of the persistent flooding experienced on the railway line in the vicinity of Plunkett Station, and to define the scope of services which should be undertaken in order to develop flood risk management infrastructure proposals, to provide the appropriate standard of flood protection to the railway line and the relocated train station.

The report titled "Flood Protection West of Plunkett Station – Scoping Report" which was completed in January 2020 identified multiple flood events in the vicinity of Plunkett Station over the 16-year period 2002-2018. Plate 2.9 below shows flooding at Plunkett Station on the 17th of October 2012. The flood level recorded for this event at Adelphi Quay (1.1 km downstream of Plunkett Station) was 2.77m OD.

Plate 2.9 Flooding at Plunkett Station on the 17th of October 2012

It was found that all flood events were related to high tide levels in the River Suir, which are often compounded by strong south easterly winds. The report determined that during frequent, low severity flood events, while water may encroach on the railway line and cause disruption to services, once the tide falls, these waters can recede and flow over the edge or through the existing quay wall.

This Scoping Report proposed a design concept for the flood protection measures west of Plunkett Station based on the completion of the topographical survey & utility survey work, and an assessment of the flood risk and further hydrological assessments of the catchment. The impact of flooding and the key design considerations identified by the Scoping Report are outlined in Table 2.1 below.

Table 2.1 Main Findings of the Flood Projection West of Plunkett Station Scoping Report

Section of Quay Wall Note 1	Impact of Flooding
Ch.150 to Ch.320	Existing quay wall comprises varying wall heights and structure types along the section. To adapt for climate change existing quay wall height will need to increase, otherwise this Section will become a weak point in the flood defences Risk of flooding at Plunkett Station and railway line east of Plunkett Station for an event > 1:20 year (excl. climate change) Likely damage to signalling, automated points in flood event.

Section of Quay Wall Note 1	Impact of Flooding
Ch.320 to Ch.1090	Existing quay wall top of wall level is too low. Sections of the existing Quay Wall are in poor condition, with wall sections missing and evidence of rotational displacement and failure. Risk of major flooding at Plunkett Station and railway line east of Plunkett Station. Risk of inundation during a high tide event, leading to significant flooding at low point on railway line at Plunkett Station. Risk of frequent localised flooding of railway line during minor events. Likely damage to signalling, automated points in flood event.

Note 1: The chainages have been updated since the publication of the Flood Projection West of Plunkett Station Scoping Report. The chainages identified in this table are updated as per the chainages illustrated in Figures 4.1 to 4.6 in Volume 3 of the EIAR.

2.5 Policy Context

The need for protection of the existing railway infrastructure and future development against existing flooding and the effects of future climate change impacts has been identified in a number of European, national, regional, and local planning policy documents. The relevant policy documents have been reviewed and it has been established that the proposed development has been identified in, and is consistent with, an array of policy documents listed in Table 2.2.

Table 2.2 Overview of Policy Documents which Support the Proposed Development

Policy Level	Policy Document
European	The EU Floods Directive
National	Project Ireland 2040, National Planning Framework and National Development Plan, 2018 – 2027;
	Investing in the Transition to a Low-Carbon and Climate-Resilient Society 2018-2027
	National Adaptation Framework: Planning for a Climate Resilient Ireland
Regional	Southern Regional Spatial and Economic Strategy (S-RSES)
Local	Waterford City Development Plan 2013-2019 (as extended)
	Kilkenny City and County Development Plan 2021 - 2027
	Ferrybank Belview Local Area Plan (LAP) 2017 – 2023
	Waterford North Quays SDZ Planning Scheme 2018
	Climate Change Adaptation Strategy 2019 – 2024

2.5.1 European Policy Context

2.5.1.1 EU Floods Directive

On November 2007, the Directive 2007/60/EC on the assessment and management of flood risks entered into force. The Directive aims to reduce and manage the risks that floods pose to human health, the environment, cultural heritage, and economic activity. The Directive requires the Member States:

- By 2011 to carry out a Preliminary Flood Risk Assessment (PFRA) to identify the river basins and associated coastal areas at risk of flooding;
- By 2013 to draw up flood risk maps for areas identified under the PFRA to be at risk from flooding; and
- By 2015, to prepare Flood Risk Management Plans (FRMPs) for the areas identified under the PFRA to focus on prevention, protection, and preparedness.

The preparation of the FRMPs and the river basin management plans under the Directive are to be carried out in coordination with the Water Framework Directive (WFD). In preparation of the aforementioned plans, the Member States are to take into consideration long term developments, including climate change, as well as sustainable land use practices in the flood risk management cycle.

2.5.2 National Policy Context

2.5.2.1 Project Ireland 2040: National Planning Framework and the National Development Plan 2018 - 2027

The National Planning Framework (NPF) is the Government's long-term strategic planning framework guiding national, regional and local planning and investment decisions over the next 25 years. The NPF companion document is the National Development Plan (NDP), a ten-year strategy for public capital investment of almost €166 Billion known as the 'Project Ireland 2040'. Their joint publication is intended to create a unified and coherent plan for the country aligning the investment strategy with strategic planning documents.

The overarching ambition of the NPF is to *"to create a single vision, a shared set of goals for every community across the country"* by achieving a number of goals including, but not limited to the following:

- Guide the future development of Ireland, taking into account a projected 1 million increase in our population by 2040.
- Of the 1 million extra people,
    - 50% of growth to occur in key regional centres, towns, villages and rural areas, to be determined in the forthcoming regional plans – Regional Spatial and Economic Strategies (RSESs).
- Regenerate rural Ireland by promoting environmentally sustainable growth patterns;
- Plan for and implement a better distribution of regional growth, in terms of jobs and prosperity;
- Co-ordinate delivery of infrastructure and services in tandem with growth, through joined-up NPF/National Investment Plan and consistent sectoral plans, which will help to manage this growth and tackle congestion and quality of life issues in Dublin and elsewhere.

These goals are expressed in the Framework across ten National Strategic Outcomes (NSOs), as illustrated in Plate 2.10 and have taken into account the overarching themes of wellbeing, equality, and opportunity.

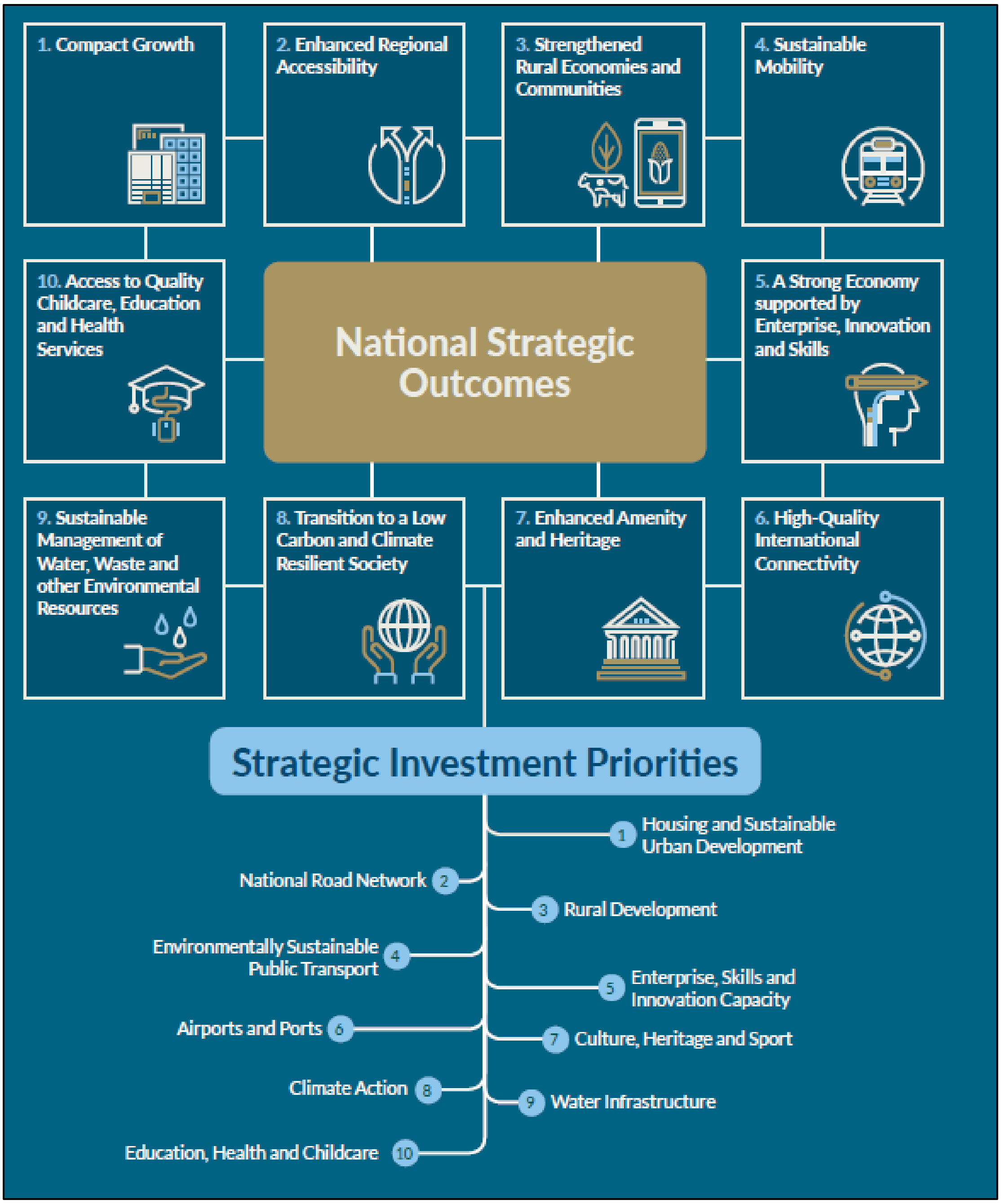

Plate 2.10 National Strategic Objectives and Strategic Investment Priorities (NPF)

The NPF recognises the need for a planned and co-ordinated development of our existing cities and towns. It states that 40% of Ireland's population lives within 5km of the coast including all of our major cities which are the most densely populated parts of the country.

Climate change is a key issue for planning and flood risk management, particularly in existing coastal settlements such as Waterford City, where future development and population growth is being targeted and supported by the National Development Plan

(NDP). Flooding induced by extreme weather events and sea level rise are some of the key issues of climate change and poses a major threat to existing settlements.

The proposed flood defence measures will protect the existing rail infrastructure and any future built infrastructure envisaged for the north bank of Waterford City and will support the delivery of objectives under the following five NSOs:

1. **NSO 1** Compact Growth: by protecting the area from potential flooding, the proposed development supports the sustainable development of Waterford City on the northern side of the River Suir.
2. **NSO 2** Enhanced Regional Accessibility and **NSO 4** Sustainable Mobility: the proposed development will protect the existing rail corridor from flood events into the future and will eliminate existing flood related disruption to rail services arriving to and departing from Waterford City. The proposed development will also facilitate the development of the separately proposed Transportation Hub, which was granted planning permission in 2019 and which will enhance the City's regional connectivity through rail, as a sustainable transport method.
3. **NSO 8** Transition to Low Carbon and Climate Resilient Society: The proposed development will protect the public transport rail network in Waterford City from flooding, and in turn, will support the transition to a low carbon and climate resilient society.
4. **NSO 9** Sustainable Management of Water, Waste and other Environmental Resources. Under NSO 9, the NPF states that it will:

   "Coordinate EU Flood Directive and Water Framework Directive implementation and statutory plans across the planning hierarchy, including national guidance on the relationship between the planning system and river basin management. Local authorities, DHPLG, OPW and other relevant Departments and agencies working together to implement the recommendations of the CFRAM programme will ensure that flood risk management policies and infrastructure are progressively implemented"

   "Improve storm water infrastructure to improve sustainable drainage and reduce the risk of flooding in the urban environment;"

   The proposed development supports the sustainable management of water resources by upgrading the existing drainage system and flood defence measures along the north bank of Waterford City, reducing the risk of flooding of these lands.

To deliver the desired NSOs, the Framework developed a series of National Policy Objectives (NPOs) that will set a new way forward for regional and local planning and sustainable development policy in Ireland. The key NPOs for coastal environment, such as Waterford City, and planning for climate change, are:

NPO 41a *"Ensure that Ireland's coastal resource is managed to sustain its physical character and environmental quality"*

NPO 41b *"In line with the collective aims of national policy regarding climate adaptation, to address the effects of sea level changes and coastal flooding and erosion and to support the implementation of adaptation responses in vulnerable areas"*

The proposed flood defences will protect the railway corridor, including Plunkett Station and the associated rail infrastructure against coastal, tidal, and combined flood events. The proposed development will also support the implementation of the NSOs and NPOs identified in the NPF and NDP respectively.

2.5.2.2 Investing in the Transition to a Low-Carbon and Climate-Resilient Society 2018-2027

The effects of climate change are beginning to have an impact on Ireland's environments, economy, natural resources, and society. The key issues attributed to climate change are predicted to include more intense storm and rainfall events, sea level rise as well as more frequent and more intense river and coastal flooding events. In 2011, 300 areas, including Waterford City, were identified by the Government as being potentially at significant risk from flooding and "together account for 80% of Ireland's potential flood risk from rivers and seas, the primary source of flooding in Ireland". In response to climate change, the Irish Government aims to transition to a low carbon economy and to create a climate resilient society. To achieve this, investment into several areas have been targeted to make the transition, as well as to build resilience to climate change, as outlined in this policy document. A total of €940m has been allocated for the development of flood defences which will enable Ireland to become more resilient to the effects of climate change.

The Strategic Flood Risk Assessment (SFRA) conducted for Project Ireland 2040 identified that Waterford City is subject to coastal flooding and to fluvial flooding from the Suir river catchment. The SFRA identified that some areas within the North Quays SDZ, are at risk from fluvial and tidal flooding. The SFRA states that *"regeneration needs to be sustainable and should consider the Planning System and Flood Risk Assessment Guidelines for Planning Authorities (2009) and Circular PL02/2014 (August 2014). The circular specifically addresses regeneration areas and flood risk management of their development".* The proposed flood defences will protect the lands along the northern bank of the River Suir and the railway infrastructure against coastal and fluvial flood risk.

2.5.2.3 National Adaptation Framework: Planning for a Climate Resilient Ireland

The National Adaptation Framework (NAF) has been developed to address current and future risks associated with climate change, including impacts attributed to increase in heavy rainfall events, intensity of storms, sea level rise etc.

The NAF acknowledges that changes in Ireland's climate correlate with the global trends; temperature increased by approximately 0.8ºC between the 1900-2020 period and due to a slow response time of the climate system, changes in temperature are predicted to increase over the coming decades.

Specifically to Ireland, average annual rainfall has increased by approx. 60mm, or 5% in the 1981 to 2020 period, compared to the 30-year period between 1961 and 1990. The number of annual frost days has decreased while the number of warm days has increased. The sea level rise has been observed to increase by 1.7cm per decade since 1916 in Newlin (southwest England), which is considered to be representative of the situation in the south of Ireland, such as Waterford.

The NAF recognises that climate change will have a negative impact on a number of key socio, economic and environmental sectors including the following:

- **Critical infrastructure:** encompassing transport, emergency, water, energy, and communications services that are at risk from a range of climate induced impacts such as sea level rise, changing rainfall patterns, increasing temperature and extreme weather events.
- **Water Management:** climate change induced impacts are likely to pose a significant risk to water management by intensifying the pressures associated with flooding, provision of adequate water supply, and quality.

- **Human Health and wellbeing:** increase in extreme weather events is likely to have a significant impact on human health and wellbeing by increasing the risk of physical injuries / death and sustaining mental health effects related to potential loss and displacement from flooding.

In response to climate change, the NAF aims to set up effective adaptation strategies to reduce the vulnerability of Ireland's environment, society, and economy and to increase its resilience to the effects of climate change. The NAF identified an array of adaptation measures that *"enhance adaptive capacity of social, industrial and environmental infrastructures and mitigate the effects of climate change"*. Adaptation measures have been categorised in the NAF as follows:

- *"Soft adaptation involves alteration in behaviour, regulation or system of management,*
- *Green adaptation measures seek to utilise ecological properties to enhance the resilience of human and natural systems to climate change impacts.*
- *Grey adaptation measures involve technical or engineering solutions to climate impacts"*

Building new or raising the level of existing flood defences is an example of 'grey' adaptation measures.

The rail corridor servicing Waterford City is particularly susceptible to both river and coastal flooding due to its proximity to the tidal estuary of the River Suir. The proposed development will provide protection to the rail corridor, a critical piece of infrastructure, against existing and future flood risk and will support Waterford City in building its resilience to climate change.

2.5.3 Regional Planning Context

2.5.3.1 Southern Region Regional Spatial and Economic Strategy (RSES)

Arising under the Local Government Reform Act 2014, the Southern Regional Assembly has assumed a number of new functions. Chief among these responsibilities is the preparation of a Regional Spatial and Economic Strategy (RSES) for the Southern Region. The Southern Regional Assembly prepared the Regional Spatial and Economic Strategy (RSES) in 2020. The RSES provides a framework for the implementation of policies and objectives under the National Planning Framework (NPF) at regional level.

Objectives RPO 89 and RPO 119 of the RSES support measures outlined in the 'Investment in the Transition to a Low Carbon Society 2018-2027' to address climate change induced effects and to ensure transition to low carbon economy:

<u>RPO 89: Building Resilience to Climate Change</u>

"Local Authorities and other public agencies shall continue to work with the Office of Public Works to implement the Flood Risk Management Plans and address existing and potential *future flood risks arising from coastal, fluvial, pluvial, groundwater and potential sources of flood risk".*

<u>RPO 119: Flood Relief Schemes</u>

a. "Support investment in the sustainable development of Strategic Investment Priorities under the National Development Plan 2018-27 and to ensure that flood risk assessment for all strategic infrastructure developments is future-proofed to consider potential impacts of climate change;

b. *"Support investment in subsequent projects by capital spending agencies to deliver flood relief schemes under National Strategic Outcome: Transition to a Low Carbon and Climate Resilient Society. Such projects should be future proofed for adaptation to consider potential impacts of climate change.*

c. *"All Infrastructure and energy providers/ operators should make provision for adaptation measures to protect strategic infrastructure (including roads, railways, ports and energy infrastructure) from increased flood risk associated with climate change".*

The importance of flood defences in maintaining a good water quality status has also been highlighted in RPO 112:

RPO 112: Water Quality

"It is an objective to support commitments to achieve and maintain "At Least Good" status, except where more stringent obligations are required, and no deterioration of status for all water bodies under the Marine Strategy Framework Directive and its programme of measures, the Water Framework Directive and the River Basin Management Plan. Key challenges include, inter alia, the need to address significant deficits in urban waste-water treatment and water supply, addressing flooding and increased flood risks from extreme weather events and increased intense rainfall because of climate change".

Waterford Metropolitan Area Strategic Plan (MASP)

The Southern RSES seeks to align with the NPOs and the goals set out in the NPF, including NPO 7 which seeks to accelerate the development of Waterford, Cork, and Limerick to grow by at least half of the 2016 Census population, i.e., by 60% by 2040.

The Waterford Metropolitan Area Strategic Plan (MASP) was developed as part of the RSES to meet the required population growth targets of NPO 7 by providing a high-level strategic framework for the sustainable growth of Waterford City "*both north and south of the River Suir*" (see Plate 2.11). The objective of Waterford MASP is for the City to become an essential driver of national growth and a 'Regional City of Scale'.

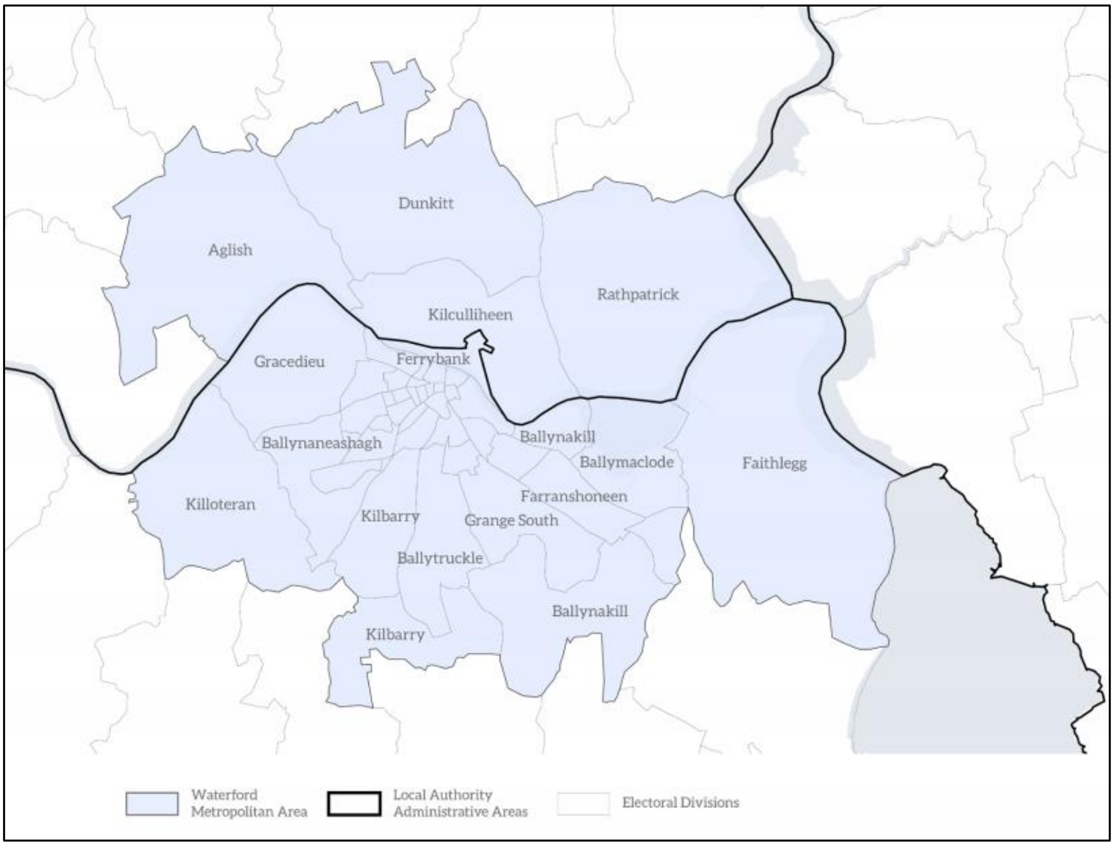

Plate 2.11 Waterford Metropolitan Area. Source: Southern Regional RSES 2020 – 2040

To meet the growth targets identified in NPO 7, the MASPs are prepared in accordance with four Regional Planning Objective (RPOs), including RPO 9 which aims to deliver and future proof infrastructure in each City, including Waterford:

RPO 9: Holistic Approach to Delivering Infrastructure

"It is an objective to ensure investment and delivery of comprehensive infrastructure packages to meet growth targets that prioritise the delivery of compact growth and sustainable mobility as per the NPF objectives including:

Water services, digital, green infrastructure, transport and sustainable travel, community and social, renewable energy, recreation, open space amenity, climate change adaptation and future proofing infrastructure including flood risk management measures, environmental improvement, arts, culture and public realm".

The Waterford MASP was also developed with reference to the objectives listed under seven strategic 'Goals' for the development of the metropolitan areas. The proposed development will facilitate the achievement of objectives prescribed under the following Goals:

Goal 1 Sustainable Place Framework:

- *"Enhancing the quality of our existing places through retrofitting a high standard of infrastructure, services and amenities that improve the liveability and quality of place in existing settlements and communities, especially locations that experienced significant new population growth in the past (such as metropolitan towns) and existing areas experiencing positive growth (such as city centre neighbourhoods).*

- *Resilience to climate change and flooding*".

Goal 2 Excellent Connectivity and Sustainable Mobility:

- *"Inter-regionally through efficient rail, road, bus networks and services.*
- *To achieve efficient mobility, with close alignment between home and work locations, ease of travel on sustainable transport modes, efficient and sustainable movement of freight and logistics, guaranteed journey times for inter-city and inter-regional travel".*

The proposed development supports the RPOs of the RSES document listed above by addressing existing and potential future flood risks and future proofing rail infrastructure. In addition, the proposed development will enhance the quality of the existing areas on the north bank and facilitate the sustainable development of Waterford City, while building its resilience against climate change induced impacts, such as flooding. The proposed development will future proof the Waterford railway station, Plunkett Station, and associated rail infrastructure from future flood events, ensuring that inter-regional sustainable travel is safeguarded. By protecting the rail infrastructure from extreme weather events, the proposed development will minimise impacts on journey times for freights and rail Inter-City commuter services as a result of flooding.

2.5.4 Local Planning Context

2.5.4.1 Waterford City Development Plan 2013-2019 (as extended)

The Waterford City Development Plan sets out a strategy which guides the proper and sustainable development of Waterford City for the 2013 – 2019 period. The Development Plan identifies Waterford City as being particularly susceptible to climate change induced flooding. The City is situated on a tidal estuary of River Suir which currently floods the low-lying areas. The existing Waterford railway station, Plunkett Station, is located within Flood Zone A and is susceptible to both fluvial and tidal flooding. Flooding within the City is predicted to become more frequent and severe due to climate change. One of the core strategy objectives of the Development Plan (OBJ 2.1.10) is *"to require new development to account for known and anticipated climate change impacts including flood risk"*.

Consequently, all future developments are required to consider potential flood risk issues as outlined in the following planning policies:

POL 11.7.1

"Applications for development on lands identified on the SFRA maps, shall be subject to a site specific Flood Risk Assessment appropriate to the type and scale of the development being proposed, and pass the Development Management Justification Test as detailed in the Flood Risk Management Guidelines in accordance with the Planning Guidelines requirements and those of the Waterford City SFRA"

POL 11.7.3

"All applicants shall primarily be responsible in the first instance when making a planning application for assessing whether there is a flood risk issue and how it will be addressed in the development they propose"

The proposed development is located within lands zoned as Flood Zone A as identified by the Waterford City SFRA. The proposed flood defence measures will protect the existing Plunkett Station and the railway tracks west of the train station from future flooding by incorporating the projected effects of climate change into its design and will support further development of the City in the north quays area.

Draft Waterford City and County Development Plan 2022 - 2028
Draft Waterford City and County Development Plan (CCDP) for the 2022 – 2028 period has been prepared and is currently being reviewed following public consultation. While the draft has not yet been adopted, it has been reviewed to ensure that the proposed development is consistent with the draft policies and objectives.

The draft Waterford CCDP supports the Key Future Growth Enablers for Waterford City set out in the NPF, Southern Region RSES and Waterford MASP.

In relation to rail transport, the General Public Transport Policy Objective **Trans 22** in the Draft Plan aims to *"support the optimal use of the rail network, in catering for the movement of people and goods and thereby enhance the economic corridor between Dublin and Waterford City and the Key towns of Kilkenny and Carlow, Clonmel and Wexford Town"*.

The proposed Flood Defences West development will protect the Waterford – Dublin railway line against existing and future flood risk and will support Objective **Trans 22** to optimise the use of the railway line for commuter services and freight transport.

2.5.4.2 Kilkenny City and County Development Plan –2021 - 2027

The Kilkenny City and County Development Plan (CCDP) for the 2021 to 2027 period has been made by Kilkenny County Council (KCC) on 3rd of September 2021 and came into effect on the 15th of October 2021.

The Plan identifies that 57.60sq.km of the area subject to the Waterford MASP is within the administrative area of KCC. The National Planning Objective (NPO 8) of the National Planning Framework (NPF) sets out a 60% minimum population growth for Waterford City and Suburbs by 2040. The Kilkenny CCDP acknowledges that this will require targeted growth on both south and north sides of the River Suir focussed on development of significant housing and employment locations.

The northern suburb of Ferrybank is within the administrative area of KCC and is also included in the Waterford MASP area. The Kilkenny CCDP is supportive of the Waterford MASP as outlined in the RSES, which identifies policy objectives supporting sustainable mobility and improved regional connectivity to / and from Waterford, including rail connectivity.

Furthermore, the Plan states that KCC will *"ensure that new developments do not reduce the effectiveness or integrity of any existing or new flood defence infrastructure, and will facilitate the provision of new, or the reinforcement of existing, flood defences and protection measures where necessary" [pp. 183]*.

The proposed Flood Defences West will form a continuation of the flood defences east which received planning approval as part of the SDZ Transportation Hub and will cumulatively protect the Waterford City North Quays area against existing and future flood risk. As such, the proposed development will assist the Kilkenny CDP to provide new flood protection measures and to realise its sustainable development objectives by enabling sustainable growth of areas on the northern side of the River Suir, such as Ferrybank.

2.5.4.3 Ferrybank Belview Local Area Plan 2017 - 2023

The Ferrybank Belview Local Area Plan (LAP) 2017 – 2023 outlines a strategy for the proper planning and sustainable development of an area of land stretching from Grannagh to Belview and from the River Suir to the line of the Waterford bypass. The Ferrybank Belview LAP area is located adjacent to the lands to be protected as part of the proposed Flood Defences West.

The Ferrybank Belview LAP supports the development strategy set out in the Waterford Planning, Land Use and Transportation Study (PLUTS) to achieve a balanced and sustainable growth of Waterford. The PLUTS proposed to bring the "*North Quays and the Suburbs* fully *into the social and economic domain of the City"*. To achieve this overarching objective, the study advocated for future growth to be distributed between the north and south quays of the city, including Ferrybank. The principal goals included in PLUTS include, but are not limited to, the following:

- Provision for a population increase of almost 30,000 people, or 57% population growth, in Waterford City and Environs between 2004 and 2020;
- Requirement for approximately 11,500 new dwellings located both north and south of the River Suir;
- Provision of a rail-passenger platform on the North Quays as part of a new Public Transport Interchange;

The proposed development will assist Ferrybank Belview LAP to realise its sustainable growth objectives by protecting the areas on the northern bank of River Suir from potential flood events. Proposed Flood Defences West will form a continuation of the flood defences east which received a planning approval as part of the SDZ Transportation Hub and will cumulatively protect the rail infrastructure in the City against existing and future flood risk.

2.5.4.4 Waterford North Quays SDZ Planning Scheme 2018

The Government designated lands on the North Quays in Waterford City as a SDZ on 20th January 2016. SDZ designations are created to facilitate development which in the opinion of the Government is of economic or social importance to the State. Waterford City and County Council as the 'Development Agency' prepared the North Quays SDZ Planning Scheme which was adopted by the elected members of Waterford City and County Council in February 2018. The Planning Scheme sets out a Vision to:

- To create a sustainable, compact extension to the City Centre that will serve a future population of 83,000 people.
- A regeneration catalyst for the City and Region and the establishment of a sustainable modern city quarter.
- Creation of an integrated multi-modal transport hub designed to sustainably meet the access requirements of The City.
- Building on the context and the riverside location of the site to create a high-quality urban quarter as a natural extension of the City Centre.

The Planning Scheme vision is supported by a range of principal goals, including, but not limited to, the following:

- To promote the expansion of the City Centre to the north of the River Suir in a manner that enhances and supports balanced and sustainable growth in Waterford City and encourages its vitality and viability

- To create a sustainable urban environment, which respects it's natural, historic and cultural heritage.
- To provide sustainable solutions that address and manages the risk of flooding and climate change.

Plate 2.12 Photomontage of the Waterford SDZ development site. Source: Waterford SDZ Planning Scheme 2018

The proposed Flood Defences West will form a continuation of the flood defences east which received a planning approval as part of the SDZ Transportation Hub and will cumulatively protect the Waterford City North Quays area against existing and future flood risk. As such, the proposed development will assist the sustainable development of the Waterford SDZ site.

2.5.4.5 Climate Change Adaptation Strategy 2019 – 2024

The Climate Change Adaptation Strategy for the 2019 to 2024 period prepared by Waterford City and County Council (WCCC), forms part of the Ireland's national strategy for climate adaptation as set out in the National Adaptation Framework (NAF) to deliver the national transition objective to a low carbon society and a climate resilience future.

This adaptation strategy provides the Local Authorities' primary tool at a local level to:

- *"Ensure a proper comprehension of the key risks and vulnerabilities of climate change*
- *Bring forward the implementation of climate resilient actions in a planned and proactive manner.*
- *Ensure that climate adaptation considerations are mainstreamed into all plans and policies and integrated into all operations and functions of the LA".*

The adaptation strategy has undertaken a baseline assessment to identify the potential future climate hazards that may have an impact on WCCC infrastructure and the population of the county by reviewing historic extreme weather events using Met Éireann and WCCC data, in addition to data from the local sources, such as libraries.

Based on the information, the climate hazards that are relevant to County Waterford include extreme wind events, extreme heat/drought events and extreme rainfall/flood events. Over the past 211 years, 20 extreme events have been attributed to extreme rainfall/flood events, 5 of which have been recorded in the past 20 years.

WCCC identified the potential impacts associated within each climate hazard, including extreme rainfall/flood events on infrastructure and the population. To alleviate and eliminate these potential impacts, high level adaptation goals have been established under eight 'Operational Areas' of WCCC. The proposed Flood Defences West are likely to alleviate the potential impacts associated with extreme rainfall/flood events under two of the WCCC operational areas; 'Infrastructure & Built Environment' and 'Water Services', as discussed below.

Infrastructure & Built Environment

According to the strategy, the potential impacts from extreme rainfall/flood events on Infrastructure & Built Environment include, but are not limited to the following:

- *"Affect critical infrastructure through flooding and inundation. Damage to critical infrastructure will impact the function of transport routes, resulting in increased costs of clean up, maintenance, repair and have a wider economic impact.*
- *Failure of WCCC's flood defence system and barriers would be likely due to increased rainfall requiring modification and upgrade of the current system along with construction of new barriers in predicted flood prone locations.*
- *Rising sea levels will quite likely see more extensive damage of low-lying coastal roads and an increase in flood plain areas both coastally and in land. Many low-lying buildings will likely be exposed to more intense storms resulting in coastal erosion which will require coastal protection measures to be implemented.*
- *Coastal infrastructure such as piers / harbours will require additional protection*".

The high-level goals identified within the strategy to alleviate the potential impacts include, but are not limited to the following:

- *"To increase the resilience of roads and transport infrastructure to the impacts of extreme weather events.*
- *To ensure and increase the resilience of critical infrastructure and infrastructural assets."*

The proposed development will protect the railway corridor in Waterford City, a critical piece of infrastructure from future flood events by including provision for climate change into its design.

Water Services

The potential impacts from extreme rainfall/flood events on Water Services as outlined in the strategy which include, but are not limited to the following:

- *"With a higher risk of flooding and inundation and more impactful storm surges, this will result in significant impacts on property, land and critical infrastructure affecting the economic viability of certain areas and increasing further the vulnerability of communities.*
- *Extreme rainfall events will increase the risk of impacting water quality and the ability of the LA to meet the requirements of the WFD.*
- *Rising sea levels will affect coastal region water supplies due to the infiltration of sea water into ground water aquifers as the barrier between sea and freshwater is diminished, resulting in salinization of the groundwater supply.*

- *Flood water drains would likely become completely submerged with rising sea levels requiring existing drain systems to be elevated."*

High-level goals are identified within the strategy to alleviate the potential impacts on Water Services which include, but are not limited to the following:

- *"To implement adaptation measures to limit the risk and impact of urban flooding.*
- *To provide and plan for effective drainage systems."*

The proposed development will reduce the risk of urban flooding through the provision of flood defences measures along the northern bank of Waterford City, protecting the existing and future built infrastructure from future flood risk. The proposed development will also upgrade the existing drainage network and will include the provision of new surface water outfalls to remove excess runoff in high rainfall events, reducing the risk of water quality impacts. The proposed development will therefore support the goals of the Strategy as outlined above and will mitigate a number of the potential impacts outlined which are likely to occur as a result of future climate hazards.

2.5.4.6 Summary

The proposed development supports national, regional, and local policies and seeks to protect the existing built infrastructure, namely the existing Plunkett Station and the associated rail infrastructure in Waterford City from flood damage. The proposed development will also support the sustainable growth of Waterford City on the north side of River Suir and will support the City in building its resilience against flooding induced by climate change.

Waterford City and County Council is developing the proposed Flood Defences West in consultation with all relevant stakeholders and will be cognisant of the relevant policies and guidance documents.

Chapter 3
Alternatives Considered

Chapter 3 Alternatives Considered

3.1 Introduction

EIA Directive 2011/92/EU (as amended by Directive 2014/52/EU), Article 5(d) requires that the information to be provided by the developer shall include *"a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment*". This chapter has identified the flood defence options considered during the project development and the reasons why the proposed design was chosen.

3.2 Study Area

The study area of the proposed development is located on the north bank and within the foreshore of the River Suir in Waterford City and is bound to the north by the existing road infrastructure and the Iarnród Éireann railway corridor serviced by the Plunkett Station, the Waterford railway station. Plunkett Station is bounded to the north by a steep rock slope which is subject to rock stabilisation works as part of the overall Waterford City Public Infrastructure Project. To the south, the railway corridor is bounded by the existing quay wall and the River Suir as shown in Plate 3.1 below. The assessment of alternatives was limited to the northern bank of the River Suir, where Plunkett Station, its associated rail infrastructure and Rice Bridge Roundabout are located.

Plate 3.1 Study Area – View east towards Plunkett Station and Rice Bridge from the west

3.3 Key Constraints Identified

The constraints for the proposed Flood Defences West were identified through desk study and site surveys to determine the physical, environmental and engineering constraints which exist, and which could affect the design and progress of the proposed development. The main constraints identified are listed below and have been considered during the assessment of alternatives.

3.3.1 Biodiversity

The principal ecological constraint identified was the requirement to protect and enhance the conservation objectives of the Lower River Suir Special Area of Conservation (SAC) (site code 002137). The Lower River Suir SAC supports a range of Annex II species and Annex I habitats. Benthic surveys have been undertaken to confirm the presence of habitats and species on site. Hydrodynamic modelling has been undertaken, and a Natura Impact Statement (NIS) has been prepared for the proposed development. Consultations with National Parks and Wildlife Service (NPWS), Inland Fisheries Ireland (IFI) and the Department of Housing, Local Government and Heritage regarding the application for a foreshore licence have also been carried out as part of this process.

Other Natura 2000 and designated sites within the Zone of Influence (ZOI) of the proposed development are identified in Table 3.1 below.

Table 3.1 Designated sites within the Zone of Influence of the Proposed Development

Designated Site [site code]	Distance from the proposed development
European Sites	
Lower River Suir SAC [002137]	Immediate proximity
River Barrow and River Nore SAC [002162]	9 km downstream
Nationally Designated Sites	
Ballyhack pNHA [000695]	14.5 km downstream
Barrow River Estuary pNHA [000698]	9 km downstream
Duncannon Sandhills pNHA [001738]	18.6 km downstream
Fiddown Island pNHA [000402]	19.3 km upstream
King's Channel pNHA [001702]	3.6 km downstream
Lower River Suir (Coolfinn, Portlaw) pNHA [000399]	12.6 km upstream
River Suir Below Carrick-on-Suir pNHA [000655]	25.1 km upstream
Tibberaghny Marshes pNHA [000411]	21.8 km upstream
Waterford Harbour pNHA [000787]	15.5 km downstream

3.3.2 Hydrology

The protection of river water quality of the Lower River Suir SAC was an important consideration throughout the project design. Compliance with the requirements of the Water Framework Directive and the protection of fish populations were key considerations of the design process. Flood risks during construction and the extents of potential flood level under various scenarios during the operation of the proposed development were also important considerations. The report titled "Flood Protection West of Plunkett Station – Scoping Report" was completed in January 2020 for the proposed development, the findings of which were incorporated into the design of the proposed development.

3.3.3 Archaeological and Architectural Heritage

There are no Architectural Conservation Areas (ACA) within the study area or its immediate environs. Cartographic sources show evidence of a number of landing stages within the site of proposed development which protruded from the northern bank into the River Suir. Remnants of these landing stages have been identified during site inspections in 2018. These timber structures facilitated the transfer of goods from shipping to the railway. The existing quay wall along the north bank of the River Suir is a cultural heritage resource.

3.3.4 Soils and Geology

Geotechnical investigations have been carried out within the study area to inform of potential contaminated land issues and ground conditions / depth to rock. All soil samples within the study area were classified as non-hazardous, however, Chloride, Sulphate, Antimony, Mercury and Fluoride were indicated to exceed the inert WAC in a number of samples. Trace levels of Asbestos (<0.001%) were detected in one sample which was taken from the southern boundary of the Sallypark Industrial Estate.

3.3.5 Structures and Utilities

The proposed development is largely located within Córas Iompair Éireann (CIÉ) lands which are operated by Iarnród Éireann (IÉ). IÉ assets within the site of proposed development include the existing railway infrastructure, utilities, Plunkett Station, and the associated car parking area(s). IÉ requires that a minimum clear distance of 2.04m is maintained between the nearest rail track and any proposed structures so as not to directly impinge on the rail line itself, or its operation. In addition, it is an IÉ requirement that construction works must not impact the normal rail traffic. These restrictions have been considered in the design of the proposed development.

A Ground Penetrating Radar (GPR) survey was carried out in 2018 along the extent of the lands west of the Plunkett Station adjacent to the existing quay wall and river embankment. The aim of the survey was to determine the nature and condition of existing rail network services, drainage, and utilities. The location of existing facilities have been taken into consideration in the design of the proposed flood defence measures.

3.4 Do-Minimum Scenario

The 'Do – Minimum' Option represents the minimum intervention, which acts as the basis against which flood defence options are appraised. The Do-Minimum Option for the project would be for the existing masonry flood defence wall to remain unchanged.

The Do – Minimum Option does not meet the project objectives and is not considered to be a feasible option for the following reasons:

- The Iarnród Éireann railway line currently floods and is susceptible to future climate change induced flooding. The frequency and the extents of the flooding are likely to increase in the future and causing a significant risk to both the public transport infrastructure and public safety; and
- Sections of the existing masonry flood defence wall are in poor condition and are likely to further degrade and collapse into the river in the near future.

3.5 Do-Something Scenario

The Do – Something Scenario consists of the construction of flood defence measures west of the North Quays development site. The proposed development will protect Waterford's railway station, Plunkett Station, and the associated rail infrastructure from existing and future flood risk. A number of Do-Something options are considered below.

3.6 Flood Defence Options Considered

The main physical constraints within the study area include the existing railway line to the north, and River Suir to the south which allow for a limited number of options to be considered as part of the assessment of alternatives. Two options, Option A and Option B were developed as part of the option selection process and are shown in Plate 3.2 below (also refer to Figures 3.1 and 3.2 in Volume 3 of this EIAR). Table 3.2 provides a description of the two options considered, both of which commence in front of Plunkett Station and continue westwards, largely parallel to the alignment of the existing quay wall.

The description of Options A and B is provided in Table 3.2 below. The design of the preferred option has been further developed since the options assessment stage, which is why the description of the proposed development in Chapter 4 of the EIAR has slightly different chainages to either of the options presented below. Further design considerations implemented for the proposed development are detailed in Section 3.9.

For the avoidance of doubt, the do-something options described in Table 3.2 below (Options A and B) were as developed for the Options Assessment stage and do not reflect subsequent design of the proposed development.

Table 3.2 Description of Options Considered

<table>
<tr><th>Chainage</th><th>Option A</th><th>Option B</th></tr>
<tr><td>0.000 to 0.270</td><td colspan="2">No works are proposed at this location as part of Options A and B as the existing flood wall from Rice Bridge roundabout to Chainage 0.270 is of sufficient height (i.e., above the design flood level).</td></tr>
<tr><td>0.270 to 0.370</td><td colspan="2"><u>Remedial Works to Exiting Masonry Flood Wall</u>
Raising of the existing masonry flood wall for c.100m to add between 0.7m and 1.3m in height is proposed as part of both options for this section due to physical constraints within the site area in the form of existing road infrastructure such as R448 Terminus Street, Rice Bridge Roundabout and R711 Dock Road. The remedial works will likely involve the construction of a reinforced concrete wall add-on and the localised repointing of the existing masonry wall. No permanent works encroachment into the Lower River Suir SAC will be necessary at this location. The majority of works are expected to be undertaken from the landside with some access required from the riverside during low tides.</td></tr>
<tr><td>0.370 to 0.520</td><td colspan="2"><u>Riverside Sheet-Pile Flood Defence Wall</u>
Construction of approximately 150m of new flood defence wall within the Lower River Suir SAC. This section of the driven sheet pile wall will be constructed using a jack up barge from within the river. The sheet pile wall would be constructed approximately 1 metre in front of the existing quay wall in the River Suir mudflats (in the SAC) and the gap would be backfilled with clean imported granular (Class 1 or 6) earthworks fill material. The demolition of localised sections of existing masonry quay wall will also be</td></tr>
</table>

Chainage	Option A	Option B
	required in order to connect this section of in-river sheet piles to the adjacent flood walls proposed up and down chainage. The reason for placing sheet piles in river in this section is due to requirements for minimum clear distance from rail tracks to the nearest structure that have to be respected according to Iarnród Éireann guidelines. The distance between the rail tracks and the existing wall is extremely tight over this section, with not enough place to fit sheet piles on the landside.	
0.520 to 0.950	**Landside Sheet-Pile Defence Wall (nightworks)** Construction of a sheet piled flood defence wall on land between the existing quay wall and the rail tracks, typically 1.0m behind the existing quay wall. The permanent works will not encroach into the Lower River Suir SAC. The works will be completed overnight (between 21.30 to 05.30 hours) during absolute possessions of the railway line provided by Irish Rail in order for works to have no effect on rail traffic. These reduced working hours will prolong the construction programme. Significant H&S risks will exist for night-working in a tight sliver of land between rail tracks and quay wall. The realignment of Irish Rail signal ducting and the re-pointing and re-building of the sections of existing masonry wall will also be required, in order to avoid potential damage (dislodging blocks into the Lower River Suir SAC) during sheet pile wall installation and during the design life of the flood defences, as the existing quay wall is in poor condition.	**Riverside Sheet-Pile Flood Defence Wall** Construction of a new flood defence wall located within the Lower River Suir SAC. This section of the driven sheet pile wall will be constructed using a jack up barge. The sheet pile wall would be constructed approximately 1.0m in front of the existing quay wall in the River Suir mudflats (in SAC) and the gap would be backfilled with clean imported granular (Class 1 or 6) earthworks fill material. This would be a continuation of the sheet pile wall constructed in the 0.330 to 0.500 section using the same method. Minimal night-works and rail possessions are required. The works will simultaneously address the issue of quay wall in poor condition as the loose blocks and section will be secured by backfill.
0.950 to 0.1090 and isolation structure	**Landside sheet piles (dayworks).** Construction of a sheet piled flood defence wall on land between the existing quay wall and the rail tracks. The works will not encroach into the Lower River Suir SAC. The works are envisaged to be undertaken during the day with a temporary fence separating the works from the railway tracks and will therefore not affect IE rail traffic, since the cess in this area is wide. The underground isolation structure across and under the rail-line at chainage Ch.1090, will be approximately 30m in length and will require nightworks and track possessions.	
0.000 to 0.1090	**Drainage.** Upgrade of drainage system and outfalls. Replacement/ provision of flap-valves on existing and proposed back-of-wall drainage. New drainage will be limited to the relief of any trapped groundwater behind the new wall. No alteration or addition to existing land drainage is proposed.	

The installation of sheet piles comprises a large part of the proposed flood defence works in both options. Other structural elements have also been considered in lieu of sheet piles at the early stage of option assessment. Earthwork bunds were ruled out due to large footprint required for them, which would result significant landtake affecting either or both the Lower River Suir SAC and or/ the Waterford to Dublin railway line. Raising the existing quay wall was ruled out due to the poor condition of the wall, which would require extensive work including demolition and replacement to achieve a sufficient wall height. The raised wall would also require a separate underground solution to prevent groundwater flooding through deep granular layers. This would require deep temporary excavation and complex temporary works in a very constrained site, with stability risks to both quay walls and rail tracks.

Sheet piles were selected as the optimal solution as they simultaneously address both overground and underground flooding, have a very small footprint, as well as having other advantages such as cost and constructability. The small footprint of the sheet piles would have the least impact on the footprint of the Lower River Suir SAC and on unknown archaeology as it would require little to no excavation or disturbance to the mudflats within the river. The selection of sheet piles instead of the aforementioned options also requires minimal demolition works to existing structures, having the least impact on sensitive noise and air quality receptors during construction. Sheet piles are used as a state-of-the-practice solution for countless flood defences projects in Ireland and abroad.

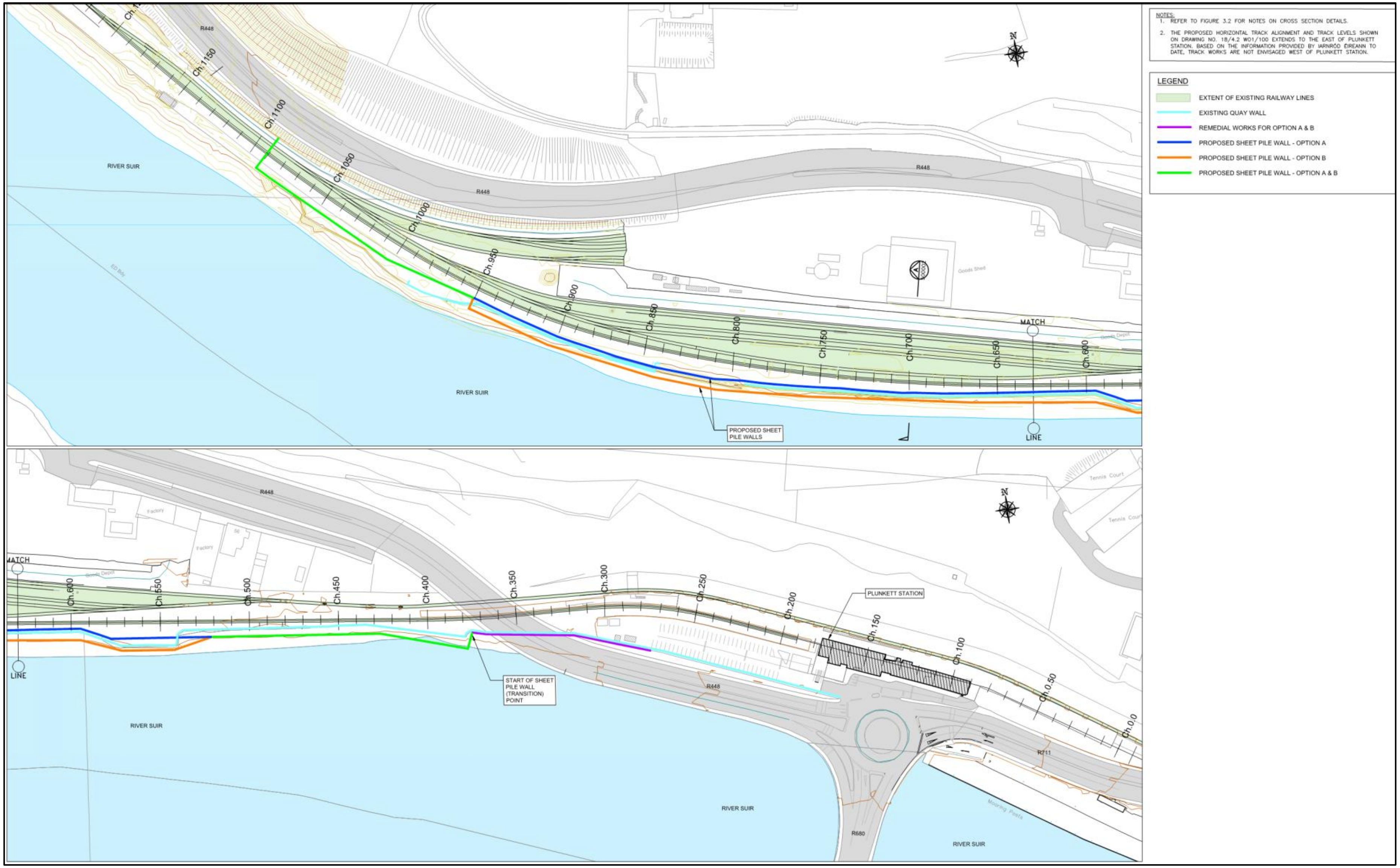

Plate 3.2 **Options A and B considered for the proposed development**

3.7 Multi-Criteria Assessment of Options Considered

A methodology was developed for the assessment of the two flood defence options considered. Options A and B were assessed in accordance with the Common Appraisal Framework (CAF) criteria of Safety, Economy, Integration, Environment, Accessibility & Social Inclusion, having regard to the associated sub-criteria outlined in the Transport Infrastructure Ireland's (TII) *'Project Appraisal Guidelines for National Roads Unit 7.0 – Multi Criteria Analysis'*. The options considered were not assessed under the Physical Activity criteria as they are considered to be very similar, with the adjacent lands being either within CIÉ ownership which are not accessible to the public, or mudflats which are unsafe for public access. As such, the proposed options will not impede on any existing cycling/walking infrastructure, nor will they provide any additional infrastructure to enhance physical activity in the area. The options under each of the criteria and associated sub-criteria were subject to preference ranking outlined in Table 3.3 below.

Table 3.3 MCA Ranking Scale

MCA	Colour codes ranking scale
	Option has significant comparative advantage over other options
	Option has some comparative advantage over other options
	Options are comparable to each other
	Option has some comparative disadvantage over other options
	Option has significant comparative disadvantage over other options

The full Multi Criteria Analysis is provided in Appendix 3.1 of this chapter. While the two options were found to be comparable for most of the MCA criteria, the main differences arose under the following sub- criteria and are outlined in the following paragraphs:

- Under the heading of Economy:
  - Construction and Cost
  - Constructability
- Under the heading of Environment:
  - Noise and Vibration
  - Landscape and Visual
  - Biodiversity
  - Soils and Geology

3.7.1 Construction and Cost

This section provides a comparative impact assessment of options under the 'Construction and Cost' sub-criteria. This sub-criteria assesses options in relation to costs associated with both permanent and temporary acquisition of land and the costs incurred for the construction of each option.

Option A

A larger portion of landside sheet-pile installation works (c.570m) are proposed as part of Option A and will require night works in a physically constrained sliver of land between the rail tracks and the masonry quay wall between chainages Ch.520 to

Ch.1090. This option will be more expensive than driving the sheet piles from a barge located in the river which requires a shorter construction programme.

The preliminary estimate of the total cost of sheet piling for Option A is expected to be approximately 25% more than Option B.

Option B

No nightworks required or less issues with a physically constrained site are expected for Option B, however some restrictions may be required as part of the mitigation measures to be identified as part of the Environmental Impact Assessment / Appropriate Assessment. A large portion of the sheet pile wall (c.580m) will be installed from within the river using a barge. Added costs which include barge commissioning and associated work rate reduction are comparably lower than nightworks as described in Option A.

The preliminary estimate of the total cost of sheet piling for Option B is expected to be approximately 25% less than Option A.

Preference

Option B has a significant advantage over Option A under the Construction and Cost MCA sub-criteria.

3.7.2 Constructability

This section provides a comparative impact assessment of options under the sub-criteria of constructability.

Option A

A larger portion of landside sheet-pile installation works (c.570m) are proposed as part of Option A from chainages Ch.520 to Ch.1090 (refer to Figure 3.1 in Volume 3 of this EIAR) and will require night works in a physically constrained sliver of land between the rail tracks and quay wall. This option involves increased complexity, increased interface with third parties (Iarnród Éireann) and the increased Health and Safety risks associated with night-time works in a constrained site adjacent to a tidal watercourse. This option will result in a prolonged construction period and significant technical and Health and Safety challenges for the Contractor. There is an increased risk of potential changes to design due to unexpected underground conditions being identified on site. There is a risk of destabilising the local sections of the existing quay wall where dislodged blocks may collapse into the Lower River Suir SAC. The problem of further deterioration of the existing quay wall, which is already in poor condition, is not solved using this solution which leaves it exposed; despite the intention of re-pointing the most critical areas as a part of this option.

Option B

Option B involves approximately 580m of river side sheet pile installation from chainages Ch.370 to Ch.950 (refer to Figure 3.1 in Volume 3 of this EIAR). In-river works from a barge are a routine method of installation for many marine structures, including sheet piles. This option has increased time working over water with increased Health and Safety risks associated with such works. This method avoids major obstacles associated with working around night-time possessions and as currently envisaged enables uninterrupted works (note at the time of writing the options assessment - consultations with NPWS and the development of the mitigation measures in the AA/NIS may require timing restrictions on the works). Barges are readily available from operators with a local knowledge of working conditions. This solution will prevent further deterioration of the existing quay walls and the connected risks to riverbed and mudflats.

Preference

Option B has a significant advantage over Option A under the Constructability MCA sub-criteria.

3.7.3 Noise and Vibration

Based on the options designs at the options selection stage, no significant difference in noise and vibration levels between options A and B was identified, except for two considerations:

- There will be comparatively more piling taking place in the river from a barge under Option B, however this will require minimal night-time works;
- Option A requires a larger section of landside sheet pile installations that will require longer night-time works.

Longer night-time works required for construction of Option A are likely to have greater impacts on sensitive receptors in comparison to Option B, where a negligible amount of night works is expected. The duration of works is also expected to be significantly longer in Option A than for Option B. The nearest residential receptor is located on the opposite side of River Suir, over 200m from the proposed options.

Preference

Option B has some comparative advantage over Option A under the Noise and Vibration MCA sub-criteria.

3.7.4 Landscape and Visual

This section provides a comparative impact assessment of options under the sub-criteria of landscape and visual.

Both Options are located within an urban environment, where the predominant land use is commercial/industrial in nature and as such, the landscape sensitivity of the site is considered to be low. However, Option B consists of a longer section of riverside sheet piles (c.580m) when compared to Option A which requires 150m of riverside sheet pile. Option B will be visible over larger extents along the northern bank of the River Suir, particularly at low tide from the south quays of Waterford City.

Preference

Option A has some comparative advantage over Option B under the Landscape and Visual MCA sub-criteria.

3.7.5 Biodiversity

The potential impacts of both options under the biodiversity sub-criteria were assessed under the headings of:

- Design-related and operational impacts;
- Construction-related impacts; and
- Cumulative impacts.

Table 3.4 below provides the comparative impact assessment of options for biodiversity.

Table 3.4 Comparison of Options in terms of Biodiversity

<table>
<tr><th>Option A</th><th>Option B</th></tr>
<tr><td colspan="2">Design-related and operational impacts</td></tr>
<tr><td><u>Habitat loss:</u> Permanent loss of c. 240 m² of upper intertidal mudflat (Annex I habitat type, not a qualifying interest of the SAC, important habitat for qualifying interest species Twaite Shad).
Permanent loss of c. 150 m length of stone wall or other hard upper intertidal habitat, which would also result in reduced habitat heterogeneity.</td><td><u>Habitat loss:</u> Permanent loss of c. 800 m² of upper intertidal mudflat (Annex I habitat type, not a qualifying interest of the SAC, important habitat for qualifying interest species Twaite Shad).
Permanent loss of c. 580 m length of stone wall or other hard upper intertidal habitat, and reduced habitat heterogeneity.</td></tr>
<tr><td><u>Reduced habitat connectivity:</u> Constriction of the intertidal corridor by c. 1.0 m over a length of c. 150 m and associated reduction in the portion of the tidal cycle when there is exposed mudflat.</td><td><u>Reduced habitat connectivity:</u> Constriction of the intertidal corridor by c. 1.0 m over a length of c. 580 m and associated reduction in the portion of the tidal cycle when there is exposed mudflat.</td></tr>
<tr><td colspan="2"><u>Hydraulic impacts:</u> The presence of the flood defence structures in the river in both options will likely lead to some change in flow patterns and erosion, transport, and deposition of sediment in the vicinity of the project. While these effects have not yet been modelled, experience on projects such as the River Suir Sustainable Transport Bridge would indicate that they are very unlikely to be significant.</td></tr>
<tr><td colspan="2">Construction-related impacts</td></tr>
<tr><td><u>Disturbance:</u> The use of barges and daytime sheet piling is likely to cause some physical and hydroacoustic disturbance to fauna in the River Suir, most notably Twaite Shad. Based on the assessments of similar impacts as carried out for other WPIP applications they are unlikely to give rise to significant effects. This is due to the pile type (sheet piles), piling method (vibration) and the location (at the edge of the river) during the daytime (when fish are active and in the centre of the channel), as well as the short duration of the works (15-25 weeks in total).
Night-time piling from Ch.0.520 – 0.950, while on land, is sufficiently close to the river to pose a risk of significant disturbance (noise and light) to juvenile Twaite Shad, which would be less active and at the edge of the river. This disturbance may reduce the survival rate of the two age classes affected (0+ and 1+). Depending on the severity of this impact, the conservation objective for this species may be adversely affected through reduced recruitment and change in the population structure.
Impacts on juvenile shad cannot be avoided or minimised through seasonal restrictions as they are present throughout the estuary for the full first two years of their lives.
Other species vulnerable to disturbance from night-time piling include Otter (also a qualifying interest of the SAC) and bats.
Due to the extended construction programme associated with nightwork constraints, the</td><td><u>Disturbance:</u> The disturbance impacts from this option are similar to those from Option A, except that the total <u>daytime</u> impacts occur over a longer extent and duration. However, there are <u>none</u> of the impacts associated with night-time piling.
Daytime piling poses some risk of disturbance to nocturnal species such as Sea Lamprey which may shelter at the edge of the channel during the day during their upstream migration (April-May). Such impacts, however, can be avoided through seasonal programming of works. It is considered that such avoidance is feasible as it would leave c. 9 months available for works, while a maximum of 6 months is likely to be required.</td></tr>
</table>

Option A	Option B
impact of disturbance from this option would occur over a longer timeframe.	
Water quality: Both options provide for similar risks in terms of water quality impacts arising from the use of barges and construction equipment and materials near water, disturbance of sediment from piling and repointing of damaged masonry quay walls. It is expected that water quality impacts will be mitigable and controlled using routine procedures for flood defence projects.	
Invasive non-native species: Both options pose a risk of the spread of invasive non-native species to, from or within the vicinity of the works. A species of particular concern in this case is Chinese Mitten Crab. This risk is slightly greater from Option B due to the greater reliance on the use of barges during construction. Either option would require the implementation of a biosecurity protocol during the construction stage.	
Cumulative impacts	
Habitat loss: Both options involve permanent habitat loss (Option B more so than Option A) in addition to habitat loss arising from other projects in the Suir-Barrow-Nore estuary. The significance of the effects of this cumulative impact will be evaluated within the Appropriate Assessment.	
Increased train movements: Both options will protect the existing rail infrastructure and will facilitate an increase in the number or frequency of train movements in the future, proposed as part of the SDZ Transportation Hub planning application which was granted planning permission in 2019. This poses an increased risk of direct mortality of Otter (and other animals) which might cross the railway line. However, due to the nature of the terrestrial habitats in the vicinity, the numbers of mammals, particularly otters, crossing the railway line at this location are likely to be insignificant.	
Disturbance: During the construction stage, disturbance from the works will likely interact with disturbance from other projects in the vicinity, e.g., the River Suir Sustainable Transport Bridge and South Plaza and the North Quays Development. Controls to ensure the effective coordination of works with potential to cause significant cumulative disturbance are already included in the planning conditions of the relevant projects and will be incorporated into the Flood Defence West assessment.	

Consultation with Prescribed Bodies

Consultations with the National Parks & Wildlife Services (NPWS) and Inland Fisheries Ireland (IFI) were carried out in December 2020 to inform the option selection process for the proposed flood defences.

The NPWS acknowledged that both Option A and Option B provide for ecological impacts which may constitute significant effects on the conservation objectives of the Lower River Suir SAC and, therefore, that either option would likely require full appropriate assessment. The NPWS reiterated the requirements for appropriate assessment under Article 6(3) and (4) of the Habitats Directive and the precautionary principle but did not express any preference for one option over the other.

IFI also acknowledged that both options provide for likely significant impacts on fish, particularly Twaite Shad, but considered that on balance Option B could be supported as presenting the least risk of adverse effects to fish populations in the medium or long term. IFI acknowledged that Option B will result in a greater loss of the upper intertidal mudflat (Annex I) habitat compared to Option A. However, working within the railway corridor means that Option A would necessitate significantly more night-time works and, consequently, a longer construction programme and duration of disturbance. IFI also observed that night-time works for Option A would be in much closer proximity to juvenile Twaite Shad and occur when these fish ought to be inactive, which presents a risk of reduced survival rates and recruitment to the population. IFI recognised that this may constitute an adverse effect on the population structure of Twaite Shad in the SAC which would be very difficult to mitigate.

Preference

Taking into consideration the biodiversity assessment of options and the feedback received from IFI and NPWS, Option A has some comparative advantage over Option B due to the reduced permanent loss of the upper intertidal mudflat (Annex I) habitat.

3.7.6 Soils and Geology

No hazardous/contaminated land has been encountered within the extents of both options based on the thorough ground testing, except at a single location where traces of asbestos were detected. Furthermore, a relatively small volume of ground will need to be excavated for both Options when compared to their overall scheme size.

However, Option B will require the construction of a larger section of riverside sheet pile wall (c.570m) in front of the existing quay wall in comparison to c.150m required for Option A. The gap between the new riverside sheet pile wall and the existing quay wall will need to be backfilled with clean granular material. As such, the import fill requirement for Option B is 3.25 times that of Option A. It is noted however that even in Option B, no more than 2,600m^3 of imported backfill is required, which is a very small amount for a project of this size and scope.

Preference

Option A has some comparative advantage over Option B under the Soils and Geology MCA sub-criteria.

3.8 Assessment Summary

Taking into consideration the impact assessment of the proposed flood defence options under the MCA sub-criteria of land and cost, constructability noise and vibration, biodiversity and soils and geology, Option B was identified as the preferred option.

The larger extent of landside works proposed as part of Option A presented constraints both from economical, constructability and biodiversity perspectives when compared with Option B. In terms of biodiversity, the extended night-time works, and construction programme proposed as part of Option A is likely to cause disturbance to the Lower River Suir SAC over a longer period, and thus, will cause a slower recovery time. However, Option B will result in a greater habitat loss when compared with Option A.

Option A requires an installation of sheet piles from the landside over a larger area than Option B and will require longer night-time works that introduce greater complexity in terms of constructability, increased construction duration and health and safety risk. The longer night-time works required for construction of Option A are also likely to have a greater impact on noise sensitive receptors. Economically, the landside sheet piling installation over a longer distance proposed is more costly than driving sheet piles from a barge as proposed as part of Option B. Option B requires greater import of fill to backfill the gap between the new riverside sheet pile wall and the existing quay wall when compared to Option A. As such, Option A is preferred under the soils and geology sub-criteria, however the overall volumes of imported fill, and thus the significance of the impact, are very small to start with.

Option B is also seen as advantageous as it removes the risk of the existing quay wall, which is in poor condition, from collapsing into the River Suir, and avoiding any subsequent impacts to SAC over the design life of the proposed development.

Option B was therefore selected as the Preferred Option.

Table 3.5 Options MCA Summary Assessment

MCA Sub- Criteria	Option A	Option B
Cost	Significant comparative disadvantage over other options	Significant comparative advantage over other options
Constructability	Significant comparative disadvantage over other options	Significant comparative advantage over other options
Noise and Vibration	Some comparative disadvantage over other options	Some comparative advantage over option options
Landscape and Visual	Some comparative disadvantage over other options	Some comparative advantage over option options
Biodiversity	Some comparative advantage over other options	Some comparative disadvantage over other options
Soils and Geology	Some comparative advantage over other options	Some comparative disadvantage over other options

3.9 Further Design Considerations

As noted in Section 3.6, a number of design changes have been introduced to the design of the proposed development since Option B was determined as the preferred option in the option selection process. The main changes which have been made to Option B and which now form part of the design of the proposed development described in Chapter 4 of this EIAR are as follows:

- Very minor changes in the alignment of the sheet pile wall have been introduced upon further review of the existing topography, quay wall geometry and condition and other obstacles. One of these changes included the revision of the transition point between the landside and riverside sheet pile wall, from Ch.950 to Ch.900 (see Figure 4.4 in Volume 3 of this EIAR) due to the discovery of an Annex I saltmarsh habitat during April 2021 site surveys.
- The extent of the concrete wall required to be remediated was revised. Upon detailed inspection of the existing quay wall, it was found that a larger section of the quay wall was at the required design level of 4.3 mOD, and as such, the section of wall to be remediated was reduced from 100m in length to 75m.
- Inclusion of underground flood protection measures in a form of an impermeable trench in front of Plunkett Station. Measures to protect IÉ infrastructure and associated utilities from groundwater seepage were deemed necessary after reviewing further available groundwater monitoring data. The proposed underground flood protection measures in front of the Plunkett Station, together with overground measures in this area described in the next bullet point, will ensure that there is no gap between the Flood Defences West and the Flood Defences East which have been approved in 2019 as part of the Transportation Hub planning application.
- Inclusion of overground flood protection measures for the Rice Bridge Roundabout. As the surface levels of Rice roundabout and entrance to Plunkett station are slightly lower than the design flood levels, low glass flood barriers and demountable flood barriers will be set up at the verges of the roundabout as part of the proposed development.

- Drainage design and description is at a more advanced level in Chapter 4 of this EIAR compared to the options stage. However, no fundamentals were changed, and the drainage elements described as part of Options A and B have been retained. The vast majority of drainage works are the same for both options.

The design changes outlined above are stand-alone construction elements, and it is very likely that they would have been identical in Options A and B and as such, would not have affected the option selection process.

Appendix 3.1
MCA Summary
Assessment Matrix

APPENDIX 3.1
MCA Summary Assessment Matrix

Criteria	Parameter	Option A	Option B
Economy	1.1.Construction and Land Cost	**Significant comparative disadvantage over other options**	**Significant comparative advantage over other options**
		Current cost estimate shows the construction cost of Option A to be approximately 25% more expensive than Option B. Preliminary approximate price €4.2m. Lands are mainly owned by CIÉ. CPO of lands not in the ownership of CIÉ or WCCC will be required. Foreshore licence will be required for development on the foreshore. Significant disadvantage for option A.	Current cost estimate shows the construction cost of Option B to be approximately 25% less expensive than Option A. Preliminary approximate price €3.2m. Lands are mainly owned by CIÉ. CPO of lands not in the ownership of CIÉ or WCCC will be required. Foreshore licence will be required for development on the foreshore.
	1.2 Long Term Maintenance costs	**Options are comparable to each other**	**Options are comparable to each other**
		Both options involve virtually the same structure options across the same length. The selected option (sheet pile wall) will be designed to minimise the long-term maintenance costs through design decisions (sacrificial corrosion thickness, coating, and other) and achieve 120 years design life without maintenance interventions. Option A has slightly less exposure to elements as it has longer landside length compared to option B, but not enough to warrant any discernible difference between options in terms of maintenance.	Both options involve virtually the same structure options across the same length. The selected option (sheet pile wall) will be designed to minimise the long-term maintenance costs through design decisions (sacrificial corrosion thickness, coating, and other) and achieve 120 years design life without maintenance interventions. Option B has slightly more exposure to elements as it has longer riverside length compared to option A, but not enough to warrant any discernible difference between options in terms of maintenance.
Economy	1.3 Traffic Functionality / Economic Benefit	**Options are comparable to each other**	**Options are comparable to each other**
		The development will not affect journey times as it does not interfere with any local infrastructure. Construction methodology will be set to have no effect to day-to-day rail traffic in the vicinity of the proposed development. Proposed development will have a positive benefit to rail traffic in the area by preventing the flooding that has, up to now, caused frequent temporary closures of the local rail line.	The development will not affect journey times as it does not interfere with any local infrastructure. Construction methodology will be set to have no effect to day-to-day rail traffic in the vicinity of the proposed development. Proposed development will have a positive benefit to rail traffic in the area by preventing the flooding that has, up to now, caused frequent temporary closures of the local rail line.

Criteria	Parameter	Option A	Option B
	1.4 Constructability	**Significant comparative disadvantage over other options**	**Significant comparative advantage over other options**
		Option A involves approximately 570m of landside sheet piling works, of which more than 400m are located in a very narrow strip of land (<6m wide) between the existing quay wall and the rail tracks. This will require night-time works as absolute possession will be required from Irish Rail which can only be accommodated during night. Night-time works will raise the complexity and risks (technical and H&S) in addition to technical and logistical challenges of working in such a confined area. There is a risk of destabilising the local sections of the existing quay wall where dislodged blocks may collapse into the Lower River Suir SAC. The duration of construction is expected to be significantly longer than for Option B. In addition, option A would leave the current quay wall in poor condition exposed to flood waters.	Option B involves approximately 580m of river side sheet pile installation which is a relatively routine and straightforward way of installing similar marine structures. The works do not require any possession from Irish Rail and can be carried out during the day. The 140m of landside works will be carried out in an area with adequate clearance, enabling the works to be done behind temporary fence while keeping rail traffic open. Option B has significant comparative advantage over Option A in this view.

Criteria	Parameter	Option A	Option B
Integration	2.1 Transport Integration	**Options are comparable to each other**	**Options are comparable to each other**
		Both options support the overall transport integration associated with the development of a more sustainable Waterford City. No existing level crossing affected. Possessions will occur during night-time therefore no impact on rail passengers' journeys.	Both options support the overall transport integration associated with the development of a more sustainable Waterford City. No existing level crossing affected. No rail possessions will be required due to working in river therefore no impact on rail passengers' journeys.
	2.2 Land Use Integration	**Options are comparable to each other**	**Options are comparable to each other**
		Relevant planning policy is contained in the Waterford City Development Plan 2013-2019 (as extended): The city administrative areas are zoned for Industrial use. The site is also within Flood Zone A&B. Ferrybank Belview Local Area Plan 2017 identifies relevant adjoining zoned lands as: 'BITP - Business, Industry and Technology Parks' in which there is a small area zoned for 'Community facilities. The site is	Relevant planning policy is contained in the Waterford City Development Plan 2013-2019 (as extended): The city administrative areas are zoned for Industrial use. The site is also within Flood Zone A&B. Ferrybank Belview Local Area Plan 2017 identifies relevant adjoining zoned lands as: 'BITP - Business, Industry and Technology Parks' in which there is a small area zoned for 'Community facilities'. The site is

Criteria	Parameter	Option A	Option B
		contained with the Lower River Suir SAC and lands are zoned for 'Opportunity Sites' and 'Mixed Use'. The existing land use of the site consists of rail infrastructure, while commercial/industrial use is evident within the Sallypark industrial site which is adjacent to the railway corridor and located to the north of the proposed options.	contained within the Lower River Suir SAC. and lands are zoned for 'Opportunity Sites' and 'Mixed Use'. The existing land use of the site consists of rail infrastructure, while commercial/industrial use is evident within the Sallypark industrial site which is adjacent to the railway corridor and located to the north of the proposed options.

Criteria	Parameter	Option A	Option B
Environment	3.1 Noise and Vibration	**Some comparative disadvantage over other options**	**Some comparative advantage over other options**
		Driven sheet pile walls. The vibrations to the nearby infrastructure (rail tracks and existing masonry quay wall) will be considered. Based on existing information there is not likely to be any discernible difference in noise and vibration levels between options A and B, except for two considerations. i) there will be comparatively more piling taking place in the river in Option B, and ii) the noise produced in Option A will be largely during night which has more negative impacts on the environment and any sensitive receptors in comparison to Option B, where a negligible amount of night works in expected. The duration of works is also expected to be significantly longer in option A than for Option B. The nearest residential receptor is located on the other side of river Suir, over 200m to the south.	Driven sheet pile walls The vibrations to the nearby infrastructure (rail tracks and existing masonry quay wall) will be considered. Based on existing information there is not likely to be any discernible difference in noise and vibration levels between options A and B, except for two items: i) there will be comparatively more river piling in Option B, and ii) the produced noise in Option A will be largely during night much has more adverse effects in comparison to Option B where a negligible amount of night works in expected. The nearest residential receptor is located on the other side of river Suir, over 200m to the south.
	3.2 Air Quality and Climate	**Options are comparable to each other**	**Options are comparable to each other**
		Temporary construction stage effects will be required to be considered and are not likely to be significantly different at this stage in the process.	Temporary construction stage effects will be required to be considered and are not likely to be significantly different at this stage in the process.
	3.3 Landscape and Visual (including light)	**Some comparative advantage over other options**	**Some comparative disadvantage over other options**
		Flood defence wall will raise the top visible level of built infrastructure by between 1.0m and 1.7m, to +4.3mOD, and will be visible above the existing masonry quay wall. For 150m length, the sheet pile wall will be installed in front of the	Flood defence wall will raise the top visible level of built infrastructure by between 1.0m and 1.7m, to +4.3mOD, and will be visible above the existing masonry quay wall. For 580m length, the sheet pile wall will be installed in front of the

Criteria	Parameter	Option A	Option B
		existing quay wall (riverside). Sheet piles are typical quay and flood defence systems in urban infrastructure, particularly in industrial zones such as this one, and are in keeping with landscape character. However, the riverside sheet pile walls will be more visible during low tide from the River Suir. As such, Option A has some comparative advantage over Option B by requiring a shorter section of riverside sheet piles.	existing quay wall (riverside). Sheet piles are typical quay and flood defence systems in urban infrastructure, particularly in industrial zones such as this one, and are in keeping with landscape character. However, the riverside sheet pile walls will be more visible during low tide from the River Suir. As such, Option B has some comparative disadvantage over Option A as it requires a longer section of riverside sheet piles which will be visible over longer extent along the north bank.
	3.4 Biodiversity	**Some comparative advantage over other options**	**Some comparative disadvantage over other options**
		Permanent loss of intertidal mudflats (approx. 240 m^2). This habitat is of a type listed on Annex I to the Habitats Directive (92/43/EEC) and the area that would be lost is within the Lower River Suir SAC. While not listed as a qualifying interest of the SAC, intertidal mudflats are critical to the achievement of the conservation objectives for Twaite Shad and other qualifying interests of the SAC. Permanent reduction in habitat connectivity along intertidal mudflat corridor due to narrowing by 1 m along 150 m length. Habitat loss and fragmentation unlikely to be mitigable in this case. This poses a risk of adverse effects on the SAC. Potential permanent reduction in habitat heterogeneity/zonation and, consequently, species diversity due to loss of upper intertidal mudflat and hard, structured, upper intertidal and splash zone habitat provided by existing quay wall. This is potentially partially mitigable in the medium term through the use of ecostructures on the new wall, though the loss of upper intertidal mudflat will not be mitigable. Likely significant cumulative effect of loss of intertidal mudflats resulting from this project, other projects in the vicinity and historic reclamation. Potential changes to sediment erosion, transport, and deposition patterns due to presence of new in-stream structure may also affect intertidal mudflats and other habitats beyond project boundary. Use of jack-up barges would cause temporary/short-term disturbance to habitats and species. Piling for the new flood defence wall would	Permanent loss of intertidal mudflats (approx. 800 m^2). This habitat is of a type listed on Annex I to the Habitats Directive (92/43/EEC) and the area that would be lost is within the Lower River Suir SAC. While not listed as a qualifying interest of the SAC, intertidal mudflats are critical to the achievement of the conservation objectives for Twaite Shad and other qualifying interests of the SAC. Permanent reduction in habitat connectivity along intertidal mudflat corridor due to narrowing by 1 m along 580 m length. Habitat loss and fragmentation unlikely to be mitigable in this case. This poses a risk of adverse effects on the SAC. Potential permanent reduction in habitat heterogeneity/zonation and, consequently, species diversity due to loss of upper intertidal mudflat and hard, structured, upper intertidal and splash zone habitat provided by existing quay wall. This is potentially partially mitigable in the medium term through the use of ecostructures on the new wall, though the loss of upper intertidal mudflat will not be mitigable. Likely significant cumulative effect of loss of intertidal mudflats resulting from this project, other projects in the vicinity and historic reclamation. Potential changes to sediment erosion, transport, and deposition patterns due to presence of new in-stream structure may also affect intertidal mudflats and other habitats beyond project boundary. Use of jack-up barges would cause temporary/short-term disturbance to habitats and species. Piling for the new flood defence wall would

Criteria	Parameter	Option A	Option B
		cause hydroacoustic impacts on habitats and species, particularly Twaite Shad, which is very sensitive to noise. This impacts would be temporary and, as the piling will mainly involve sheet piles being driven by vibration at the edge of the channel, not likely be significant. As with all construction in and adjacent to waters, there is a risk of temporary/short-term water quality impacts could negatively affect aquatic ecosystems. However, given the nature and scale of the project, mitigation to effectively control this risk is feasible. The uses of vessels such as jack up barges poses a risk of the introduction or spread of invasive alien species, e.g., Chinese Mitten Crab. This risk can be effectively controlled by implementation of an appropriate biosecurity protocol. All of the operational impacts associated with Option A are the same as those for Option B, except that permanent impacts are of a lesser magnitude for Option A than for Option B. Construction-related impacts differ slightly, as follows: sheet piling on land for Option A would take place at night and would be of a slightly higher magnitude and longer duration in terms of noise impacts, which would increase potential disturbance impacts to nocturnal species and Otter when compared with Option B, but would eliminate the risk of significant impacts on the most noise-sensitive receptor, Twaite Shad. However, there is a risk of destabilising the local sections of the existing quay wall when installing the landside sheet piles, where dislodged blocks may collapse into the Lower River Suir SAC.	cause hydroacoustic impacts on habitats and species, particularly Twaite Shad, which is very sensitive to noise. This impacts would be temporary and, as the piling will mainly involve sheet piles being driven by vibration at the edge of the channel, not likely be significant. As with all construction in and adjacent to waters, there is a risk of temporary/short-term water quality impacts could negatively affect aquatic ecosystems. However, given the nature and scale of the project, mitigation to effectively control this risk is feasible. The uses of vessels such as jack up barges poses a risk of the introduction or spread of invasive alien species, e.g., Chinese Mitten Crab. This risk can be effectively controlled by implementation of an appropriate biosecurity protocol. All of the impacts associated with Option B are the same as those for Option A, except that permanent impacts are of a greater magnitude for Option B than for Option A. Construction-related impacts differ slightly, as follows: sheet piling into the mudflats for Option B would take place mostly during the day and would be of a slightly lower magnitude and shorter duration in terms of noise impacts, which would reduce potential disturbance impacts to nocturnal species and Otter when compared with Option A, but would increase the risk of significant impacts on the most noise-sensitive receptor, Twaite Shad.
	3.5 Cultural, Archaeological and Architectural Heritage	**Options are comparable to each other**	**Options are comparable to each other**
		There are no protected structures, recorded historic or archaeological monuments likely to be affected by the proposed works. However, there is potential of encountering previously unrecorded underwater archaeology. Local impacts to the masonry quay wall may arise.	There are no protected structures, recorded historic or archaeological monuments likely to be affected by the proposed works. However, there is potential of encountering previously unrecorded underwater archaeology. Local impacts to the masonry quay wall may arise.

Criteria	Parameter	Option A	Option B
	3.6 Water Resources	**Options are comparable to each other**	**Options are comparable to each other**
		Both options will defend lands to the north against flooding up to the design flood event. As a result, flood waters will be displaced from existing area liable to flood and confined to the River Suir. The flood regime at this location is tidally dominated and the volume of the flood waters displaced by either option is negligible in the context of the tidal extents of the Suir, Barrow, Nore and Waterford Harbour. Option A will displace less flood water than option B. However, the resultant difference in flows and flood levels will be imperceptible. Potential impacts to floodplain displacement are likely imperceptible permanent and are comparable between both options. Both options require construction in and adjacent to the River Suir, as such there is a risk of temporary/short-term negative impacts to water quality. However, given the nature and scale of the project, mitigation of these impacts is likely feasible. The potential impact to water quality is comparable between both options.	Both options will defend lands to the north against flooding up to the design flood event. As a result, flood waters will be displaced from existing area liable to flood and confined to the River Suir. The flood regime at this location is tidally dominated and the volume of the flood waters displaced by either option is negligible in the context of the tidal extents of the Suir, Barrow, Nore and Waterford Harbour. Option B will displace a greater volume of flood water than option A. However, the resultant difference in flows and flood levels will be imperceptible. Potential impacts to floodplain displacement are likely imperceptible permanent and are comparable between both options. Both options require construction in and adjacent to the River Suir, as such there is a risk of temporary/short-term negative impacts to water quality. However, given the nature and scale of the project, mitigation of these impacts is likely feasible. The potential impact to water quality is comparable between both options.
	3.7 Agriculture and Non-Agricultural	**Options are comparable to each other**	**Options are comparable to each other**
		Lands are mainly owned by CIÉ. CPO of lands not in the ownership of CIÉ or WCCC will be required. Foreshore licence will be required for development on the foreshore. No impact on either agricultural land take or property.	Lands are mainly owned by CIÉ. CPO of lands not in the ownership of CIÉ or WCCC will be required. Foreshore licence will be required for development on the foreshore. No impact on either agricultural land take or property.
	3.8 Geology and Soils (including Waste)	**Some comparative advantage over other options**	**Some comparative disadvantage over other options**
		No hazardous/contaminated land has been encountered through ground testing, except a single location with traces of asbestos. Relatively small volume of ground will need to be excavated, when compared to overall scheme size. Approximately 175m^3 and 50m^3 for options A and B respectively (plus approximately 1,000m^3 excavation for drainage). Approximately half of the volume will go to inert WAC landfill,	No hazardous/contaminated land has been encountered in the thorough ground testing, except a single location with traces of asbestos. Relatively small volume of ground will need to be excavated, when compared to overall scheme size. Approximately 175 m3 and 50m^3 for options A and B respectively (plus approximately 1,000m^3 excavation for drainage). Approximately half of the volume will go to inert WAC landfill,

Criteria	Parameter	Option A	Option B
		with other half to landfill that accepts the waste in excess of inert WAC limits. Option A will require approximately 800m^3 of imported clean granular fill to fill the gap between the sheet pile wall and existing quay wall.	with other half to landfill that accepts the waste in excess of inert WAC limits. Option B will require approximately 2,600m^3 of imported clean granular fill to fill the gap between the sheet pile wall and existing quay wall. Minor comparative disadvantage over Option A due to the increased volume of imported fill required in estuarine environment (SAC).

Criteria	Parameter	Option A	Option B
Accessibility & Social Inclusion	4.1 Impact on Vulnerable Groups	**Options are comparable to each other**	**Options are comparable to each other**
		Flood defences will enable safe, reliable rail passenger services to the population including vulnerable groups.	Flood defences will enable safe, reliable rail passenger services to the population including vulnerable groups.
	4.2 Social Inclusion	**Options are comparable to each other**	**Options are comparable to each other**
		No change	No change

Criteria	Parameter	Option A	Option B
Safety	5.1 Rail Safety	**Options are comparable to each other**	**Options are comparable to each other**
		Flood defences will enable more reliable functioning of the rail line. Both options will bring about the same level of rail safety.	Flood defences will enable more reliable functioning of the rail line. Both options will bring about the same level of rail safety.
	5.2 Vehicular Traffic Safety	**Options are comparable to each other**	**Options are comparable to each other**
		No change	No change
	5.3 Pedestrian, Cyclist & Vulnerable Road User Safety	**Options are comparable to each other**	**Options are comparable to each other**
		No change	No change

MCA Option Criteria and sub-criteria comparative colour coded ranking scale
Significant comparative advantage over other options
Some comparative advantage over other options
Options are comparable to each other
Some comparative disadvantage over other options
Significant comparative disadvantage over other options

Chapter 4
Description of the Proposed Development

Chapter 4 Description of Proposed Development

4.1 Introduction

This chapter provides a description of the proposed Waterford City Public Infrastructure Project - Flood Defences West hereafter referred to as the "proposed development". The chapter details land requirements, the construction methodology and operational requirements of the proposed development.

It should be noted that surveys, assessments and information that form the basis of this Environmental Impact Assessment Report (EIAR) are based on the design of the project as described in this chapter, which has been developed to a stage that permits a fully informed Environmental Impact Assessment (EIA) to be carried out by the competent authority. While further detailing will be required to fully inform procurement and construction, no design changes will be permitted that have the potential to undermine the basis of the assessment of the environmental impacts undertaken in this EIAR.

4.2 Project Overview

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City, refer to Figure 1.1 in Volume 3 of this EIAR. The development extends for approximately 1km to the west and 100m to the east of the Waterford (Plunkett) Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor located to the north of the proposed development.

The proposed flood defence measures are for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval, eliminating the risk of flooding to the Transport Hub.

A design flood level of +4.0m OD (metres above Ordnance Datum Malin) is proposed for this development. The design flood level has been based on a flood with an annual exceedance probability of 0.5% and allowances for climate change and isostatic tilt as noted below.

The design (top-of-wall) level for the proposed flood protection measures is +4.30m OD (metres above Ordnance Datum Malin). The following allowances are integrated into the proposed height of the flood defence walls:

- 0.5% annual exceedance probability combined tidal-fluvial event (+3.45 m OD)
- An additional 0.55m to allow for climate change and isostatic tilt; and,
- 0.30m freeboard to the wall, including local wave wake effects.

An overview of the structural elements of the proposed development is provided from east to west below, and should be read in conjunction with Plate 4.1 and with Figures 4.1 to 4.6 in Volume 3 of this EIAR:

- Construction of c.365m of underground flood defences (an impermeable shallow trench approx. 0.35m in width and up to 3m in depth) from Ch.0.0 to Ch.365 to cut off the potential groundwater seepage during high tide events It is possible that parts of these underground flood protection measures may be omitted during detailed design (see Figures 4.2 and 4.3 in Volume 3) or may be implemented on a phased basis depending on the ongoing groundwater monitoring results.

- Total of c.185m of overground flood defences from Ch.0.40 to Ch.210 consisting of:
  - c.170m of glass flood barrier on the river side of the road edge vehicular parapets on Rice Bridge roundabout and along the 3 roundabout arms (R680 Rice Bridge, R448 Terminus St. and R711 Dock Rd).
  - c.15m of demountable flood barriers on the R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.
- Remedial works to the existing quay wall from Ch.285 to Ch.360 by raising its height by 0.6m to 1.2m to conform with the design top-of-wall level of +4.30m OD.
- Construction of a sheet pile flood defence wall from Ch.360 to Ch.1090, with the top of wall at +4.30 mOD, to protect against overground flooding and underground groundwater seepage:
  - From Ch.360 to Ch.900 the sheet pile wall will be installed within the foreshore from the riverside, 1m from the front face of the existing quay wall. The space between the sheet pile wall and the front face of the existing quay wall will be filled with clean imported granular fill. The intertidal zone of the sheet pile wall within the foreshore will be fitted with pre-cast concrete cladding material ("eco-seawall").
  - From Ch.900 to Ch.1090, the sheet pile wall will be installed on land from the landside, 1m behind the existing quay wall.
  - The demolition of minor localised section of existing quay wall (max length of 3m) will be required in order to connect the in-river sheet piles with the landside sheet pile walls at Ch.900.
- Construction of c.20m of underground isolation structure at Ch.1090, consisting of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event.

Drainage works will be carried out for the entire extents of the proposed flood defence measures i.e., from Ch.0.0 to Ch.1090 as shown in Figure 4.11 to Figure 4.20 in Volume 3 of this EIAR:

- Remedial measures to the existing drainage outfalls to the River Suir from Ch.0.0 to Ch.1090 by extending them to reach an outlet within the new sheet pile wall, or to be retrofitted to pass through the new sheet pile wall, into the River Suir.
- In the vicinity of Plunkett Station, from Ch.0.0 to Ch.470, new trackside drainage and groundwater drains are included in the upgraded drainage works, which will include a pumping station (at approx. Ch.380) and a new surface water outfall structure in the River Suir at Ch.390.
- From Ch.370 to Ch.1090, new drainage system will be installed for trackside drainage and also to allow groundwater cut -off behind the sheet pile wall to drain to the River Suir with 2 No. new outfalls to the River Suir terminating at the front face of the proposed flood defence sheet pile wall (at Ch. 550 and Ch.900). The works will also include the construction of pumping stations at Ch.390 and Ch.550 respectively.

- Existing surface water outfalls at Ch.470 and Ch.490 which extend into the riverbed will be demolished to allow installation of the new flood defence wall; these will be replaced by new surface water outfall structures in the River Suir.
- Demolition of the existing quay wall to approximately 800mm below the existing ground level and removal of handrails from Ch.360 to Ch.900 where it is level with or above, the existing ground level. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level will be required in order to facilitate the construction of a surface water pumping station at Ch.390 (as shown in Figure 4.18 in Volume 3).
- All drainage outfalls (new and existing) will be fitted or retrofitted with non-return valves to prevent tidal water ingress.

Table 4.1 Overview of Proposed Flood Defences West

Chainage	Proposed Works
Ch.0.0 to Ch.365	Construction of an impermeable trench
Ch.0.40 to Ch.210	Construction of overground flood defences at Rice Bridge Roundabout.
Ch.285 to Ch.360	Remediation of existing quay wall
Ch.360 to Ch.1090	Construction of sheet pile flood defence wall
Ch.0.0 to Ch.1090	Drainage works

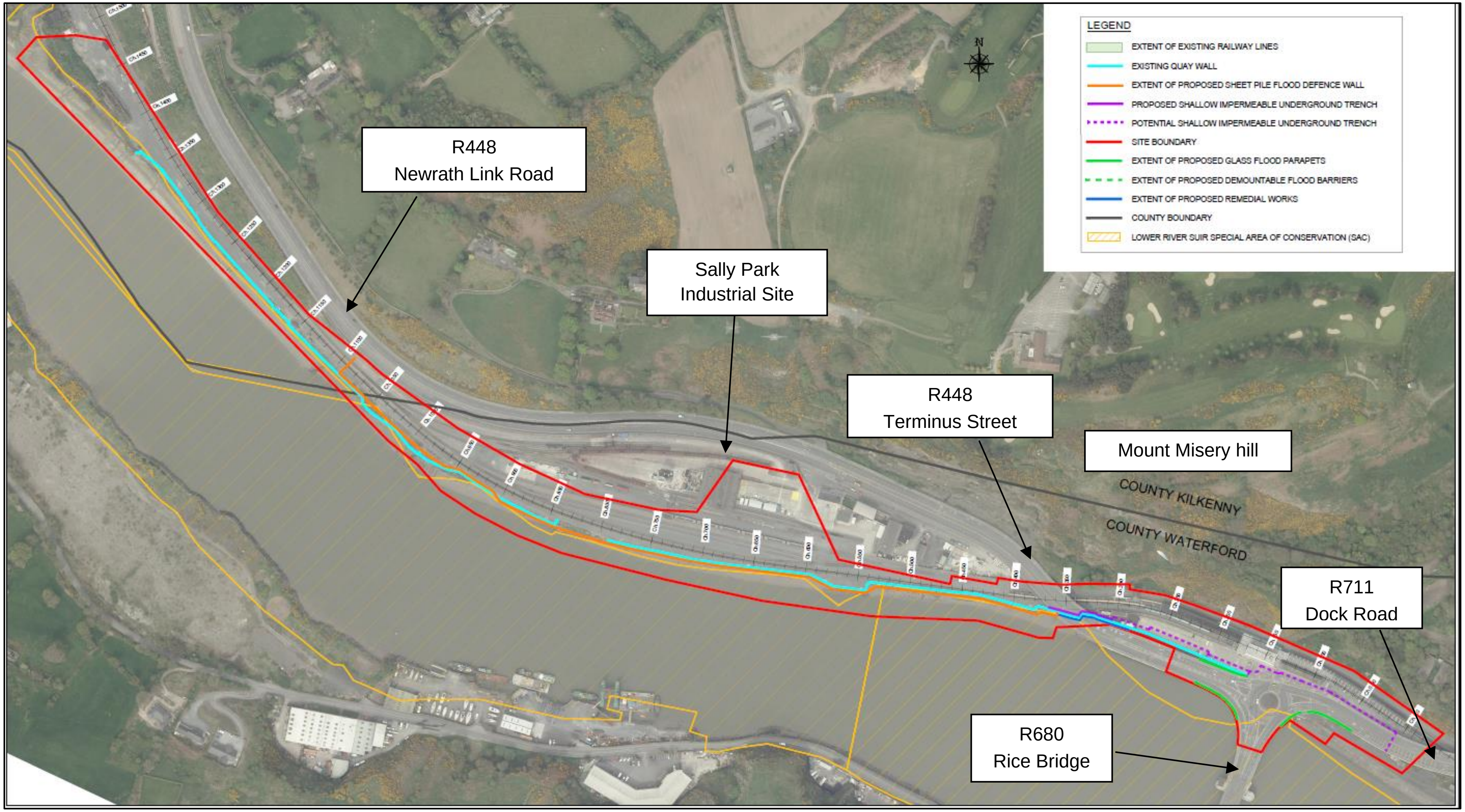

Plate 4.1 **Location of proposed Waterford City Public Infrastructure Project - Flood Defences West (Scale: 1:1400)**

4.3 Description of the Site of the Proposed Development

The site of the proposed development extends for approximately 1500 metres along the north (left) bank of the River Suir, which is designated as the Lower River Suir SAC and is hydrologically connected to the River Barrow and River Nore SAC, c. 9km downstream of the proposed development.

From Ch.0.0 to Ch.380 (see Figure 4.1 in Volume 3 of the EIAR), the site is characterised by transport infrastructure elements, namely by Plunkett Station with car parking area(s) located on both east and west sides of the main building, as well as the Rice Bridge roundabout; R711 Dock Road and R448 Terminus Street/Newrath Link Road, both of which are associated with complex construction elements such as viaducts and bridges. Plunkett Station is the terminus of the Dublin-Waterford line and has a through-platform for the extension to Belview Port. This eastern section of the site contains a considerable amount of buried/underground infrastructure mainly consisting of IÉ utilities in front of the Plunkett Station (see Chapter 16 Material Assets of this EIAR), and the obsolete remnants of historical infrastructure that include the existing quay wall and the old Newrath Road bridge foundations.

From Ch.380 to Ch.1090, the site is characterised by an existing quay wall, with one or more rail tracks parallel to the north of it, as well as ancillary rail infrastructure such as signalling and drainage. The IÉ lands occupy all of the lands between the existing quay wall and the R448 and include the rail tracks and the Sallypark industrial site.

Historical maps show that the predominant land use of the site between Ch.380 and Ch.1090 consisted of rail infrastructure and it has provided an industrial function for the past 160 years as shown in Plate 4.2 below.

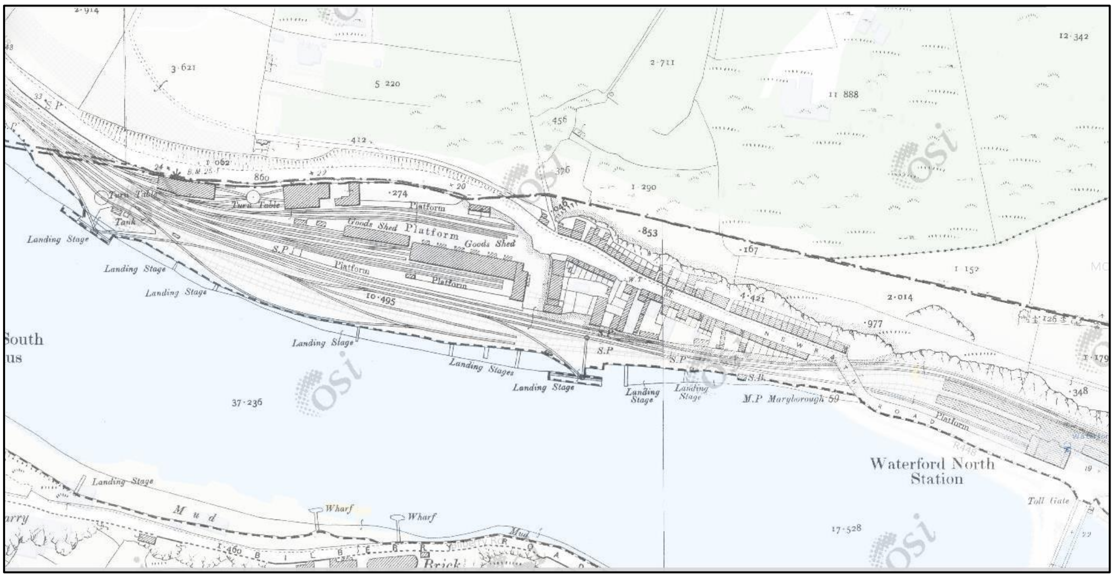

Plate 4.2 **Land use within the northern banks of Waterford City between 1888 and 1913. Source: OSi historic map 25 inch (1888-1913) taken from http://map.geohive.ie/**

The alignment of the existing quay wall remains largely unchanged throughout the years. Historically, some isolated landing stages projected into mudflats at different locations. Only the isolated remnants of wooden piles in mudflats are visible today. Historical maps from pre-industrial period (1840 and earlier) show the site to be an unoccupied coastal strip, with the extents of the westernmost half of the riverbank largely the same as currently visible. Historical maps however show that the eastern section of the riverbank within the site of proposed development is slightly north of the existing bank. This implies that the area has been reclaimed locally in width of up to 10m during the construction of the rail infrastructure and is composed of non-engineered made ground fill, which has been confirmed by ground investigations.

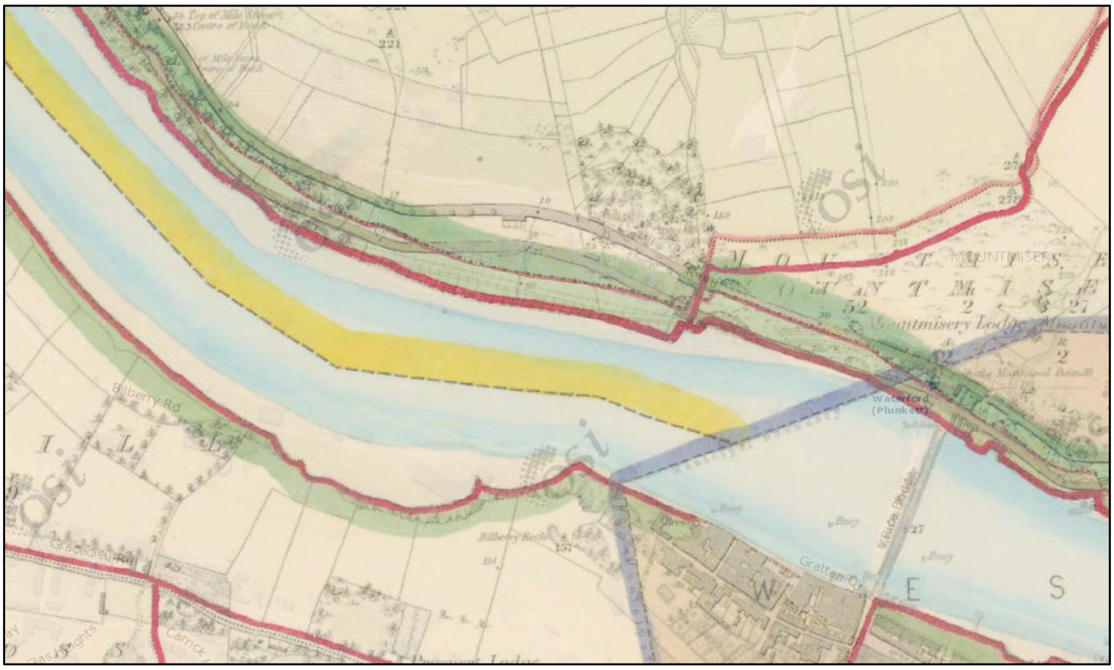

Plate 4.3 Land use within the northern banks of Waterford City from 1837 - 1842. Source: OSi historic map 6-inch colour (1837-1842) taken from http://map.geohive.ie/

The topography of the site of the proposed development is flat, with typical elevation between +2.0mOD and +3.5mOD. The mudflats within the foreshore (in front of the existing quay wall) are typically at an elevation of +0.5mOD to -1.0mOD and slope gently towards the river centreline. To the north of the site, behind the rail tracks and the R448, the ground rises steeply up to level of +60 m OD. This geographical feature is known as Mount Misery hill, see Plate 4.1 above for approximate location.

4.3.1 Existing Drainage

The existing drainage catchment is shown on Figure 4.11 in Volume 3 of this EIAR. The site is bounded to the north by Mount Misery Hill and falls to the south, draining to the River Suir. The following paragraphs provide a description of the existing drainage network within the site of the proposed development, refer to Figures 16.7 to 16.12 in Volume 3 of this EIAR.

From Ch.0.0 to Ch.320 in the vicinity of Plunkett Station (Catchment A), the site is bounded to the north by a steep rock slope which is subject to rock stabilisation works as part of the overall Waterford City Public Infrastructure Project which was granted a Part 8 planning approval by WCCC in January 2019. As part of the Rock Stabilisation works, a cut-off ditch and drainage works are being provided to divert flows from the upper catchment away from the steep rock slope.

There are existing drainage networks in the vicinity of Plunkett Station. At Ch.0.0, an existing drainage network collects drainage from the railway track and platform located to the east of Plunkett Station and the eastern car parking area (below the R711 Dock Road viaduct), before discharging it into the River Suir east of Plunkett Station.

From Ch.160 to Ch.350, there are numerous existing drainage gullies in the western IÉ car park area (to the west of Plunkett Station and under the R448 road overbridge) which have numerous outfalls directly to the River Suir via the existing quay wall.

From Ch.350 to Ch.850, the site of the proposed development is bounded to the north by the remainder of the IÉ lands, the R448, and by the upper drainage catchment and the Sallypark rock cut slopes. The upper catchment drainage at Sallypark rock cut, identified on Figure 4.11 in Volume 3 of this EIAR, comprises a series of benching and rock traps, and rock trap collection channels which discharge into the R448 road drainage network. The R448 road drainage network transversely crosses the railway line at approx. Ch.490 and outfalls in the River Suir via an existing 600mm diameter outfall pipe located in the riverbed.

From Ch.350 to Ch.1090, there are existing drainage networks which collect flows from Sally Park industrial site located to the north of the railway line and some trackside areas which transverse the railway line and outfall to the River Suir. There are also numerous outfall pipes visible through the existing quay wall which may be remnants of old drainage networks or railway\groundwater drainage measures.

From Ch.350 to Ch.1090, existing surface water flows from the railway line and adjacent flat areas, flow to the River Suir either through infiltration into the groundwater or over the edge of the existing quay wall in areas where there are significant gaps or cracks in the wall.

4.4 Design of the Proposed Development

The following paragraphs provide a detailed description of proposed flood defence measures and should be read in conjunction with Figures 4.1 to 4.20 of EIAR Volume 3.

4.4.1 Flood Defences in front of Plunkett Station

Underground Flood Protection

In front of the existing Plunkett Station building and adjacent to the parking areas (see Plate 4.4), starting from chainage Ch.0.0 and going westwards to approximately Ch.365, the ground conditions are such that the risk of flooding caused by underground seepage of waters from the River Suir during flood events are expected to be comparatively lower than within the rest of the proposed development area. It is envisaged that the potential risk from groundwater flooding is reduced due to this section being dominated by shallow bedrock and an abundance of built structures that pose obstructions to water flow, such as the historical quay walls and new boundary walls. However, with climate change and the risk of rising tide levels there is a risk of increased groundwater flooding at the low points in the railway line in front of Plunkett Station in the future. To prevent groundwater seepage at this location, it is proposed to construct an impermeable shallow trench (approximately 0.35m wide and up to 3m deep trench filled with lean mix concrete); blocking of disused drainage pipes; and retrofitting the other drainage pipes with non-return valves.

Plate 4.4 Western IÉ Car parking area in front of the Plunkett Station

It is noted that groundwater monitoring is currently ongoing as a part of the risk-based approach for this section, and it is possible that parts of these underground flood protection measures may be omitted during detailed design or may be implemented on a phased basis with ongoing monitoring of groundwater levels in the interim. However, for the purposes of the EIAR, a full length of impermeable trench is envisaged to be required, and therefore the worst-case impacts have been assessed as part of this EIAR, and separately the NIS.

The impermeable trench's depth and width have been designed on the basis of the local ground and groundwater model, and were determined using long-term monitoring and seepage design in accordance with IS EN 1997-1:2005 Eurocode 7: Geotechnical design General rules (Including Irish National Annex).

Overground Flood Protection

The ground levels at the Rice Bridge roundabout and the entrance to Plunkett Station (between chainages Ch.0.40 and Ch.210) are in parts lower than the design flood level of +4.0mOD. A system of overground flood protection measures is proposed for the Rice Bridge Roundabout and along the three roundabout arms; Rice Bridge (R680), Terminus St. (R448) and Dock Rd. (R711).

The overground flood defence measures will comprise of approximately 170m of glass flood barriers, 15m of demountable flood barriers, sealing of the roundabout and approach structure roadway movement joints, and the provision of flap valves on the existing road drainage outfall to the River Suir (see Section 4.4.4 Drainage for details).

The glass barriers will be located on the river side of the road edge vehicular parapets and will be supported off the existing concrete parapet edge beams (see Plate 4.5 as an example of a similar glass flood barrier).

Plate 4.5 Example of a glass flood barrier installed along a wall

Demountable slot-in flood barriers are required at the entrance on the Rice Bridge roundabout to the North Quays site to ensure access to these lands is maintained at all times (with the exception of at predicted estuary flood events). The demountable flood barriers require the installation of permanent below ground structural foundations at approximately two metre centres. The above ground elements (metal flood barrier posts and infill panels) will only be installed when the risk of flooding arises; the operational need for demountable barriers may only arise in the longer term when the impacts of climate change on tide levels leads to increased risk of flooding at this location. At present there is no record of flooding at this location, and the ground levels are above the current 0.5% AEP flood levels. In the shorter term (20-40 years) it is unlikely that the demountable barriers will be required to be deployed at this location.

Plate 4.6 Demountable Flood Barriers at Clancy Strand, Limerick (Source: www.floodgateireland.com)

The overground flood protection measures proposed will ensure that not only is Plunkett Station and the associated rail infrastructure protected from flooding, but the vital road network for access into Waterford City is also protected.

The proposed underground and overground flood protection measures in front of Plunkett Station will ensure that the Flood Defences West and Flood Defences East (which obtained planning approval in 2019) as part of Transport Hub Part 8 planning application are connected and that there is no gap in the flood defence measures. The Flood Defences East start at Ch.0.0 and continue eastwards. The Flood Defences East will be composed of landside sheet piles, installed south of the rail tracks and running parallel to them. The steel sheet piles will prevent both groundwater and overground flooding, except at Transport Hub development where the overground defence will be provided by the Transport Hub structural elements such as platform walls.

4.4.2 Remedial Works to the Existing Quay Wall

Between Ch.285 and Ch.360, the existing quay wall located in front of the car park (immediately to the west of the existing Plunkett Station) stretching c. 75m to the west under the R448 overbridge will be raised to add between 0.6m and 1.2m in height in order to attain the required height of +4.3mOD.

Between Ch.285 and Ch.300, the works will involve the construction of a reinforced concrete wall add-on, as the existing quay wall is reinforced concrete, and no significant defects were found in this segment of the wall during inspections. This is envisaged to be done as cast in-situ reinforced concrete, using chemically anchored reinforcing bars placed into the top of the existing wall to integrally connect the new add-on section and existing section of wall.

A similar solution will be applied to the existing quay wall between Ch.300 and Ch.360.

The wall add-on will be complemented, as stated in Section 4.4.1 above under the sub-heading of 'Underground Flood Protection', by an impermeable trench filled with lean mix concrete / grout. The impermeable trench will be constructed behind the existing quay wall to prevent the seepage through the deteriorating existing quay wall that is in poor condition at this segment of the wall.

4.4.2.1 Design Standard

The proposed remedial works involve building a reinforced concrete add-on wall on top of the existing quay wall to reach the design (top-of-wall) level of +4.30mOD. The new structure will be connected to the existing wall through chemically anchored reinforcing bars.

The design of the new wall and its connection to the existing structure follows the relevant design standards:

- I.S. EN 1992-1-1:2004+NA:2010 Eurocode–2 - Design of concrete structures - Part 1-1: General Rules and Rules for Buildings;
- I.S. EN 1992-4:2018 Eurocode–2 - Design of concrete structures - Part 4: Design of Fastenings for Use in Concrete;
- IS EN 1997-1:2005 Eurocode 7: Geotechnical design. General rules (Including Irish National Annex).

4.4.3 Sheet-Piled Flood Defence Wall

Riverside Flood Defences

Between Ch.360 and Ch.900, construction of approximately 540m of new flood defence wall within the foreshore of the River Suir will be required (in-river sheet piles). This section of the driven sheet pile wall will be constructed using a piling rig on a jack-up barge situated in-stream for the duration of works as discussed in Section 4.5.4.

The sheet pile wall will be constructed approximately 1m in front of the existing quay wall within the River Suir mudflats and the gap will be backfilled with clean imported granular (TII Specification for Road Works Series 600 Class 6) earthworks fill material. The sheet piles will not be placed closer to the existing quay wall in order to avoid obstacles such as protruding parts of the existing quay wall under the mudline, large erosion protection elements or fallen blocks, and to minimise the potential damage to the quay wall from the proposed works. Historical maps show that some sections of the study area used to contain wooden piles, used as foundations for wooden landing stages. The current visible remains of wooden piles are extremely infrequent, observed as typically isolated and narrow single pile remnant, with no large group of piles observed along the sheet pile alignment (see Plate 4.7 for locations of landing stages along the north bank of River Suir). The only large group of existing wooden piles is observed between Ch.960 to Ch.1020, which is after the transition point between the riverside and landside sheet piles and is thus outside of the sheet pile alignment. Therefore, the landing stage remnants will not be impacted by the sheet pile installation. If the remnants of wooden piles are found to present an obstacle to sheet piling installation elsewhere, the sheet pile alignment may be locally moved. Realignment will be kept to a minimum, with the expected deviation to be within a metre of the current alignment.

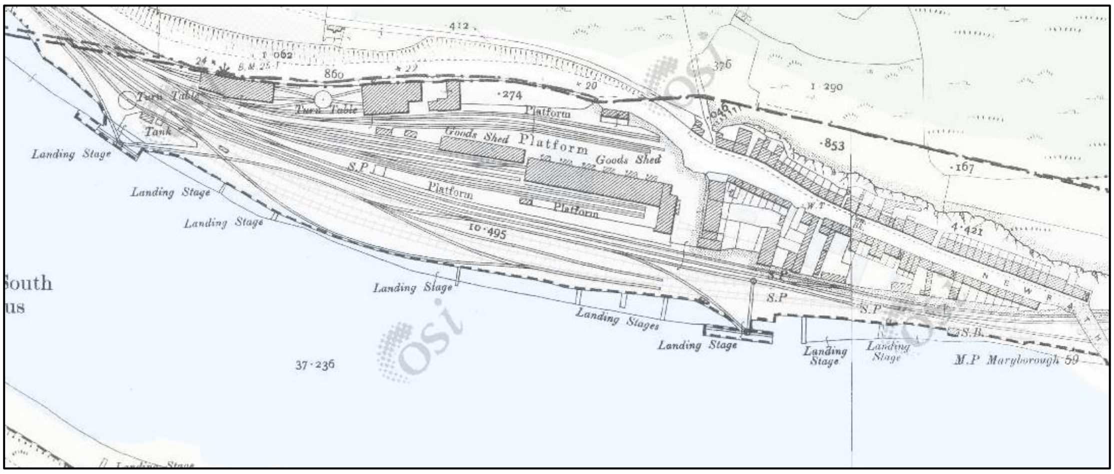

Plate 4.7 **Locations of historic landing stages along the northern bank of River Suir. Source: OSi historic map 25 inch (1888-1913) taken from http://map.geohive.ie/**

Depending on the location, the riverside sheet pile flood defence walls will range in depth of between 14m and 21m in total (including the embedded and above-ground parts). Riverside-installed sheet piles will project above the existing mudline by between 3.3m and 5.3m in order to attain the design (top-of-wall) level of +4.30 m OD.

A section of the riverside sheet piled wall within the intertidal zone of the River Suir (the area between the low- and high-water mark) will be fitted with precast concrete cladding in a form of an "eco-seawall" to enhance marine biodiversity (refer to Chapter

7 Biodiversity of this EIAR for more information). Example of an eco-seawall is shown in Plate 4.8 below.

a) Installation of an eco-seawall

b) Eco seawall submerged under high tide

Plate 4.8 Example of an eco-seawall. Source: product brochure from econcretetech.

Landside Flood Defences

Between Ch.900 and Ch.1090, the works will involve the construction of a sheet piled flood defence wall on land, 1m behind the existing quay wall, but in front of the rail tracks and will meet the IÉ clearance requirements. The landside sheet piles will be installed using a piling rig as detailed in Section 4.5.4. The permanent works will not encroach into the foreshore of the River Suir. Total height of sheet piles will be up to 10m for the landside works, with up to 8.5m of it embedded in the ground. As such, the sheet piles will project above the existing ground level by between 0.7m and 2.1m in order to attain the design (top-of-wall) level of +4.3 mOD.

For Health and Safety reasons and following IÉ standards, a steel handrail will be provided along the sheet pile wall where the distance between ground level at landside and the top of the sheet pile wall is less than 1.2m.

Underground Isolation Structure

The western end of the flood defences at Ch.1090 is set at a natural high point of the terrain and the rail track. The ground at this point is still slightly below the design flood level of +4.30mOD so an underground transverse isolation structure will be constructed in order to prevent both underground and overground flooding parallel to the rail line, i.e., it will create a cut-off return to complete the flood defences and protect from the floodwaters coming in from west to east along the rail lines. The underground isolation structure across and under the rail-line indicated at Ch.1090, will be approximately 20m in length. The underground isolation structure will consist of a sheet pile wall fully embedded in the ground, to a depth of approximately 6m below ground level. Where the sheet pile footprint is directly below rail tracks, a segment of the rail tracks will be temporarily removed to enable the piling and then reinstated back. The typical width of sheet pile profile is 450mm. The sheet pile wall proposed for the underground transverse isolation structure cannot protrude above ground at this location as its positioned directly below the existing rail tracks and would impede on the operation of the rail line. As such the sheet piles here will include a concrete capping beam finished to existing ground level. The concrete capping beam will facilitate the installation of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event. The use of demountable barriers at this location is proposed to address the long-term residual risk of flooding (when the impact of climate change on the rising tide level begins to come into effect). The use of overground flood barriers will form part of a long-term strategy to address the flood risk which will include monitoring and operation and emergency planning to be put in place. At present there is no record of flooding at this location, and the ground levels are above the current 0.5% AEP flood levels. In the shorter term (20-40 years) it is unlikely that overground flood barriers will be required to be deployed at this location. Continuing flood defences further to the west of this point would require extending them further, to a minimum distance of 1km until the next natural topographical flood cut off, hence the selection of Ch.1090 for the westernmost end of the flood defences.

4.4.3.1 Design Standard

The proposed sheet pile wall will be executed as an embedded cantilevered retaining wall throughout its length. The top of the wall will be set at +4.30 mOD, to allow for the design flood level of +4.00mOD and 300mm of freeboard to protect from wave overtopping.

The design of the sheet pile wall follows the current design standards:

- IS EN 1997-1:2005 Eurocode 7: Geotechnical design. General rules (Including Irish National Annex); and
- I.S. EN 1993-5:2007+NA:2010 Eurocode–3 - Design of steel structures - Part 5: Piling (Including Irish National Annex)

The design covers the following ultimate and serviceability limit state design checks:

- Structure global stability (overturning)
- Wall steel section capacity (bending, shear)
- Groundwater seepage cut-off
- Horizontal displacements at the top of the wall

The wall design is verified for: both drained and undrained soil geotechnical conditions; the various temporary loading conditions during the construction stage; the permanent loading conditions once constructed (highest and lowest tidal events). The sheet pile embedment (toe level), steel section and steel grade have been selected to satisfy the limit design checks and loading conditions noted above. For durability, the loss in sheet pile wall thickness due to corrosion (over a 120-year wall design life) has been determined in accordance with the design standards and adopted in the selection of the appropriate sheet pile wall section.

Standard vertical rail loading of 150 kN/m' applied over sleeper width has been adopted in the design. The wall alignment was set such that in all locations the above ground section of sheet pile wall is at an adequate distance from the nearest track, in accordance with IÉ standards. In agreement with IÉ, the sheet pile wall is not designed for accidental impact loading (which may occur in the event of a train derailment).

The characteristics of the soil backfill behind the wall and sheet piling operations will conform to the relevant TII Specification for Road Works Standards and Notes for Guidance.

4.4.4 Remedial Works to the Existing Drainage System

Modifications to the existing drainage system will be required as part of the proposed development. The proposed drainage works are described in the following sections with reference to chainages shown in Figures 4.11 – 4.20 in Volume 3 of this EIAR. The existing drainage features are also shown in Figures 16.7 to 16.12 in Volume 3 of this EIAR and are described in Section 4.3.1 above.

There are existing drainage networks in the vicinity of Plunkett Station and the associated car parking area (at approx. Ch.0.0) which will have their outfall to the River Suir cut off by a sheet pile wall proposed as part of the separately approved Flood Defence East (part of the Part 8 planning application for SDZ Transport Hub). The existing drainage networks will be upgraded, and the associated flows will be directed into the new drainage network proposed as part of the Flood Defences West.

From Ch.160 to Ch.350, the existing gully outlets through the existing quay wall will be retrofitted with non-return valves to prevent water ingress during high tides. Existing drainage networks in this area will be diverted into the proposed surface water network which will outfall to the River Suir at the proposed drainage outfall at approx. Ch.390 (via a pumping station). See section 4.4.5 for more details on the new drainage system.

From Ch.350 to Ch.1090 the existing local drainage network draining into the River Suir will be upgraded with new outlets to enable drainage pipes to pass through the new sheet pile wall. Non return valves will also be provided to prevent water backflow up through the existing outfalls. Where required, existing drainage pipes will be extended to terminate at the front face of the new sheet pile wall.

Existing drainage outfalls which are located in the riverbed of River Suir (at Ch.470 and Ch.490) will be temporarily removed to allow installation of the sheet pile wall. These surface water outfalls will be re-instated in the riverbank to match their existing footprint / length and upgraded as part of the works. Further details are given in Section 4.4.5.

All manholes (see Figures 4.12- 4.17 in Volume 3) on existing drainage networks traversing the railway track will be provided with sealed manholes covers to prevent surcharging of these manholes during high tide events. It is likely that with climate change and rising tide levels, these existing drainage networks will require modification in the future to mitigate the increased surface water flood risk; however, such works are not included as part of this development but should be considered as part of a future catchment management plan. The proposed surface water drainage networks for this development are designed to take into account the impacts of climate change on tide levels.

Several other smaller surface water or land drainage outlets were noted along the existing quay wall during a visual inspection. The proposed drainage upgrade works will connect as many of these minor outfalls as possible into the proposed drainage network and a filter drain will collect sub-surface drainage. Where this is not feasible (due to water levels), these minor land drains will be extended to outfall through the new sheet pile wall.

All existing drainage outfalls will be fitted or retrofitted with non-return valves to prevent tidal water ingress.

4.4.5 New Drainage System

The provision of proposed flood defence measures will raise the level of the quay wall and will cut off the existing flow path of over the edge surface water drainage and the existing groundwater flows.

Therefore, additional drainage pipework such as filter drains will be provided and will run linearly behind the proposed flood protection measures to accommodate the surface water and the cut-off groundwater flows.

As part of the proposed development, no significant increase in impermeable areas or changes to the overall catchment is proposed. The upgrade of the drainage networks may facilitate faster run-off of surface water from the site, however the outfall peak flows will not be increased significantly post construction.

In the vicinity of Plunkett Station from Ch.0.0 to Ch.350, a new drainage network will be provided to collect flows from the trackside drainage and also from the low point at Plunkett Station at +2.15m OD. This will reduce the risk of pluvial flooding at this location.

4.4.5.1 Outfalls to River Suir

Outfalls Terminating at the New Sheet Pile Wall

The proposed outfalls to the River Suir at Ch.550 and Ch.900 will consist of an outfall pipe fitted flush with the proposed sheet pile wall and fitted with a flap valve or other non-return valve. Outfall levels will be above the existing mud flat levels.

At new surface water outfall locations which collect surface water run-off from the railway area, the surface water run-off shall pass through a Class 1 by-pass separator prior to discharge to the River Suir.

Outfalls Extending into the Riverbed of the River Suir

A proposed new outfall structure to the River Suir will be provided at approx. Ch.390 to discharge surface water run-off from the Plunkett Station area. This new surface water outfall structure will extend between 4m and 6m into the River Suir.

At the new surface water outfall location (Ch.390) which collects surface water run-off from the railway area, the surface water run-off shall pass through a Class 1 by-pass separator prior to discharge to the River Suir.

There are 2 no. existing outfall pipes which extend past the existing quay wall into the riverbed i.e., a 750mm diameter pipe at approx. Ch.470, and a 600mm diameter pipe at approx. Ch.490. As part of the proposed works, the existing sections of these pipes which are in the riverbed will be removed and replaced in order to facilitate the construction of the proposed sheet pile wall. The new section of pipe will penetrate the new sheet pile wall and extend into the riverbed the distance required to ensure the pipe outfall invert is above bed level., the distance required to ensure the pipe outfall invert is above bed level. Refer to Figure 4.20 in Volume 3 of this EIAR for details of proposed outfall structures to the River Suir.

All three outfalls will be provided with a headwall structure and a flap valve or similar non-return valve at the outlet (see Plate 4.9 for an example). The sections of pipe located in the riverbed will be provided with a piled foundation which will be further assessed at detailed design based on localised geotechnical information. At each outfall location a stone mattress will be placed in the riverbed to prevent erosion. The stone mattress will require minor excavation works to a depth of approximately 500mm into the riverbed and will occupy an area of approximately 1.5m by 3.5m.

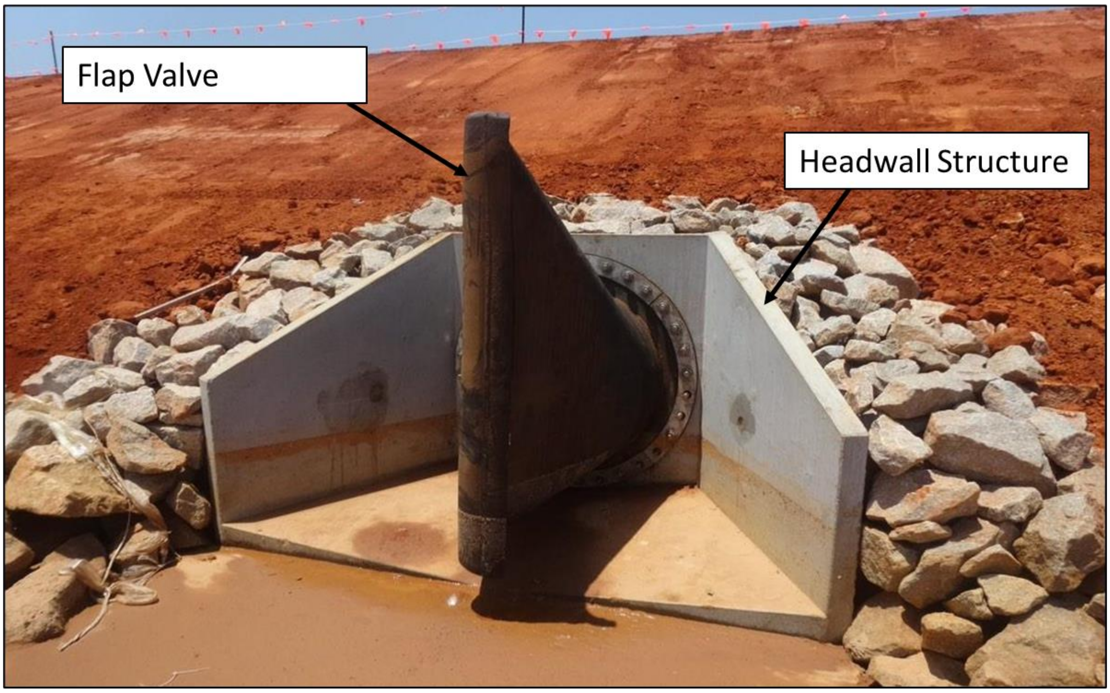

Plate 4.9 Example of a drainage outfall fitted with a flap valve protruding from a headwall structure

4.4.5.2 Surface Water Pumping Station

Surface water flows are designed to gravitate to the River Suir during normal operating and tide conditions. In the event of high tide where gravity flows are not possible, flows will pass through the proposed surface water pumping stations.

The proposed underground surface water pumping stations at approx. Ch.380 and Ch.550 are shown in Figures 4.18 and 4.19 in Volume 3 of this EIAR respectively. The pumping stations will operate in high tide events, where gravity flows are not possible by pumping the flow to the River Suir via rising mains out-falling through the sheet pile wall.

The pumping stations will discharge surface water flows from the proposed surface water network system which consist of trackside drainage and the groundwater flows cut-off by the proposed sheet pile wall. Existing surface water drainage networks (e.g. R448 road network (including the Sally Park Rock cut (upper catchment area (refer to Figure 4.11 in Volume 3)), the Sallypark Depot area surface water networks) are not included in the proposed pumping station catchment area.

The pumping station will be designed to cater for:

- A design Flood level of +4.0mOD;
- Surface water network flows for the 1 in 30-year return period, critical storm duration.

The design of the pumping stations shall be co-ordinated with IÉ to meet their requirements in relation to maintenance and access, as they are located in vicinity to an operational railway line.

Overflow Chamber

Surface water flows are designed to gravitate to the River Suir during normal operating and tide conditions. The hydraulic design of the surface water outfall at Ch.390 and Ch.550 will discharge under gravity, away from the pumping station to the River Suir so that any flood water or tidal influences do not cause damage to station equipment or loss of functionality. In the event of high tide where gravity flows are not possible, flows will pass through a 2D dynamic storm screen mounted on an overflow weir within the storm overflow chamber. These flows will then enter the wet well chamber whereby the storm pumps will operate, pumping flows to the River Suir via the proposed surface water outfall pipe. As proposed, ground levels along the surface water outfall pipe are below design flood level of +4.0mOD, and all manholes on the surface water outfall pipe shall be sealed. Telemetry and control equipment will be installed to facilitate the above sequence of operations.

Pumping Station Wet Well

The basic configuration of the pumps and motors will consist of a wet well and valve chamber arrangement with wet well submersible pump sets. There will be duty, assist/standby pumps as a minimum requirement complete with automatic switchover facilities.

Preliminary size of the pumping chambers are of circa 20m^3 to 50m^3 wet well storage volume.

The duty pump stop level will be above the top of the motor for submersible wet-well pumps. The duty pump start level will also be below the crest of the overflow weir.

No fixed man access system shall be provided into the wet well. However, consideration will be given for provision of permanent safe access to the wet well and equipment for essential maintenance purposes.

Site drainage gulley covers and access covers for manholes, valve chambers and flow meter chambers will comply with IS EN 124.

Lifting equipment will be installed to facilitate safe operation and maintenance of the pumping station.

Kiosks and Cabinets

Insulated cabinets or kiosk housings will be provided for the housing of mechanical, electrical apparatus within the site. They shall be located outside any hazardous areas on the site.

Kiosks shall be installed on a plinth 150mm above ground level to prevent the ingress of water. Typical size of the kiosks shall be 1.2m length by 0.45m wide and approx. 1.4m high. Kiosks and access covers will be locked and secure in their own right.

4.4.5.3 Design Standards

The following Design Standards, *inter alia* will be used for the design of the drainage surface water network:

- Design Manual for Roads and Bridges – Volume 4 Section 2 based on HD33/16, HA 107/04 and HD45/09;
- CIRIA C753 – The SuDS Manual;
- the Greater Dublin Strategic Drainage Strategy (GDSDS), Chapter 3 'The Regional Drainage Policies'

Pipes crossing under the Iarnród Éireann railway line shall comply with :

- Iarnród Éireann CCE-TMS-344"Requirements for Undertrack Crossings and Pressure Pipelines"

Surface water drainage networks are designed for:

- 1 in 1 year return periods, critical storm duration -to be accommodated without surcharge;
- 1 in 30-year return periods, critical storm duration -to be accommodated without surcharge above chamber cover level (e.g. no flooding along the railway corridor);
- 1 in 100-year return period, 6-hour duration event to be accommodated in all storage structures;
- an allowance for climate change to be applied to the drainage design by increasing rainfall intensity by 20%;

The GDSDS recommends that for the design of sewer (surface water) networks affected by river or tidal levels, that flood risk assessment is based on a pragmatic approach to joint probability analysis for combinations of events can be taken initially.

The following event combinations are proposed in the GDSDS, based on providing combined return periods 30 years for flooding from sewerage systems affected by river or tidal levels.

Surface water drainage network system flooding evaluation, with tides (30 years):

- MHWS (mean high water spring tide) with 30-year drainage storm event;
- 1 year tide with 1 year drainage;
- 5-year tide with 0.25-year drainage.

Where the system flooding evaluation identifies a risk of surface water network flooding for the combined tidal\ fluvial and rainfall events; including an allowance for climate change; then it is necessary to provide attenuation storage or pumping systems on the surface water network.

All proposed new drainage networks are designed to gravitate to the River Suir during normal operating and tide conditions. The proposed outfalls from the new drainage networks will be provided with either attenuation storage volume for the 6hr event during high tide in accordance with CIRIA C753, or with an underground surface water pumping station.

As noted in the previous section, the proposed development will include 2 No. underground pumping stations located adjacent to the railway line for the proposed drainage networks within the railway corridor. Additionally, the proposed new outfall at Ch.900 will be provided with oversized pipes to provide attenuation during high tide events.

The protection of watercourses within and surrounding the site, and downstream catchments that they feed is of utmost importance in considering the most appropriate drainage proposals for the site of the proposed works. The River Suir is located along the southern boundary of the site contains surface drainage channels conveying drainage to the river. The proposed development will be designed to protect the water quality of the River Suir and the drainage ditches which border the site. No routes of any natural drainage features will be permanently altered as part of the proposed development. Drainage of the completed development will be directed to a new surface water drainage system and discharged to the River Suir. All new surface water outfalls to the River Suir will be provided with Class 1 by-pass petrol separators.

4.4.6 Demolition of the Existing Quay Wall

Following the construction of the sheet piled flood defence wall the following sections of existing quay wall (and associated handrails) will require demolition to approximately 800mm below the trackside ground level to facilitate the construction of the proposed below ground drainage network;

- The existing reinforced concrete quay wall between Ch.355 and Ch.435 (the top of which is approximately 1.3m above existing ground level (trackside));
- The existing reinforced concrete quay wall between Ch.435 and Ch.555 (the top of which is approximately at existing ground level (trackside));
- The existing stone masonry quay wall between Ch.555 and Ch.590 (the top of which is approximately at existing ground level (trackside)). The removed stone masonry will be salvaged;
- The existing quay wall (stone masonry wall with the top 600mm (approx.) in reinforced concrete) between Ch.590 and Ch.790, and between Ch.840 and Ch.900 respectively (the top of which is approximately at existing ground level (trackside)).

In addition, in the vicinity of Ch.390, the demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level will be required in order to facilitate the construction of a surface water pumping station (as shown in Figure 4.18 in Volume 3 of this EIAR).

In addition, the demolition of minor localised section of existing quay wall (max length of 3m) will be required in order to connect the in-river sheet piles with the landside sheet pile walls at Ch.900. The wall will be demolished in full height over this 3m wide section and the section to the west of the transition point will be rebuilt once sheet piles are installed. The remaining masonry material will be salvaged.

4.4.7 Effect of Flood Defences on Hydrodynamics of River Suir

Project-specific hydrodynamic modelling and analyses have been carried out on behalf of WCCC to assess the effects of the proposed Flood Defences West on hydrodynamics and hydromorphology of the River Suir. The report (see Appendix 10.2) has concluded that *"the hydrodynamic simulations both normal tidal conditions and extreme flood events show an increase in velocity magnitude along the middle section of the flood wall alignment on both ebb and flood flows and a reduction in velocity locally in the vicinity of the outfall structures. The higher increases in velocity between existing and proposed cases occur on the spring tides and on the flooding tide with a general local increase of 0.05m/s and larger increases along the toe of the Flood wall of 0.075 to 0.1m/s. These local changes are not significant in comparison to the computed baseline velocity magnitudes under the present existing situation. There is no perceptible change in flow velocities in the main, deeper channel section or at the opposite far bankside. The predicted upstream and downstream changes to the flow velocity magnitude at the near bank is local and not very extensive or significant"*. For more detailed discussion, refer to Chapter 10 Hydrology of this EIAR.

4.5 Construction Methodology

4.5.1 Potential Construction Procurement Method

It is envisaged that the construction of the proposed development will be tendered under a Public Works Contract for Civil Engineering Works Designed by the Employer.

The advantage of the Employer Designed Works contract is that the design team who have undertaken the design and environmental assessment will continue with the detailed design and site supervision, ensuring a continuity of knowledge through the remaining phases of the project through to completion and handover.

4.5.2 Timescale for Construction

Subject to timely completion of the statutory procedures and availability of finance, it is anticipated that construction work could commence in 2022 with a 30 to 35-week construction programme. Table 4.2 at the end of Section 4.5.3 provides a summary of the construction sequence and programme.

4.5.3 Construction sequence

The envisaged construction sequence for the works is as follows:

(i) Site Setup and establishment of construction compounds at locations described in Section 4.5.14;

(ii) Excavation of trenches at Ch.0.0 to Ch.365 (or just in parts of this section, based on the groundwater monitoring and assessment) including:

- (a) Relocation of underground utilities, where required;
- (b) Excavation of material from trenches;
- (c) Filling in trenches with lean mix concrete / grout and reinstatement of pavement.

(iii) Installation of overground flood defences:

- (a) Glass barriers on the river side of the road edge vehicular parapets on Rice Bridge roundabout and the 3 roundabout arms (R711 Dock Road, R448 Terminus Street, and R680 Rice Bridge).
- (b) Underground foundations for the demountable flood barriers at R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.

(iv) Remedial works for raising the height of the existing quay wall including:

- (a) Setup of temporary dry (dewatered) working area in front of the wall using sandbags, Portadam system or waterfilled dams;
- (b) Setup of temporary works such as formwork, scaffolding and granular base for scaffolding in mudflats;
- (c) Anchoring and concrete pouring works;
- (d) Decommissioning of temporary works, including removal of granular base from the mudflats, any building works spoil, and dewatering system.

(v) Installation of permanent sheet pile walls on the riverside. Backfilling of the gap between the riverside sheet pile wall and the existing quay wall can take place simultaneously with sheet piling, after a short segment of the sheet pile wall (assumed 10-30 m) is piled (temporary transversal sheet pile may be installed at the end of segment to prevent fill from being washed out), or once full length of sheet piles is installed. Attaching of eco-seawall panels to the front face of the sheet piles.

(vi) Partial demolition of existing quay wall (from Ch.360 to Ch.900) above ground and to a depth of 800mm below ground (where required) to enable installation of drainage works (to be complete in tandem with step (v) above to ensure demolition takes place before backfilling);

(vii) Installation of landside sheet pile wall from Ch.900 to Ch.1090 to include:

  (a) Demolition of the 3m wide section of the existing quay wall at Ch.900 to enable joining of the riverside and landside sheet piles;

  (b) Installation of permanent landside sheet piles; and

  (c) Installation of transversal underground isolation structure at Ch.1090.

(viii) Drainage – Installation of drainage works from Ch.360 to Ch.1090 as follows:

  (a) Installation of drainage works parallel to the new sheet pile wall in tandem with construction of the sheet piling (step v);

  (b) Installation of surface water outfalls passing through the new sheet pile wall, and fitting of flap valves from the riverside on each outfall (in tandem with step v);

  (c) Demolition of existing surface water outfalls in the riverbed and provision of temporary outfalls (e.g. over pumping) on existing outfalls during the works;

  (d) Construction of new outfall structures in the riverbed (following installation of the sheet pile wall) within a sheet pile cofferdam (temporary works); the outfall structure will include a foundation structure to the outfall pipe (which may need pile supports), a headwall and erosion protection measures (inlcuding a stone mattress at the mouth of the outfall), headwall and erosion protection measures including a stone mattress at the mouth of the outfall;

  (e) Construction of 2 No. underground pumping stations to include an overflow chamber, wet well and valve chamber;

  (f) Installation of pumping station pumps, valves fitting and MEICA commissioning of pumping stations.

(ix) Drainage – Installation of drainage works from Ch.0.0 to Ch.360 at Plunkett Station as follows:

  (a) Installation of the new drainage system and associated railway undertrack crossings. All undertrack crossings will be carried out subject to IÉ agreement and where necessary, localised night-time possessions will be applied to facilitate installation,

  (b) Remedial works to existing drainage networks including retrofitting of flap valves at outfalls.

Due to the linear nature of the works, it is assumed that the works under items (ii) to (ix) above can run in parallel. The list above thus does not indicate that one activity needs to fully finish for the next one to start. It is possible that the works will be done in separate sections. Some limitations however exist, and these are outlined below:

- The sheet pile wall needs to be installed at drainage outlet locations before the outlet can be completed. It is necessary for the drainage outlet to be completed before the backfilling to the sheet pile wall (above the underside of pipe level) can be completed.
- Impermeable trench / grouting in area behind the existing quay wall (where the wall will be raised with remedial works) to be done before the commencement of wall remedial works.

- The upper sections (down to 800mm below ground level) of the existing quay wall are to be demolished after the sheet piles are installed in that location and before the drainage is installed.
- The riverside sheet piles will be installed before the eco-seawall panels are attached to them.

4.5.4 Piling Methodology

Riverside (Ch.360 – Ch.900)

The installation of riverside sheet piles will be carried out from a jack-up barge positioned in river that will move as the work progresses. The typical dimensions of such a barge are 25m x 15m (length x width). The barge will carry a crane and/or long reach excavator equipped with a vibratory hammer that drives piles into the ground by vibration. The stack of sheet piles will be placed on an additional pontoon placed next to the barge, which can be tugged by a tugboat to the main construction compound area at Ch.1340 (see Section 4.5.14) to bring more sheet piles to the barge.

Works will be carried out by two piling rigs located on two separate barges. One barge will start from the east at Ch.360 and work westwards, while the other barge will start either at the western end (Ch.900) and work eastward or start from a suitable location in the middle.

The work process involves the barge anchoring and stabilising itself, after which a line of sheet piles is driven by a crane or excavator. The pile is lowered to a position and the vibrating clamp is attached to the head of the pile. The vibrations generated by vibratory hammer drive the pile into the ground. The vibration and noise generated by this process are continuous during the driving time but are less than those induced by impact driving. After the segment (a line of piles) is completed, the barge is then either self-propelled or tugged to the next position where the next segment is being driven. The barge is assumed to be anchored approximately 6m from the quay wall, to ensure that the barge is not positioned within the tidal mud flats and can move regardless of the tide level. The barge cannot be positioned within the mud flats as it will need to wait for high tide to be able to float to a new position. The barge can, however, be brought closer to the shoreline in some specific locations (to a minimum distance of 3m from the existing quay wall), if required.

The sheet pile alignment is set so that the back side of the sheet piles is at a distance of 1.0m from the front face of the existing quay wall. The front face of the wall includes the protruding blocks or slabs at or near the toe of the wall. This will ensure that the piling is not obstructed by the wall foundation and similar obstacles. Localised obstacles such as dislodged blocks in the mudflats will be removed by an excavator bucket. An allowance is made for localised minor in-situ realignment of the sheet pile where significant obstacles such as remnants of wooden piles of landing stages are present as described in Section 4.4.3.

The gap between the sheet pile wall and the existing quay wall will be backfilled with clean imported granular fill, TII Specification for Road Works Series 600 Class 6. The top of the fill is envisaged to be flush with existing ground level or up to 500mm lower. The backfilling can be carried out once the entire sheet pile wall has been installed or can progress simultaneously with sheet piling – once a short segment (10 - 30m) of sheet piles has been installed, the gap can be filled (subject to the installation of drainage works as outlined above). A temporary transversal pile can be installed at the end of each segment to prevent washout of the backfill. Alternatively, the fill can be placed once all piling is completed. Placing of fill will be coordinated with the drainage outlet works in either case.

The total height of the sheet piles will range between 14 and 21m. The sheet piles will be embedded in the ground over approximately 11 to 16m of total length. The difference in the total sheet pile height and embedment length is due to differences in local ground conditions and retained height encountered along the alignment. All sheet piles will meet the required top of wall level of +4.30 mOD.

The construction is assumed to be carried out during normal working hours (daytime), 6 days a week. The estimated timeframe for riverside sheet pile driving is approximately 12 weeks using two barges. This excludes set up and other activities on site, either prior to, or after pile driving. The piling will occur intermittently throughout the day, with the remainder of the time spent on ancillary processes such as setting up the barge, positioning the piles, checking tolerances, delivering material and personnel, and similar. Piling duration for the temporary and permanent piles at the three drainage outfall locations will take approximately 2 weeks.

While the riverside piling works will not require extended rail possessions and night works, localised short-term possessions may be required during the passage of trains for health and safety reasons where sheet piles alignment is in close vicinity of the rail tracks, such as at Ch.430.

Landside (Ch.900 – Ch.1090, incl. transversal isolation structure)

The installation of landside sheet piles will be carried out by machinery (excavator with vibratory clamp) situated in the cess between the rail tracks and the existing quay wall. The width of the cess in the section from Ch.900 to Ch.1090 is in excess of 10m, therefore the works can be carried out during the daytime, behind a temporary fence installed at 3.0m distance from the nearest running track, with no rail possession required. Some isolated night-time work (full rail possession) may be required to fully set up the temporary fence, material, and machinery in the works area.

Total height of sheet piles will be 10m for the landside works, with up to 8.5m of it embedded in the ground.

The construction is assumed to be carried out during normal working hours (daytime), 6 days a week. The estimated timeframe for daytime landside sheet pile driving is approximately 4 weeks. This excludes set up and other activities on site carried out prior to or after pile driving. In each day, the piling will occur intermittently throughout the day.

The approximately 20m long transversal isolation structure will have to be constructed overnight in order to avail of full rail possession, as the structure will pass directly under the rail tracks. The nightworks are estimated to be carried out on Monday – Friday lasting approximately 1 to 2 weeks. Night-time working will also be required for the stretch of the landside sheet pile wall between Ch.900 and Ch.950, which was brought to landside to avoid impact on the Annex I Saltmarsh habitat. The works will require approximately 2 weeks of night-time piling works under full possession. A hoarding fence will be erected for these works around the rig's working area to reduce the noise impacts at night-time.

The total duration of landside piling works (Ch.900 to Ch.1090), including isolation structure) will be approximately 7-8 weeks.

Piling durations to satisfy environmental requirements

The following general procedure will be followed for any pilling activities from riverside and landside ("piling event" means any period of continuous piling by one or two rigs; "quiet period" means any period in which there is no piling by any rig):

- Night-time piling shall be limited to the minimum number of shifts possible and shall only be permitted for landside piling.
- In-stream (riverside) piling shall be restricted to daytime shifts only.
- Vibratory piling shall be the standard method for the installation of all piles. Impact piling shall only be employed where the required depth below ground cannot be achieved by vibratory piling.
- No more than two piling rigs shall operate simultaneously at any time.
- The duration of any *vibratory* piling event shall not exceed 55 piling minutes, i.e. the duration of piling by one rig or the sum of the duration of piling by two rigs shall not exceed 55 minutes.
- The length of any *impact* piling event shall not exceed 200 strikes from one piling rig (or 200 strikes from *each* of two piling rigs, if piling simultaneously).
- Following every piling event, there shall be a quiet period of at least 30 minutes. Only following 30 minutes of no piling whatsoever can the cumulation of piling minutes be re-zeroed.
- The above limitations apply to all piling activity for the proposed development, riverside and landside, daytime and night-time, permanent and temporary.

Based on the time expected to be required for the installation of each pile (including ancillary processes), the limits prescribed above will not prolong the proposed programme for riverside or landside piling.

4.5.5 Installation of an eco-seawall

Pre-cast concrete cladding panels ("eco-seawall") will be installed to sections of the riverside sheet pile wall that are within the intertidal zone of the River Suir. The cladding panels of the eco-seawall will be mechanically attached onto the front (riverside) face of the installed sheet pile walls without the use of in-situ concrete. The cladding panels will be attached to the attachment points that will be welded to sheet piles prior to their driving (see Section 4.5.4 for piling methodology). The attaching of the cladding panels to the sheet pile wall will be carried out from a barge. Construction personnel will also be positioned close to the sheet pile wall either from a working platform cantilevered from the barge, or on mudflats to guide the cladding panels to attachment points. Works will be undertaken at low tide.

The height of cladding will be 2.5m on average, and the final height will depend on the mudflat level at the particular section. Installation of the "eco-seawall" to the sheet piles will require approximately 3 weeks.

4.5.6 Construction of Underground Flood Defences in Front of the Plunkett Station

Impermeable trenches will be constructed between Ch.0.0 to Ch.360 using the following methodology:

(i) Traffic management to be set up;

(ii) A segment to be surveyed via CAT scan and shallow slit trenches excavated in order to confirm the position of utilities;

(iii) A main trench with width of 350mm will be excavated for the determined length of the segment (assumed up to 10m);

(iv) Excavated material from the trench will be tested for contamination levels and taken off site for disposal at a suitably licensed facility;

(v) The trench will be filled with lean mix concrete or grout.

(vi) Points ii) to iv) above are repeated for the next segment.

The construction works are assumed to be carried out in two phases in order to minimise the inconvenience to Plunkett Station car park and station users. The first phase will take place from Ch.160 to Ch.365. This will close the western car park but will retain unimpeded usage of the station building and the eastern car park. The works will be undertaken during normal working hours, with a duration of approx. 2 weeks. From Ch.280 to Ch.365, in consultation with Iarnród Éireann, a temporary fence will be erected at 3.0m distance from the rail line for Health and Safety purposes.

Once works on this section are completed, the western car park will reopen, and the works will commence on the trench at Ch.0.0 to Ch.160. Works on this section are envisaged to be carried out over ten weekend shifts to minimise the effect to working day commuters. The eastern car park will be closed on weekends as a result. Short, localised night-time works may be required to finish the section at Ch.150 where the only entrance to both car parks is situated.

4.5.7 Construction of Overground Flood Defences in the Vicinity of Rice Bridge Roundabout

The installation of the glass flood barrier and support points for the demountable flood barrier will be carried out using the following construction methodology:

Glass flood barriers

(i) Traffic management is set up to suit the location of each section of flood barrier;

(ii) Access scaffolding is installed to the outer face of the existing concrete parapet edge beam or an underbridge access unit (vehicle) is setup on the traffic lane adjacent to the footway/ vehicular parapet;

(iii) The glass barrier posts and associated base plates are fixed to the existing concrete parapet edge beams using a proprietary anchor system;

(iv) The infill glass panels with structural steel surround are installed between the posts as the post installation progresses along the length of proposed flood barrier. A continuous seal is provided between the lower glass panel framing element and the existing concrete parapet edge beam to prevent any water ingress between the elements.

(v) Points i) to iv) above are repeated for each section of barrier to be installed.

Demountable slot-in flood barrier

(i) Traffic management is set up;

(ii) The road pavement and footpath at the entrance to the North Quays site on the roundabout is surveyed via CAT scan in order to confirm the position of utilities;

(iii) The road pavement and footpath at the proposed flood barrier support locations are excavated to the required depth to install the flood barrier post foundations/ support fixings;

(iv) Remedial Works to the existing vehicular parapet at the start of the ramp at the entrance to the North Quays Site and the end of the parapet system on R711 Dock Road are undertaken to facilitate the joining of the permanent and temporary flood protection systems. The remedial works will consist of the following;

a. The section of existing metal parapet railing adjacent to the northern end of the proposed glass flood barrier on Rice Bridge (R680) is cut back to the two adjacent existing parapet posts. Parapet ends are made good (painting etc). A new concrete pillar is constructed on top of the existing concrete parapet edge beam to provide a suitable form of construction to facilitate the interface of the glass barrier and demountable barrier system.

b. A new concrete pillar is constructed on the top of the existing concrete parapet edge beam at the end of the metal parapet system on R711 Dock Road to provide a suitable form of construction to facilitate the interface of the glass barrier and demountable barrier system.

It is assumed that the construction works will be carried out in phases to minimise inconvenience to Plunkett Station and road users.

4.5.8 Remedial Works to the Existing Quay Wall (Ch.285 – Ch.360)

The remedial works to the existing quay wall (a mixture of masonry and concrete construction) will involve raising the wall height (by between 0.6m to 1.2m) to +4.3mOD.

The new raised section of wall is envisaged to be done using cast in-situ reinforced concrete construction.

The following construction methodology is envisaged:

(i) The existing handrails will be removed from the top of the wall.

(ii) The top of the existing quay walls will be suitably prepared to form a construction joint with the new wall section (i.e., thoroughly cleaned of any loose debris and the existing top of wall concrete surface scabbled (using a handheld three head scabbler or equivalent)).

(iii) Chemically anchored reinforcing bars will be placed into the top of the existing wall to integrally connect the new and existing sections of wall.

(iv) The new wall section reinforcement will be placed

(v) Formwork will be installed for the new wall section and will be supported off the existing sections of wall.

(vi) The in-situ concrete will be poured, and the formwork struck once the concrete has hardened.

No permanent works encroachment into the River Suir SAC will be necessary for the works.

The majority of the works are expected to be undertaken from the landside, however temporary access scaffolding on the outer (river) side of the existing wall may be required during construction. The scaffolding may be supported off the existing quay wall or set up in the mudflats. To ensure the stability of any scaffolding set up in the mudflats, up to a 1m thick layer of coarse granular fill will be placed on top of the mudflats. This material will be fully removed following completion of the works. A temporary dewatering system, using sandbags or Portadam system (engineered above ground cofferdam system), will be set up in front of the wall to enable dry working conditions and shall ensure that no in-situ concrete material or any other building or waste material enters the River Suir.

Railway possessions and night-time works will not be required. The works will take place behind the temporary fence set up minimum 3.0m from the nearest IÉ rail track.

The communication and connectivity to the construction compound will be via the cess, parking lot and the R448 towards the ancillary construction compound at the Sallypark Industrial site, see section 4.5.14.

4.5.9 Drainage

Landside

Landside drainage works consist of:

(i) Upgrading of existing surface water outfalls to River Suir system to be extended where necessary and fitted through the new sheet pile wall (works landside). These works will be carried out in sequence as the sheet piling moves from east to west. (Ch.360 to Ch.1090).

(ii) Construction of filter drains positioned parallel to the proposed new sheet pile wall to collect groundwater flows and surface water run-off cut-off by the new wall.

(iii) Construction of 3 No. new surface water drainage outfalls to the River Suir at approx. Ch.390 (involves both landside and riverside works) and new drainage outfalls at Ch.550 and Ch.900 which will terminate at the new sheet pile wall.

(iv) Construction of 2 No. Surface Water Pumping Stations at proposed surface water drainage outfalls at Ch.390 and Ch.550 which will consist of:

- Excavation and construction of an overflow chamber, wet well chamber and valve chamber;
- Installation of associated pumps, motors, valves, chambers, fittings and pipework, hydraulic surge protection equipment and associated lifting equipment;
- Installation of rising main and associated valves and secondary outfalls from the rising mains terminating at the sheet pile walls;
- Insulation Stations, Kiosks and Cabinets and associated electrical equipment, instrumentation, telemetry, flow monitoring equipment, facility to connect mobile electrical generator and all mechanical and electrical equipment.

The construction of the filter drainage networks can be carried out without the necessity for railway possessions, behind a temporary fence installed at 3.0m distance from the nearest rail track. Trenches for drainage networks will typically be constructed using open cut using a mini excavator. Where required, adequate trench supporting systems will be installed. The construction methodology that will be employed for the majority of the proposed outfall (land-based section) will be conventional open cut methodology. Some isolated night-time work (full rail possession) may be required to fully set up the temporary fence, material and machinery in the works area.

The construction of several elements of the landside drainage works will require extended rail possessions (3-4 weeks of night works):

- Construction of drainage networks for the railway line for the area in front of Plunkett Station and along the railway track (carried out in a westbound direction from Ch.0 to Ch.540).
- Construction of drainage networks which cross the track at various locations from Ch. 540 to Ch.1090) Trenchless methods, such as pipe jacking and micro-tunnelling, will be used at crossings of railways (where required).

- Construction of the surface water pump stations at Ch.380 and Ch. 550. Precast pump sumps, petrol interceptor, valve unit and kiosks require the provision of a crane. Access is only possible from the landside.

Riverside (c. 800m)

Riverside drainage works consist of:

(i) Upgrading of the existing surface water road gully outfalls at the Rice Bridge roundabout to retrofit non-return valves.

(ii) Retrofitting non-return valves to existing surface water outfalls from the IÉ Car Park area west of Plunkett Station (Ch.180 to Ch.360).

(iii) Installation of flap valves \ non-return valves on existing and proposed surface water outfall pipes (Ch.360- Ch.1090) penetrating through the new defence walls.

(iv) Construction of Outfall Structures to/in the River Suir (Ch.390, Ch.470 and Ch.490) to include outfall headwall/riprap/stone mattress at the outfall mouth (refer to Section 4.5.9.2 below).

4.5.9.1 Outfall Structures

Upgrade of existing structures

Upgrade works to 2 no. existing drainage outfall structures located in the riverbed at approx. Ch.470 and Ch.490 are proposed to facilitate installation of the sheet pile wall, and replacement of the existing pipe and an upgrade to outfall mouth e.g., provision of non-return valve, headwall/riprap/stone mattress at the outfall mouth.

Construction of new outfall structures

Construction of 1 no. proposed surface water outfall structure at approx. Ch 390 in the riverbed including installation of outfall pipe and outfall structure to and in the River Suir to include outfall non return valve, headwall/riprap/stone mattress at the outfall mouth.

4.5.9.2 Construction activities for outfall structures

The construction of the 3 no. outfall structures for surface water drainage will be carried out from riverside i.e., within the foreshore. The proposed works within the foreshore will consist of the construction of the outfall pipe and outfall headwall/riprap/stone mattress at the outfall mouth and will be constructed within a temporary sheet pile cofferdam.

The pipe opening will be covered with a non-return valve and the pipe will be encased in suitable fill material overlaid with a two-layer geotextile high strength mattress, grouted with cement or concrete to provide erosion and pipe protection. This will then be bounded by rip rap type rock armour. The pipe opening will be imbedded in a concrete headwall with side walls and floor from the pipe with a steel guard rail positioned on top of this headwall (if required for maintenance).

The following procedure will be followed in order to create a dry working area to facilitate this phase of the construction works.

Construction of the Outfall structures (3 no.)

(i) Existing outfall structures in the riverbed at Ch.470 and Ch.490 will be removed by excavator from the barge prior to the installation of the sheet pile wall\proposed outfall structures. A temporary outfall or over pumping of the flows will be implemented.

(ii) Drive the permanent bearing piles for outfall and headwall. Tubular steel piles to be used, installed by vibratory equipment.

(iii) A dry works area will be created by placing sheet piling or similar into the river from a jack-up barge to construct a temporary cofferdam. The sheet piling works will be carried out from riverside. Sealant will be used to make the cofferdam waterproof.

(iv) Prior to the commencement of any de-watering operations within the cofferdam, adequate and appropriate facilities for the treatment of silt laden water will be designed prior to discharge to ground or back to the River Suir.

(v) Excavate to underside of pilecap level (further assessment will be carried out at detailed design to determine if piles are required or other suitable foundations are appropriate);

(vi) Cut off any excess length at the top of permanent piles and construct the pilecap.

(vii) The outfall headwall will be a pre-cast unit. This will be dropped in place from the riverside barge.

(viii) The pipe will be fitted through the sheet pile wall and laid on the pilecap. The pipe will be encased in suitable fill material overlaid with a two-layer geotextile high strength mattress, grouted with cement or concrete to provide erosion and pipe protection.

(ix) The pipe will be further protected from erosion by using rip rap type rock armour. The rock armour will be placed by a suitable plant all of which will be located within the designated working area.

(x) A minimal amount of concrete will be poured on-site to secure the headwall.

(xi) A stone mattress will be created surrounding the outfall and will extend approximately 1.5m x 3.5m into the Suir River.

(xii) Minor excavations will be carried out to facilitate the stone mattress, extending approximately 500mm into the riverbed.

(xiii) The stone mattress wire mesh cage will be mechanically fastened to the riverbank.

(xiv) Clean, debris free stone will be utilised for the creation of the stone mattress.

(xv) Remove the temporary cofferdam sheet piling (The dry works area will remain in place until all in-stream works have been completed and all concrete material has had sufficient time to cure).

4.5.10 Demolition Works

Existing Quay Wall

From approx. Ch.355 to Ch.950, the existing masonry quay wall shall be demolished above ground level and to a depth of approx. 800mm below ground level to facilitate installation of drainage pipelines and the pumping stations. In addition, in the vicinity of Ch.390, the demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level will be required in order to facilitate the construction of a surface water pumping station (as shown on Figure 4.18 in Volume 3). The demolition of the existing quay wall sections will be carried out using an excavator (16 tonne or similar) and a wheeled or track mounted dumper (12 tonne or similar).

Existing Outfall Structures

Existing surface water outfall structures and pipes in the river side at Ch.470 and Ch.490 will be demolished as part of the works to allow installation of the sheet pile wall. The methodology for the replacement of these outfall structures is outlined in

Section 4.5.9.2 above. Existing outfall structures in the riverbed will be removed by excavator from the barge prior to the installation of the sheet pile wall.

4.5.11 Summary of Construction Programme

Table 4.2 below provides the summary of the construction programme for the proposed Flood Defences West.

Table 4.2 Summary of Construction Programme

Construction Element	Chainage	Approx. Duration of task (in weeks)
Mobilisation, compound set up	Compound area	2 weeks
Remedial Works to existing quay wall	Ch.285 to Ch.360	4 weeks
Impermeable trench in front of the Plunkett Station	Ch.0.0 to Ch.160	2.5 months (10 weekends)
	Ch.160 to Ch.360	2 weeks
Works at Rice Bridge Roundabout – Installation of Glass barriers, movement joint sealing & the provision of flap valves on existing road drainage gullies	Ch.0.40 to Ch.210	6-8 weeks
Sheet-pile wall installation (two piling rigs on two barges operating simultaneously)	Ch. 360 to Ch.900 (Riverside)	12 weeks
	Attaching cladding to installed riverside piles	2-3 weeks
	Ch.900 to Ch.1090 (Landside, incl. transverse structure)	7-8 weeks
Drainage Works	Upgrade of existing drainage	9-12 weeks
	New Drainage network and proposed outfall structures	9-12 weeks
	Pumping Stations	9-12 weeks
Total Construction Phase		**30 - 35 weeks**
Notes: Due to linear nature of the works, the majority of the works will be able to be done in parallel. See section 4.5.3 for more details.		

4.5.12 Construction Materials

Steel sheet piles will be grade S355 steel complying with Irish Standard I.S. EN 10025. The steel sheet piles will be between 6 and 21m length. The total length of sheet pile wall, including transversal isolation structure, is assumed to be approximately 770m. Sheet pile section AZ20-700 is assumed throughout the length, with exception of two localities where section AZ42-700 is assumed. The total surface of the sheet piles is assumed to be approximately 11,000m^2 with the total tonnage of approximately 1,400 tonnes.

The imported backfill for placing between sheet pile wall and the existing quay wall will be imported granular Class 6 material in accordance with TII Specification for Road Works Series 600.

The concrete and steel reinforcement used to raise the height of the existing quay wall will be C35/45 in accordance with IS EN 206-1 and grade B500B in accordance with I.S. EN 10080 respectively. The chemical anchoring system to fix reinforcing bars into the existing quay wall will be a proprietary product complying with all relevant Irish standards.

The materials used for drainage works will be in accordance with TII Specification for Road Works Series 500.

Table 4.3 Resources to be used During Construction

Element	Resources
Earthworks	Installation of a sheet pile wall will not require excavation of waste material. Imported material to fill the gap between the sheet pile wall and the existing quay wall will be clean granular material Class 6, totalling approximately 2000m^3. Approximately 2,500m^3 of clean imported granular fill material Class 6, will also be required for drainage works.
Structural Works	The project will require import of steel sheet piles for construction of new flood defence walls as well as material for in-situ concrete for remedial works on the existing quay wall. Total length of sheet pile wall will be approximately 770m, with height of piles between 10 and 21m. The total surface of the sheet piles is assumed to be approximately 11,000m^2 with the total tonnage of approximately 1,400 tonnes. Approximately 1,500 m^3 of precast concrete eco-seawall panels (with depth of approximately 13 cm) will be attached to riverside sheet pile wall. Approximately 50 m^3 of concrete will be used for remedial works (raising) to the existing quay wall. Minor quantity of reinforcement steel will also be imported. Up to approximately 350m^3 of lean mix concrete / grout will be required to infill the impermeable trench.
Drainage	Drainage pipes (approx. 1,310m), valves, manholes, 2 No. precast pumping chambers, 3 No. precast headwalls, handrails, riprap, stone mattresses etc. 70m^3 fill of concrete surround for pump chambers of the pumping stations will be required.
Construction and Demolition Waste	The removal of the upper section of the existing wall to the level of 800mm below existing ground level will generate approximately 600 m^3 of waste. Material excavated during demolition of a small section of the quay wall for the purpose of joining the riverside and landside sheet piles, will amount to approximately 50m^3. Another approximately 70 m^3 of wall will be demolished during the construction of a pumping station. All of this waste will be considered waste for disposal off-site. The waste will be disposed of in licensed landfills and will receive inert WAC and material exceeding inert WAC. Up to c.350m^3 of waste material will be generated during shallow excavations for the impermeable trench. The material with undergo environmental testing to determine the level of potential contaminants and disposed off-site in the suitably licensed facility. Approximately 2,600m^3 of in-situ ground and ballast will be excavated during the drainage outlet remediation works and other drainage works such as installation of filter drains, with approximately half of it expected

Element	Resources
	to be used again as a backfill across the site for ground levelling purposes. As such, approximately 1,300m^3 of surplus excavation, will also have to be disposed off-site to a suitably licensed facility.

4.5.13 Sourcing of Imported Earthworks Materials and Disposal of Waste

The deficit of material for the construction of the earthworks, and the need for stone to establish haulage routes, will require quarried material to be sourced. All imported material will be sourced from the nearest possible locations. There are a number of commercial quarries in the vicinity of the proposed development, which may be utilised in the sourcing of this material including:

- Oaklands Quarry in Ballykelly, New Ross, Co. Wexford; and
- Cappagh Quarry in Cappagh, Dungarvan, Co. Waterford.

There may be other suitable quarries, in addition to those identified above, that the Contractor may select as the source for construction materials. Only those quarries that conform to all necessary statutory consents may be used in the construction phase by the appointed Contractor. For whatever quarry source, or sources, utilised for the fill material to be imported to the proposed development, all will require suitable access routes for HGV traffic from their sites to the suitable main road network, in accordance with their planning approvals. The haulage route for access into the proposed road development has been determined to be restricted to use of the national and regional roads that are connected to the site, and other unsuitable local roads may not be used for such traffic. In this context, traffic from all potential quarry sources as described above would have no more adverse effect on general traffic than as assessed in Chapter 5 Traffic Analysis of this EIAR.

4.5.14 Temporary Construction Compound Areas

The main temporary construction compound area is situated at Ch.1340, approximately 300 m northwest of the proposed development works, in a very wide cess area between River Suir and rail lines. The land is in Córas Impair Éireann (CIÉ) ownership and is operated by Iarnród Éireann (IÉ). A public level crossing is situated nearby which facilitates access to the works area.

An ancillary site compound is proposed in the IÉ's Sally Park yard, currently used for material storage, situated across from the rail lines from Ch.640.

Refer to Figure 4.21 in Volume 3 of this EIAR for locations of the two temporary construction compound areas.

Impacts of such temporary sites have been assessed in this EIAR (refer to Chapter 6 Population and Human Health, Chapter 7 Biodiversity, Chapter 9 Hydrogeology, Chapter 10 Hydrology, Chapter 12 Noise and Vibration and Chapter 13 Air Quality and Climate) and will be subject to the control measures proposed in this EIAR in terms of dust control and noise, and night-time illumination, including at night-time, etc. The storage of fuels, other hydrocarbons and other chemicals within the construction compounds will comply with the protection / mitigation measures described in this EIAR, the NIS and the Environmental Operating Plan.

4.5.15 Enabling Works and Site Access

4.5.15.1 Site Access Routes

The material for the construction of sheet pile wall will be stored at the main construction compound located at Ch.1340. It will be loaded by crane to a barge. The main access route to the main construction compound is the R448 Regional Road which has a direct connection to the N25 National Road. A local road off the R448, near Newrath roundabout, goes directly to the assumed construction compound location.

An ancillary construction compound at Sally Park depot can be reached directly from the R448.

4.5.15.2 Construction Traffic Routing

No construction traffic will be permitted to enter the construction site via Waterford City Centre. Material and machinery for remedial works to the existing quay wall and impermeable trenching will be routed from the ancillary compound at Sally Park depot via R448 (Terminus Street) to the works area in front of the Plunkett station. It is envisaged that the loading of the pontoon with the steel sheet piles can be carried out by crane over the riverbank from the main construction compound area. From the main construction compound, the machinery can also track down the cess into the working area for the purpose of landside sheet piling and associated drainage works. Signal cables running on the surface perpendicular to the cess from a signal cabin at approximately Ch.1190 present an obstacle, but it is envisaged that movements will be minimised and that a suitable temporary crossing bridge/mechanism or usage of localised night-time possessions will be applied.

4.5.16 Working Hours

Daytime working hours will be Monday to Saturday, 07:00 to 19:00 hrs. Where works during full rail possessions are required, night-time works will be required and will be carried out from Monday evening to Friday morning, 21:30 to 05:30 hrs.

Works on Sundays and Bank Holidays will only be permitted with the approval of the Waterford City and County Council (WCCC) and within the hours of 08:00 to 16:30 hrs.

4.6 Operation of the Proposed Development

Drainage maintenance works will be required during the operation phase of the proposed development to include inspection of outfall structures and inspection of wall mounted flap valves and replacement where necessary. The exposed parts of sheet pile wall above the cladding will require periodical corrosion protection by painting (approximately every 10 years). No night-time works will be required for this.

4.7 Project Change and Decommissioning

There are no plans proposed for the decommissioning of the project given the nature of the project – i.e. the development of flood defence measures can in this instance, be considered as a 'permanent' operation. The decommissioning of the flood defences is likely to form part of subsequent planning consent procedures and in the unlikely event that specific decommissioning requirements are necessary, appropriate mitigation can be applied to those consents.

4.8 Environmental Operating Plan

Appendix 4.1 contains the Environmental Operating Plan (EOP) which shall be finalised by the Contractor, in agreement with Waterford City and County Council, prior to the commencement of the construction phase.

The EOP is a document that outlines procedures for the delivery of environmental mitigation measures and for addressing general day-to-day environmental issues that can arise during the construction phase of developments. Essentially the EOP is a project management tool. It is prepared, developed and updated by the Contractor during the construction stage and will be limited to setting out the detailed procedures by which the mitigation measures proposed as part of the EIAR and NIS and arising out of the Board's decision (if approving the proposed development) will be achieved. The EOP will not give rise to any reduction of mitigation measures or measures to protect the environment.

Before any works commence on site, the Contractor will be required to prepare an Environmental Operating Plan (EOP) in accordance with the TII/NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIAR and measures stipulated in the planning conditions. Details within the plan will include, as a minimum:

- All environmental commitments and mitigation stipulated in the planning documentation in respect of the proposed development, including sediment controls and other measures to ensure that water quality in the River Suir and Waterford Harbour is not degraded.
- Any requirements of statutory bodies such as the NPWS and IFI, including adherence to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016).
- A detailed Biosecurity Protocol.
- A list of all applicable legislative requirements in relation to environmental protection and a method of documenting compliance with these requirements.
- Outline methods by which construction activities will be managed in such a manner as to avoid, reduce or remedy potential negative impacts on the environment.

To oversee the implementation of the EOP, the Contractors will be required to appoint a person to ensure that the mitigation measures included in the EIAR, the EOP and the statutory approvals are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly.

The EOP has been appended (Appendix 4.1). This is a preliminary document, which will be updated and finalised by the successful Contractor. Appended to the EOP are the following constituent plans, also to be finalised by the Contractor:

Appendix A: Construction Environmental Management Plan (CEMP)

Appendix B: Construction and Demolition Waste Management Plan (CDWMP)

Appendix C: Incident Response Plan (IRP)

Each of these plans is discussed in the following sections. The obligation to develop, maintain and implement the EOP and all of the above-listed plans will form part of the contract documents for the construction phase.

Construction Environmental Management Plan

Prior to any demolition, excavation or construction a Construction Environmental Management Plan (CEMP) will be produced by the successful contractors for each element of the proposed development. The CEMP will set out the Contractor's overall management and administration of the construction project. A Construction Environmental Management Plan has also been prepared as part of this EIAR, see Appendix A of Appendix 4.1. The CEMP will be developed by the Contractors during the pre-construction phase, to ensure commitments included in the statutory approvals are adhered to, and that it integrates the requirements of the Environmental Operating Plan (EOP).

The CEMP will contain the following information of general importance:

- An overview of the proposed development.
- An organisational chart illustrating the structure of the Contractor's project team and the duties and responsibilities of the various members.
- The Contractor's communications strategy.
- The contact details of relevant persons/entities, e.g. the Safety Officer, the Site Environmental Manager and the emergency services.
- A list of the documents which will have informed the CEMP, including all relevant legislation and construction/environmental guidelines.

In relation to environmental management, the CEMP will provide and full list of the Contractor's environmental commitments and will detail the Contractor's approach to the following:

- Details of working hours and days.
- Details of emergency plan - in the event of fire, chemical spillage, cement spillage, collapse of structures or failure of equipment or road traffic incident within an area of traffic management. The plan must include contact names and telephone numbers for: Local Authority (all sections/departments); Ambulance; Gardaí and Fire Services.
- Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages).
- Details of construction plant storage, temporary offices.
- Traffic management plan (to be developed in conjunction with the Local Authority – Roads Section) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic; programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements;
- Truck wheel wash details (including measures to reduce and treat runoff).
- Dust management to prevent nuisance (demolition & construction).
- Control of sediment, run-off, erosion and pollution.
- Noise and vibration management to prevent nuisance (demolition & construction).
- Landscape management.
- Management of contaminated land and assessment of risk for same by suitably qualified, trained and licenced personnel.
- Management of waste arising from construction and demolition.

- Minimisation of artificial lighting and shading.
- Management of risk from invasive alien species
- Stockpiles.
- Project procedures & method statements for:
    - Site clearance, site investigations, excavations
    - Diversion of services.
    - Excavation and blasting (through peat, soils & bedrock).
    - Piling.
    - Temporary hoarding & lighting.
    - Borrow Pits & location of crushing plant.
    - Storage and Treatment of peat and soft soils.
    - Disposal of surplus geological material (peat, soils, rock etc.).
    - Earthworks material improvement.
    - Protection of watercourses from contamination and silting during construction.
    - Works from a barge, including protection of watercourses from contamination when working in-river
- Site Compounds.
- Monitoring, inspection and auditing of the Contractor's compliance with his/her environmental commitments.

The production of the CEMP will also detail areas of concern with regard to Health and Safety and any environmental issues that require attention during the construction phase. Adoption of good management practices on site during the construction and operation phases will also contribute to reducing environmental impacts.

Construction and Demolition Waste Management Plan

The CDWMP sets out the Contractor's strategy (and measures required) to ensure that waste arising during the construction and demolition phase of the proposed development will be managed and disposed of in a way that ensures the provisions of European and Irish waste legislation (particularly the Waste Management Acts 1996 – 2011) are complied with, and to ensure that waste is managed in accordance with waste hierarchy insofar as possible.

The finalised CDWMP will contain the following information:

- Material transport routes;
- Methods by which construction works shall be managed in accordance with the relevant legislative instruments, including but not limited to:
    - An analysis of the different waste streams expected to be generated;
    - A demolition plan, with the purpose of ensuring that demolition occurs in an orderly fashion so that the re-use and recycling of the resultant materials is given due priority;
    - Details of waste storage (e.g. skips, bins, containers) to be provided for different waste streams and collection times;
    - Details of where and how materials are to be disposed of, i.e. landfill or other appropriately licensed waste management facility;
    - Details of storage areas for waste materials and containers;

- Details of how unsuitable excess materials will be disposed of, where necessary; and
- Details of how and where hazardous wastes, such as contaminated land, hydrocarbons and other hazardous substances, are to be stored and disposed of in a suitable manner;

- Estimates of waste management costs;
- Specific waste management objectives for the project;
- Identification of the roles and responsibilities of the relevant personnel regarding waste management;
- Procedures for communication and training in relation to on-site waste management;
- Record keeping procedures; and
- Details of an audit system to monitor implementation of the CDWMP.

The CDWMP is appended to the EOP (i.e. Appendix B of Appendix 4.1). The plan shall be finalised by the successful Contractor, in agreement with WCCC, and in accordance with TII's guidelines on *The Management of Waste from National Road Construction Projects* (2017), the TII *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan* (2007) and the Department of the Environment, Housing and Local Government's *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects* (2006). This will be a live document, which will be amended and updated to reflect the policy context, as well as conditions on site, as the construction of the proposed development progresses.

Incident Response Plan

The Incident Response Plan (IRP) describes the procedures, lines of authority and processes that will be followed to ensure that incident response efforts during the construction stage of the proposed development are prompt, efficient, and appropriate to particular circumstances.

The Contractor will finalise the IRP prior to the commencement of the proposed works to include the following information, at a minimum:

- Contact names and telephone numbers for the local authority, i.e. WCCC (all sections and departments), An Garda Síochána and ambulance and fire services; and,
- Method statements for weather forecasting and continuous monitoring of water levels in the River Suir and Waterford Harbour. The plan must outline how the Contractor will respond to forecasted flood events, including but not limited to, details of removal of site materials, fuels, tools, vehicles and persons from flood zones.
- The measures to be taken to avoid or reduce the incident risk potential;
- Reference to the method statement and management plans for construction activities, insofar as they are relevant for the purposes of mitigating against health and safety and pollution incidents;
- Procedures to be adopted to contain, limit and mitigate any adverse effects, as far as reasonably practicable, in the event of a health and safety or pollution incident;
- Persons responsible for dealing with incidents and their contact details;

- Procedures for alerting key staff, appropriate emergency services, authorities, the Employer's Representative and clean-up companies, where required, and contact details of same;
- Procedures for notifying relevant statutory bodies, environmental regulatory bodies, local authorities and local water and sewer providers of pollution incidents, where required, and contact details of same;
- Standby / rota systems; and
- The types and location of emergency response equipment available and appropriate personal protective equipment to be worn.

An IRP has been appended to the EOP (i.e., Appendix C of Appendix 4.1). The document in its current form will be finalised by the successful Contractor prior to the commencement of the construction phase of the proposed development.

Implementation of the EOP

It will be a condition of the Contract for the construction of the proposed development that the successful Contractor fully implement the EOP throughout the works. To oversee the implementation of the EOP, the Contractor will be required to appoint a responsible Site Environmental Manager (SEM) to ensure that the environmental commitments (as described above) and the EOP are fully executed for the duration of works, and to monitor whether the mitigation measures employed are functioning properly (i.e. are effectively addressing the environmental impact(s) which they were prescribed for).

Appendix 4.1 Environmental Operating Plan

Prepared by
Roughan & O'Donovan
Arena House, Arena Road, Sandyford, Dublin 18
Tel: +353 1 2940800 Fax: +353 1 2940820
Email: info@rod.ie www.rod.ie

Comhairle Cathrach & Contae Phort Láirge
Waterford City & County Council

WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT

FLOOD DEFENCES WEST

Environmental Operating Plan

October 2021

WPIP-ROD-ENV-S1_AE-RP-EN-400045_[S3-P01] W Flood Def EOP

<u>Client:</u>
Waterford City & County Council
35 The Mall
Waterford

ROD
ROUGHAN & O'DONOVAN

Waterford City Public Infrastructure Project

Flood Defences West

Environmental Operating Plan

TABLE OF CONTENTS

1.0 INTRODUCTION

This document is a project-specific Environmental Operating Plan (EOP). It is presented to inform and provide practical experience of developing, submitting, and maintaining an EOP for the Flood Defences West.

1.1 Purpose and Scope

This EOP sets out the mechanism by which environmental protection is to be achieved on the proposed Waterford City Public Infrastructure Project - Flood Defences West development. This EOP describes the Environmental Management System (EMS) of the proposed development, which will be devised according to the criteria of ISO 14001:2004 – Environmental Management Systems and developed in line with the NRA *"Guidelines for the creation and maintenance of an Environmental Operating Plan".* This EOP will be complemented by General Procedures, Work Procedures and Operations Instructions. These documents will be in place within the site administration offices and appropriate site locations during works.

This EOP covers the activities of the [*Successful Contractor Name*] and that of its sub-contractors. It outlines the environmental commitments in relation to the construction works and how these commitments are to be managed, including details of the monitoring systems and mitigation measures to be employed by the successful contractor. It also assigns responsibilities for ensuring the effective implementation of this EOP.

1.2 Environmental Policy Statement

Environmental Management is fundamental to the successful operation of construction activities. Therefore, the Environmental Policy must, as a priority, be understood by all parties involved in the contract and adhered to throughout the course of the works to allow for legal compliance and continuous improvement.

[*Successful Contractor Name*] Environmental Policy Statement is detailed below.

[*Insert policy statement*]

2.0 GENERAL PROJECT DETAILS

This section will be completed by the successful contractor once appointed:

- Brief overview;
- Location of the Project;
- Location of compounds;
- Contact Sheets for site, employer and third party contacts;
- Register of all applicable legislation, including relevant standards, Codes of Practice and Guidelines;
- Organisational chart; and,
- Duties and responsibilities.

Project details which have been identified prior to appointment of the contractor are described in the subsequent subsections:

2.1 Concrete Works

2.1.1 Introduction

The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. Alternate construction methods have been proposed where possible, e.g. use of pre-cast units, use of cofferdams/ diversions/ over pumping (or other) to place concrete in the dry, and permanent formwork will reduce the risks associated with concreting works. Where the use of in-situ concrete near and in watercourses cannot be avoided the following control measures will be employed:

- The use and management of concrete in or close to watercourses will be carefully controlled to avoid spillage. Washout from concrete mixing plant will be carried out only in a designated contained impermeable area.
- All shuttering shall be securely installed and inspected for leaks prior to cement being poured and all pouring operations shall be supervised monitored for spills and leaks at all times.
- All pouring of concrete, sealing of joints, application of water-proofing paint or protective systems, curing agents etc. for outfalls shall be completed in dry weather.
- Any concrete used in or over the River Suir shall be pre-cast, where possible.
- All concrete pouring will be conducted under controlled conditions to prevent any potential runoff to the River Suir.
    - All shuttering will be adequately constructed and sealed to prevent leakage or spillage and will have sufficient capacity to support all poured concrete.
    - The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if inclement weather is forecast such that precipitation may make it difficult to maintain a dry working area.
    - There will be no wash out of concrete vehicles on site.
    - No discharge of water which may contain cement or residues will be permitted to any watercourses.
- Where concrete or other wet materials are to be used over water, appropriate bunded platforms shall be in place to capture any spilled concrete, sealants or other materials.

- A geotextile screen and boom with oil barrier will be required around such marine works to prevent runoff, silt, oil or other deposits generated by construction activities such as boring in overburden or rock from polluting the river.
- Any materials collected on these platforms shall be transferred to the landside construction areas and disposed of in accordance with the CDWMP.
- When working in or near the surface water and the application in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used;
- Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters;
- Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW);
- There will be no hosing into surface water drains of spills of concrete, cement, grout or similar materials. Such spills shall be contained immediately, and runoff prevented from entering the watercourse;
- Concrete waste and wash-down water will be contained and managed on site to prevent pollution of all surface watercourses;
- On-site concrete batching and mixing activities will only be allowed at the identified construction compound areas;
- Washout from concrete lorries will not be permitted on site.
- In order to attenuate flows and minimise sediment input into River Suir through run-off, all surface water run-off from the construction site shall be directed to a temporary facility, where the flow will be attenuated and sediment allowed to settle, before passing through a hydrocarbon interceptor and being discharged to River Suir. An impermeable membrane overlaid with suitable fill will be provided to storage areas to prevent contamination or pollution of the groundwater.

2.2 Construction Compounds

2.2.1 Introduction

It is likely that two construction compounds will be set up within lands in the ownership of Córas Impair Éireann (CIÉ) and operated by Iarnród Éireann (IÉ) as identified in the EIAR.

The construction compound(s) may include stores, offices, materials storage areas, material processing areas, plant storage, parking of site and staff vehicles, and other ancillary facilities and activities.

2.2.2 Control Measures

The compound will have appropriate levels of security to deter vandalism, theft and unauthorised access.

Surface runoff from the compound will be minimised by ensuring that the paved/ impervious area is minimised. All surface water runoff will be intercepted and directed to appropriate treatment systems (settlement facilities and oil trap) for the removal of pollutants prior to discharge. The site compound will be fenced off as part of the site establishment period.

Wastewater drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner to prevent water pollution and in accordance with the relevant statutory requirements.

The storage of all fuels, other hydrocarbons and other chemicals shall be within the construction compound only and shall be in accordance with relevant legislation and best practice. In particular:

- Fuel storage tanks shall have secondary containment provided by means of an above ground bund to capture any oil leakage.
- Storage tanks and associated provision, including bunds, will conform to the current best practice for oil storage and will be undertaken in accordance with *Best Practice Guide BPGCS005 – Oil Storage Guidelines* (Enterprise Ireland).

The Incident Response Plan shall include arrangements for dealing with accidental spillage and relevant staff shall be trained in these procedures.

2.3 Site Environmental Manager (SEM)

In order to ensure the successful development, implementation and maintenance of the EOP, the Contractor will be required to appoint an independent Site Environmental Manager (SEM).

He/she must possess training, experience and knowledge appropriate to the role, including a National Framework of Qualifications (NFQ) Level 8 qualification (or equivalent) or other acceptable qualification in Environmental Science, environmental Management, Hydrology or Engineering.

The principal functions of the SEM will be to ensure that the mitigation prescribed in the NIS, this EIAR, the CEMP, the EOP and the CDWMP, is fully and properly implemented and to monitor the construction stage from an environmental perspective. The SEM will also provide independently verifiable audit reports.

Separate from the on-going and detailed monitoring carried out by the Contractor as part of the EOP, the SEM will carry out the inspection and monitoring described below on behalf of WCCC. The results will be stored in the SEM's monitoring file and will be available for inspection or audit by WCCC, the NPWS or IFI.

- Daily reporting on weather and flood forecasting and daily reporting on the monitoring of water levels in the River Suir.
- Weekly inspections of the principal control measures described in the CEMP and reporting of findings to the Contractor.
- Daily inspections of surface water treatment measures.
- Daily inspections of all outfalls to watercourses.
- Daily visual inspections of watercourse to which there are discharges from the works and those in the vicinity of construction works.
- Weekly inspections of wheel-wash facilities.
- Daily monitoring of any stockpiles.
- Auditing at least six times per quarter of the Contractor's EOP monitoring results.

2.4 Ecological Clerk of Works (ECoW)

In order to ensure the successful development and implementation of the EOP, the Contractor will appoint an independent Ecological Clerk of Works (ECoW). The ECoW must possess training, experience and knowledge appropriate to the role, including:

- An NFQ Level 8 qualification or equivalent or other acceptable qualification in ecology or environmental biology; and,
- Demonstrable experience in the protection of European sites.

The principal functions of the ECoW are:

- To provide ecological supervision of the construction of the proposed development and thereby ensure the full and proper implementation of the mitigation prescribed in Chapter 7 Biodiversity of the EIAR and in the NIS;
- To highlight the sensitivity of ‘Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)’, and the need to avoid disturbance of the same, during tool-box talks and other relevant communications with site personnel.
- To regularly review the outcome of the ongoing monitoring during construction (as described in Section 5.2.7 of the NIS);
- To carry out inspections of all vehicles, vessels, plant, equipment, PPE, construction materials or excavated materials prior to their movement from areas known to contain invasive alien species; and,
- To carry out weekly inspections and reporting on the implementation of the Contractor’s Biosecurity Protocol.

During the preparation of the Contractor’s EOP, the SEM may, as appropriate, assign other duties and responsibilities to the ECoW. In exercising his/her functions, the ECoW will be required to keep a monitoring file and this will be made available for inspection or audit by WCCC, the NPWS or IFI at any time.

3.0 PLANNING CONSENT

If planning permission is granted for the proposed development, the entire contents of the planning consent are inserted at this location.

[*Waterford City and County Council / successful Contractor shall insert planning consent*]

4.0 SCHEDULE OF COMMITMENTS

The Schedule of Commitments will comprise:

(1) The mitigation measures as outlined in Chapter 19 Mitigation Measures of the EIAR for the proposed development, with the addition of any additional mitigation measures set out in the NIS for the proposed development;

(2) Any commitments arising during the statutory planning process up to and including the Oral Hearing, and any conditions imposed by the Board on the approval of the proposed development;

(3) Any relevant specifications and / or methodologies required to implement the prescribed measures / commitments properly; and

(4) Any procedures for the monitoring of the implementation of the stated measures / commitments, which may identify whether (i) the measure / commitment will be implemented by the Contractors and (ii) once implemented, whether the measure/ commitment is effectively addressing the environmental impact it was prescribed to address.

The current Schedule of Commitments is as follows:

[*Waterford City and County Council / successful contractor shall Insert Schedule of Commitments, as described above*]

In addition, the Contract documents, the conditions imposed by An Bord Pleanála, the Schedule of Commitments, and relevant environmental legislation all prescribe environmental performance criteria.

The following table lists the complete suite of Environmental Commitments together with the relative specification and evidence of how each commitment will be met. An example of the layout of this table and potential entries is given below.

Table 1 Environmental Commitments

Environmental Commitment	Legislation / Specific Ref.	Action Owner	Evidence	Target Date	Close Date
Noise and Vibration	EIAR Volume 2, Chapter 12 Noise and Vibration; EIAR Volume 2, Chapter 19 Mitigation Measures	Env. Manager / Noise Specialist / Env. Designer / Site Agent / Foreman	Method Statement / Site Inspections / Monitoring Data / Environmental Control Measure Sheet	Ongoing	End of contract
Biodiversity (Flora and Fauna)	EIAR Volume 2, Chapter 7 Biodiversity; EIAR Volume 2, Chapter 19 Mitigation Measures	Env. Manager/ Specialist Ecologist/ Env. Designer / Site Agent / Foreman	Method Statement / Ecological Walkover / Pre-surveys / agreement from IFI / Site Inspections	Ongoing	End of Contract

Environmental Commitment	Legislation / Specific Ref.	Action Owner	Evidence	Target Date	Close Date
Soils and Geology	EIAR Volume 2 Chapter 8 Soils and Geology; EIAR Volume 2, EIAR Volume 2, Chapter 19 Mitigation Measures	Env. Manager/ Specialist Ecologist/ Env. Designer / Site Agent / Foreman	Method Statement / Site Inspections / Monitoring Data	Ongoing	End of Contract
Hydrology and Hydrogeology	EIAR Volume 2, Chapter 7 Biodiversity; EIAR Volume 2 Chapter 10 Hydrology; EIAR Volume 2, Chapter 9 Hydrogeology; EIAR Volume 2, Chapter 19 Mitigation Measures	Env. Manager/ Specialist Ecologist/ Env. Designer / Site Agent / Foreman	Method Statement / Site Inspections / Monitoring Data	Ongoing	End of Contract
Air Quality and Climate	EIAR Volume 2, Chapter 13 Air Quality and Climate; EIAR Volume 2, Chapter 19 Mitigation Measures;	Env. Manager/ Site Agent / Foreman	Method Statement / Site Inspections / Monitoring Data	Ongoing	End of Contract
Archaeology and Cultural Heritage	EIAR Volume 2, Chapter 14 Archaeological and Cultural Heritage; EIAR Volume 2, Chapter 19 Mitigation Measures;	Env. Manager/ Site Agent / Foreman	Method Statement / Site Inspections / Monitoring Data	Ongoing	End of Contract

5.0 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

The Construction Environmental Management Plan (CEMP) provides the environmental management framework for the appointed Contractors and Sub-contractors to ensure that the works are carried out with minimal impact on the environment.

The CEMP for the proposed development is contained in **Appendix A**. This document will need to be finalised by the Contractor prior to the commencement of the proposed works.

6.0 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT PLAN

A Construction and Demolition Waste Management Plan (CDWMP) is prepared to ensure that waste arising during the construction and demolition phase of the development on site will be managed and disposed of in a way that ensures the provisions of the Waste Management (Amendment) Acts, 1996-2011 and associated Regulations (1996-2011) are complied with and to ensure that optimum levels of reduction, re-use and recycling are achieved.

The CDWMP, consistent with mitigation measures as contained within the EIAR and the Schedule of Commitments, at this time is contained in **Appendix B**.

7.0 INCIDENT RESPONSE PLAN

This document describes the procedures, lines of authority and processes that will be followed to ensure that incident response efforts are prompt, efficient, and appropriate to particular circumstances.

An Incident Response Plan consistent with mitigation measures as contained within the EIAR and the Schedule of Commitments at this time is contained in **Appendix C**.

APPENDIX A

Construction and Environmental Management Plan

Prepared by
Roughan & O'Donovan
Arena House, Arena Road, Sandyford, Dublin 18
Tel: +353 1 2940800 Fax: +353 1 2940820
Email: info@rod.ie www.rod.ie

WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT

FLOOD DEFENCES WEST

Construction Environmental Management Plan

October 2021

WPIP-ROD-ENV-S1_AE-RP-EN-400035_[S3-P01] W Flood Def CEMP

Client:
Waterford City & County Council
35 The Mall
Waterford

Waterford City Public Infrastructure Project

Flood Defences West

Construction Environmental Management Plan

TABLE OF CONTENTS

1. INTRODUCTION

This Construction Environmental Management Plan (OCEMP) is prepared for the construction of the proposed Waterford City Public Infrastructure Project - Flood Defences West ("the Project") on behalf of Waterford City and County Council (WCCC).

This CEMP applies to all works associated with the construction of the proposed civil works and buildings works including the pre-construction site clearance works.

As a Contractor has not yet been appointed, this CEMP has not been formally adopted and further development and commitment to the CEMP will be undertaken following selection of Contractors and before commencement of site works.

The CEMP provides the environmental management framework for the appointed Contractors and Sub Contractors as they incorporate the mitigating principles to ensure that the work is carried out with minimal impact on the environment. The construction management staff as well as Contractors and Sub Contractors staff must comply with the requirements and constraints set forth in this CEMP in developing their Construction Environmental Management Plan (CEMP). The key environmental aspects associated with the construction of the proposed Flood Defences West, the appropriate mitigation and monitoring controls, are identified in the CEMP and its supporting documentation.

The implementation of the requirements of the CEMP will ensure that the construction phase of the Project is carried out in accordance with the commitments made by WCCC in the planning application process for the development, and as required under the planning approval. Once adopted, the CEMP is considered a living document that will be updated according to changing circumstances on the proposed development and to reflect current construction activities. The CEMP will be reviewed on an ongoing basis during the construction process and will include information on the review procedures.

1.1 Roles and Responsibilities

The Contractor is responsible to ensure that all members of the Project Team, including sub-contractors comply with the procedures set out in the CEMP. The Contractor will ensure that all persons working on site are provided with sufficient training, supervision and instruction to fulfil this requirement.

The Contractor will ensure that all persons allocated specific environmental responsibilities are notified of their appointment and confirm that their responsibilities are clearly understood. The principal environmental responsibilities for key staff can be identified as follows:

1.1.1 Site Manager

The Site Manager's environmental management responsibilities include, but are not limited to:

- Preparation and implementation of the CEMP;
- Close liaison with the Site Environmental Manager (SEM) to ensure adequate resources are made available for implementation of the CEMP;
- Ensuring that the risk assessments for control of noise and environmental risk are prepared and effectively monitored, reviewed and communicated on site;

- Managing the preparation and implementation of method statements; and
- Ensuring that the SEM reviews all method statements and that relevant environmental protocols are incorporated and appended.

1.1.2 Site Environmental Manager (SEM)

The responsibilities of the SEM include, but are not limited to:

- Maintaining environmental records;
- Providing guidance for the site team in dealing with environmental matters, including legal and statutory requirements affecting the works;
- Reviewing environmental management content of method statements;
- Reporting environmental performance to the Site Manager;
- Liaising with statutory and non-statutory bodies and third parties with an environmental interest in the proposed development; and
- Collecting and collating of CEEQUAL evidence.

1.1.3 Engineering Staff

The Engineering Staffs' environmental management responsibilities include but are not limited to:

- Reporting any operations and conditions that deviate from the CEMP to the Site Manager;
- Taking an active part in site safety and environmental meetings; and
- Ensuring awareness of the contents of method statements, plans, Supervisors' meetings or any other meetings that concern the environmental management of the site.

1.1.4 Supervisors

The Supervisors' environmental management responsibilities include but are not limited to:

- Ensuring all personnel affected by a method statement are briefed and fully understand its content;
- Monitoring operatives for compliance, including sub-contract operatives;
- Implementing environmental management activities required by the CEMP and works method statements; and
- Ensuring that all inspections are carried out as prescribed in the CEMP.

1.2 Training and Induction

1.2.1 Site Induction

All personnel involved in the proposed Flood Defences West development will receive environmental awareness training. The environmental training and awareness procedure will ensure that staff are familiar with the principles of the CEMP, the environmental aspects and impacts associated with their activities, the procedures in place to control these impacts and the consequences of departure from these procedures.

1.2.2 Specific Training and Awareness Raising

A project specific training plan that identifies the competency requirements for all personnel allocated with environmental responsibilities will be produced by the Contractor. Training will be provided by the Contractor to ensure that all persons working on site have a practical understanding of environmental issues and management requirements prior to commencing activities. A register of completed training is to be kept by the SEM. The Site Manager will ensure that environmental emergency plans are drawn up and the SEM will conduct the necessary training/inductions.

2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Project Description

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City, refer to Figures 1.1 in Volume 3 of this EIAR. The development extends for approximately 1km to the west and 100m to the east of the Waterford (Plunkett) Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor located to the north of the proposed development.

The proposed flood defence measures are for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval, eliminating the risk of flooding to the Transport Hub.

A design flood level of +4.0m OD (metres above Ordnance Datum Malin) is proposed for this development. The design flood level has been based on a flood with an annual exceedance probability of 0.5% and allowances for climate change and isostatic tilt as noted below.

The design (top-of-wall) level for the proposed flood protection measures is +4.30m OD (metres above Ordnance Datum Malin). The following allowances are integrated into the proposed height of the flood defence walls:

- 0.5% annual exceedance probability combined tidal-fluvial event (+3.45 m OD);
- An additional 0.55m to allow for climate change and isostatic tilt; and,
- 0.30m freeboard to the wall, including local wave wake effects.

An overview of the structural elements of the proposed development is provided from east to west below, and should be read in conjunction with Figures 4.1 to 4.6 in EIAR Volume 3:

- Construction of underground flood defences (an impermeable shallow trench approx. 0.35m in width and up to 3m in depth) from Ch.0.0 to Ch.365 to cut off the potential groundwater seepage during high tide events. It is possible that parts of these underground flood protection measures may be omitted during detailed design (see Figures 4.2 and 4.3 in Volume 3) or may be implemented on a phased basis depending on the ongoing groundwater monitoring results.
- Total of c.185m of overground flood defences from Ch.0.40 to Ch.210 consisting of:
    - c.170m of glass flood barrier on the river side of the road edge vehicular parapets on Rice Bridge roundabout and along the 3 roundabout arms (R680 Rice Bridge, R448 Terminus St. and R711 Dock Rd).

  - c.15m of demountable flood barriers on the R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.
- Remedial works to the existing quay wall from Ch.285 to Ch.360 by raising its height by 0.6m to 1.2m to conform with the design top-of-wall level of +4.30m OD.
- Construction of a sheet pile flood defence wall from Ch.360 to Ch.1090, with the top of wall at +4.30 mOD, to protect against overground flooding and underground groundwater seepage:
  - From Ch.360 to Ch.900 the sheet pile wall will be installed within the foreshore from the riverside, 1m from the front face of the existing quay wall. The space between the sheet pile wall and the front face of the existing quay wall will be filled with clean imported granular fill. The intertidal zone of the riverside sheet pile wall will be fitted with pre-cast concrete cladding material ("eco-seawall").
  - From Ch.900 to Ch.1090, the sheet pile wall will be installed on land from the landside, 1m behind the existing quay wall.
  - The demolition of minor localised section of existing quay wall (max length of 3m) will be required in order to connect the in-river sheet piles with the landside sheet pile walls at Ch.900.
- Construction of c.20m of underground isolation structure at Ch.1090, comprising of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event.

Drainage works will be carried out for the entire extents of the proposed flood defence measures i.e., from Ch.0.0 to Ch.1090 as shown in Figure 4.7 to Figure 4.11 in EIAR Volume 3:

- Remedial measures to the existing drainage outfalls to the River Suir from Ch.0.0 to Ch.1090 by extending them to reach an outlet within the new sheet pile wall, or to be retrofitted to pass through the new sheet pile wall, into the River Suir.
- In the vicinity of Plunkett Station, from Ch.0.0 to Ch.470, new trackside drainage and groundwater drains are included in the upgraded drainage works, which will include a pumping station (at approx. Ch.390) and a new surface water outfall structure in the River Suir at Ch.390.
- From Ch.370 to Ch.1090, new drainage system will be installed for trackside drainage and also to allow groundwater cut -off behind the sheet pile wall to drain to the River Suir with 2 No. new outfalls to the River Suir terminating at the front face of the proposed flood defence sheet pile wall (at Ch 550 and Ch.900). The works will also include the construction of pumping stations at Ch.390 and Ch.550 respectively.
- Existing surface water outfalls at Ch.470 and Ch.490 which extend into the riverbed will be demolished to allow installation of the new flood defence wall; these will be replaced by new surface water outfall structures in the River Suir.
- Demolition of the existing quay wall to approximately 800mm below the existing ground level and removal of handrails from Ch.360 to Ch.900 where it is level with or above, the existing ground level. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level will be required in order to facilitate the construction of a surface water pumping station at Ch.380 (as shown in Figure 4.18 in EIAR Volume 3).

- All drainage outfalls (new and existing) will be fitted or retrofitted with non-return valves to prevent tidal water ingress.
- All ancillary works.

Table 2.1.1 Overview of Proposed Flood Defences West

Chainage	Proposed Works
Ch.0.0 to Ch.365	Construction of an impermeable trench
Ch.0.40 to Ch.210	Construction of overground flood defences at Rice Bridge Roundabout.
Ch.285 to Ch.360	Remediation of existing quay wall
Ch.360 to Ch.1090	Construction of sheet pile flood defence wall
Ch.0.0 to Ch.1090	Drainage works

2.2 Construction Programme Sequence

The construction methodology is preliminary and subject to change following the detailed design and preparation of the CEMP by the appointed Contractor. Irish Rail operations will be maintained throughout the construction phase. However, there may be restrictions to Plunket station car park, and/or disruption to utilities during certain periods but these will be minimised to avoid significant impacts. These will be detailed as part of the CEMP which will be developed by the Contractor and agreed with WCCC at contract award stage.

The anticipated construction duration for the proposed Flood Defences West will be 30-35 weeks. The construction of the proposed development is anticipated to take place in the following sequence:

The envisaged construction sequence for the works is as follows:

(i) Site Setup and establishment of construction compounds;

(ii) Excavation of underground trenches (or just in parts of this section, based on the groundwater monitoring and assessment) including:
   - (a) Relocation of underground utilities, where required;
   - (b) Excavation of material from trenches;
   - (c) Filling in trenches with lean mix concrete / grout and reinstatement of pavement.

(iii) Installation of overground flood defences:
   - (a) Glass barriers on the river side of the road edge vehicular parapets on Rice Bridge roundabout and the 3 roundabout arms (R711 Dock Road, R448 Terminus Street, and R680 Rice Bridge).
   - (b) Underground foundations for the demountable flood barriers at R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.

(iv) Remedial works for raising the height of the existing quay wall including:
   - (a) Setup of temporary dry (dewatered) working area in front of the wall using sandbags, Portadam system or waterfilled dams;

(b) Setup of temporary works such as formwork, scaffolding and granular base for scaffolding in mudflats;

(c) Anchoring and concrete pouring works;

(d) Decommissioning of temporary works, including removal of granular base from the mudflats, any building works spoil, and dewatering system.

(v) Installation of permanent sheet pile walls on the riverside. Backfilling of the gap between the riverside sheet pile wall and the existing quay wall can take place simultaneously with sheet piling, after a short segment of the sheet pile wall (assumed 10-30 m) is piled (temporary transversal sheet pile may be installed at the end of segment to prevent fill from being washed out), or once full length of sheet piles is installed. Attaching of eco-seawall panels to the front face of the sheet piles.

(vi) Partial demolition of existing quay wall (from Ch.360 to Ch.900) above ground and to a depth of 800mm below ground (where required) to enable installation of drainage works (to be complete in tandem with step (v) above to ensure demolition takes place before backfilling);

(vii) Installation of landside sheet pile wall from Ch.900 to Ch.1090 to include:

(a) Demolition of the 3m wide section of the existing quay wall at Ch.900 to enable joining of the riverside and landside sheet piles;

(b) Installation of permanent landside sheet piles; and

(c) Installation of transversal underground isolation structure at Ch.1090.

(viii) Drainage – Installation of drainage works from Ch.360 to Ch.1090 as follows:

(a) Installation of drainage works parallel to the new sheet pile wall in tandem with construction of the sheet piling (step v);

(b) Installation of surface water outfalls passing through the new sheet pile wall, and fitting of flap valves from the riverside on each outfall (in tandem with step v);

(c) Demolition of existing surface water outfalls in the riverbed and provision of temporary outfalls (e.g. over pumping) on existing outfalls during the works;

(d) Construction of new outfall structures in the riverbed (following installation of the sheet pile wall) within a sheet pile cofferdam (temporary works); the outfall structure will include a foundation structure to the outfall pipe (which may need pile supports), a headwall and erosion protection measures (including a stone mattress at the mouth of the outfall), headwall and erosion protection measures including a stone mattress at the mouth of the outfall;

(e) Construction of 2 No. underground pumping stations to include an overflow chamber, wet well and valve chamber;

(f) Installation of pumping station pumps, valves fitting and MEICA commissioning of pumping stations.

(ix) Drainage – Installation of drainage works from Ch.0.0 to Ch.360 at Plunkett Station as follows:

(a) Installation of the new drainage system and associated railway undertrack crossings. All undertrack crossings will be carried out subject to IÉ agreement and where necessary, localised night-time possessions will be applied to facilitate installation,

(b) Remedial works to existing drainage networks including retrofitting of flap valves at outfalls.

Due to the linear nature of the works, it is assumed that the works under items (ii) to (ix) above can run in parallel. The list above thus does not indicate that one activity needs to fully finish for the next one to start. It is possible that the works will be done in separate sections. Some limitations however exist, and these are outlined below:

- The sheet pile wall needs to be installed at drainage outlet locations before the outlet can be completed. It is necessary for the drainage outlet to be completed before the backfilling to the sheet pile wall (above the underside of pipe level) can be completed.
- Impermeable trench / grouting in area behind the existing quay wall (where the wall will be raised with remedial works) to be done before the commencement of wall remedial works.
- The upper sections (down to 800mm below ground level) of the existing quay wall are to be demolished after the sheet piles are installed in that location and before the drainage is installed.
- The riverside sheet piles will be installed before the eco-seawall panels are attached to them.

Table 2.2.2 Draft Construction Program

Works element		Duration of task (approx.)
Start July 2023		
Mobilisation, site clearance and compound set up		2 weeks
Remedial works for raising the height of the existing concrete wall		4 weeks
Impermeable trenches Ch.0.0 to Ch.160 (eastern car park, in front of the Plunkett Station and the Rice Bridge Roundabout)		2.5 months (10 weekends)
Impermeable trenches Ch.160 to Ch. 360 (western car park and under Terminus Street Viaduct)		2 weeks
Works at Rice Bridge Roundabout – Installation of Glass barriers, movement joint sealing & the provision of flap valves on existing road drainage gullies		6-8 weeks
Sheet pile installation	Ch. 360 to Ch. 900 (riverside)	12 weeks (two rigs)
	Attaching cladding to installed riverside piles	2-3 weeks
	Ch.900 to Ch.1090 (Landside, incl. transverse structure)	7-8 weeks
Drainage works	Upgrade of existing drainage	9-12 weeks
	New drainage network and proposed outfall structures	9-12 weeks
	Pumping stations	9-12 weeks
Total Construction Phase		**7 months approx.**
End February 2023		

Works element	Duration of task (approx.)
Start July 2023	
Notes: Due to linear nature of the works, the majority of the works will be able to be done in parallel.	

2.2.1 Sourcing of Materials

There are several registered/authorised quarries near the proposed development which may be utilised in the sourcing of the required imported granular fill material, to include:

- Oaklands Quarry in Ballykelly, New Ross, Co. Wexford; and
- Cappagh Quarry in Cappagh, Dungarvan, Co. Waterford.

Only those quarries that conform to all necessary statutory consents will be used in the construction phase.

It is assumed that the Contractor will source the sheet piles directly from the manufacturer/supplier. While Irish-based sheet pile suppliers exist, the larger quantities of heavy sheet piles, typically required on large projects such as this one, are typically obtained from a number of large-scale manufacturers/suppliers that exist in the UK.

2.2.2 Construction Traffic Management

Temporary traffic management arrangements are to be implemented to facilitate ongoing access to construction access points throughout the works.

Some works will require night-time works when railway track possessions are needed.

As part of the Waterford City Public Infrastructure Project, it is likely that a number of infrastructure projects will take place concurrently. Traffic management and phasing of works and transport / haulage routes will be required to be co-ordinated by all stakeholder through the various construction stages.
The following restrictions will be adhered to unless agreed otherwise with Waterford City & County Council's Roads Department:

- The Contractor shall provide and maintain temporary traffic management in accordance with the Department of Transport Traffic Signs Manual.
- Access to local properties shall be maintained at all times. Works to any accesses shall be planned in consultation with the property owners to minimise disruption.
- Existing footways and cycle tracks shall be maintained at all times except where such footways and cycle tracks are at the point of being removed for the completion of the Works. In such circumstances, the Contractor shall provide temporary footpath or cycle track diversions, with sufficient advance signage informing people of the diversions.
- Fuel for vehicles will be stored in a mobile double skinned tank.
- The contractor will be required to submit a Construction and Demolition (C&D) Waste Management Plan Council to WCCC for approval which should address all types of material to be disposed of.

- Roads used by construction traffic will be monitored visually and a road sweeper used to remove debris from construction activities when required.
- Loads of materials leaving site shall be assessed and covered where necessary to reduce dust impacts.
- Development of a detailed construction programme that gives consideration to traffic flows and aims to avoid coincidentally high volumes of traffic using the same roads where possible.
- The Contractor shall allow for variable message signs (VMS) in accordance with Chapter 8 paragraph 8.2.4 of the Traffic Signs Manual on approach routes affected by traffic management measures, restrictions or road closures.
- The Contractor shall liaise with the Roads Authority in respect of any temporary road closures, lane closures, and other traffic management controls required to be carried out to ensure the safety of the workforce and the general public during the duration of the works.
- Where floodlighting of the works area is required in poor daylight conditions, the positioning of the lighting units must not be such as to cause glare to drivers.

Visual inspections will also be undertaken and recorded at regular, frequent intervals, to ensure that the existing road infrastructure remains in an acceptable condition throughout the duration of construction activities or should evidence of any defects arise during the construction period, remedial actions and/or works can be put in hand forthwith. Wheel washes for construction vehicles will be provided (if necessary) at the development site to prevent mud and dust being brought onto the public road. The site entrance and the immediate approach roads will be monitored and swept clean when necessary.

Construction vehicles and site personnel will be required to adhere to the approved access routes and timing restrictions. Construction plant, equipment and vehicles will be parked onsite. No vehicles associated with the proposed development will be parked on the public roads.

2.3 Operation Stage

The live rail line Dublin – Waterford will remain open at all times during the construction phase. Where railway possessions will be required for some elements of work, such as for landside sheet pile installation and for some drainage segments, night-time rail possessions will be arranged, that will not affect the normal train operations.

Once the development is constructed and handover completed, the live rail line will continue to operate according to the normal timetable.

3. CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

This CEMP will be used to develop the CEMP by the Contractor to meet the requirements of ISO 14001 and all site works will be undertaken in compliance with the CEMP. The CEMP will include details of the topics listed below:

- Environmental Policy;
- Environmental Aspects Register;

- Project Organisation and Responsibilities;
- Project Communication and Co-ordination;
- Training;
- Operational Control;
- Checking and Corrective Action;
- Environmental Control Measures; and
- Complaints Procedure.

The CEMP will detail all the environmental aspects and impacts associated with this contract such as waste management, pollution prevention and protection of flora and fauna with particular emphasis on the nearby Special Area of Conservation (SAC), Special Protection Area (SPA), proposed Natural Heritage Area (pNHA) and water quality in the watercourses. The Register of Impacts provides the framework for identifying the potential environmental impacts generated by construction and the associated works. The Environmental Operational Control Procedures and activity-specific method statements will detail the working methods necessary for managing and mitigating these impacts, whether it is by prevention or mitigation. Prior to the commencement of construction activities, the Environmental Operational Control Procedures and activity-specific method statements will be completed so as to conform to precise site-specific requirements at the location of the proposed Flood Defences West.

3.1 Environmental Policy

The Contractor will complete an Environmental Policy with consideration for impacts on the natural and built environment. All project personnel will be accountable for the environmental performance of the Project and will be made aware of the Environmental Policy at induction. The environmental policy will consider and make commitments with regard to the protection of Natura 2000 sites, and any pNHA and/or Natural Heritage Area (NHA) sites, emissions to the atmosphere, maintenance of water quality, resource usage, energy consumption and waste management.

3.2 Environmental Aspect Register

Once appointed, the Contractor will prepare a register of all sensitive environmental features which have the potential to be affected by the construction works, together with details of commitments and agreements made during the EIAR planning process (i.e. commitments contained within the EIA Report and An Bord Pleanála conditions) and the Contract Documentation, with regards mitigation of potential environmental impacts.

The Environmental Aspects Register provides the relevant information for the preparation of construction method statements and will be regularly updated during the works.

The Environmental Aspects Register will consider sensitive environmental features as listed below (please note this list is not exhaustive and will be amended and expanded upon as required by the Contractor):

- Identification off all waterways and drainage outlets for the protection against ingress of suspended solids or any pollutant;
- Air emissions;

- Noise emissions
- Vibration emissions;
- Light emissions;
- Waste generation;
- Treatment of contaminated materials;
- Treatment of invasive species;
- Use of hazardous materials;
- Energy usage;
- Water usage;
- Discharge of wastewater;
- Traffic generation;
- Biodiversity (terrestrial and aquatic ecology);
- Landscape and Visual impacts;
- Soils, Geology and Hydrogeology;
- Hydrology; and
- Archaeology, Architectural and Cultural Heritage.

3.3 Project Organisation and Responsibilities

The adopted CEMP will define the roles and responsibilities of the project team. The overall responsibility lies with the Site Manager whose responsibility it will be to approve key personnel required for employment on the Project. He/She will liaise with the SEM.

The Project Manager will lead the works on site. He/She will be responsible for the management and control of the activities and will have overall responsibility for the implementation of the CEMP. He/She will be assisted by the SEM who will act as his/her deputy.

The SEM will prepare and implement all aspects of the CEMP.

Site Manager

The Site Manager's main duties and responsibilities in relation to the CEMP include liaising with the Project Team in assigning duties and responsibilities in relation to the CEMP to individual members of the main Contractor's project staff.

Site Environmental Manager (SEM)

The main duties and responsibilities of the SEM include and are not limited to the following:

- Liaise with the Site Manager during the finalisation of the CEMP to assign individual duties and responsibilities bearing in mind the overall organisational structure, the nature of the Environmental Commitments and Requirements and the proposed Flood Defences West development specific characteristics;
- Ensuring that the CEMP is finalised, implemented and maintained;
- Liaising with WCCC's Environmental Manager on all Method Statements, any alterations to live documents and any other works to ensure protection of water quality;

- Being familiar with the information in the pre-construction surveys, construction requirements, the competent authority's decision and all relevant Method Statements;
- Being familiar with the contents, environmental commitments and requirements continued within the reference documentation listed in this CEMP;
- Being familiar with the baseline data collated during the compilation of the EIAR;
- Assisting management in liaising with the Engineers and WCCC and the provision of information on environmental management during the construction of the proposed development;
- Liaising with the Project Team in assigning duties and responsibilities in relation to the CEMP, to individual members of the main Contractor's project staff;
- Overseeing, ensuring coordination and playing a lead role in third party consultations required statutorily, contractually and in order to fulfil best practice requirements;
- Liaising with management in agreeing site specific Method Statements with Third Parties;
- Ensuring that all relevant works are undertaken in accordance with the relevant legislation in the Republic of Ireland;
- Bring any legal constraints that may occur during certain tasks to the attention of management;
- Hold copies of all permits and licenses provided by waste contractors;
- Ensuring that any operations or activities that require certificates of registration, waste collection permits, waste permits, waste licences, etc have appropriate authorization;
- Gathering and holding documentation with respect to waste disposal;
- Keeping up to date with changes in environmental practices and legislation and advising staff of such changes and incorporating them into the CEMP;
- Liaising with contactors and consultants prior to works;
- Procuring the services of specialist environmental contactors when required;
- Ensuring that all specialist environmental contactors are legally accredited and proven to be competent;
- Coordinating all the activities of the specialist environmental contractors;
- Ensuring that environmental induction training is carried out on all personnel on site and ensuring that toolbox talks include aspects of environmental awareness and training;
- Respond to all environmental incidents in accordance with legislation, the CEMP and company policy/procedures;
- The SEM is responsible for notifying the relevant statutory authority when environmental incidents occur and producing the relevant reports as required;
- Ensuring that all relevant works have (and are being carried out in accordance with) the required permits, licenses, certificates and planning permissions;
- Liaising with the designated licence holders and specific agent defined in the licence with respect to licences granted pursuant to the European Commission (EC) (Natural Habitats) Regulations 1997;

- Carrying out regular documented inspections of the site to ensure that work is being carried out in accordance with the Environmental Control Measures and relevant site-specific Method Statements;
- The SEM should prepare and be in readiness to implement at all times the Emergency Incident Response Plan;
- Responsible for reviewing all environmental monitoring data and ensuring that they all comply with stated guidelines and requirements; and
- Liaising with management in preparing and inspection of site-specific method statements for activities where there is a risk of pollution or adverse effects on the environment.

Design Manager

The main duties and responsibilities of the Design Manger having regard to the implementation of the CEMP:

- Be familiar with the CEMP and relevant documentation referred to within; and
- Participate in Third Party Consultations and liaising with third Parties through the SEM.

Section Managers and Agents

The Section Managers and Agents are responsible for the following:

- Ensuring Forepersons under his/her control adhere to the relevant Environmental Control Measures and relevant site-specific Method Statements, etc.;
- Ensuring that the procedures agreed during third party consultations are followed;
- Reporting immediately to the SEM any incidents where there has been a breach of agreed environmental management procedures, where there has been a spillage of a potentially environmentally harmful substance, where there has been an unauthorised discharge to ground, water or air, damage to habitat, etc.; and
- Attending environmental review meetings and preparing any relevant documentation as required by management.

Forepersons

The forepersons on site are responsible for the following:

- Ensuring personnel under his/her control adhere to the relevant environmental control measures and relevant site-specific Method Statements; and
- Reporting immediately to the site agents and SEM any incidents where there has been a breach of agreed procedures e.g., spillages and discharges.

All Project Personnel

All project personnel have the following responsibilities:

- Attend environmental training as required; and
- Reporting immediately to the Forepersons/Agents or SEM any spillage incidents or observations regarding adverse effects to the environment.

3.4 Project Communication and Co-ordination

Environmental issues and performance aspects will be communicated to the workforce on a regular basis. Weekly project meetings, which follow a set agenda incorporating the environment, will be held alongside overall management meetings.

All staff and sub-contractors involved in all phases of the Project will be encouraged to report environmental issues.

3.5 Training

All employees and subcontractors involved on site will be given a comprehensive induction prior to commencement of the works. This environmental training can be run concurrently with safety awareness training.

Training will include:

- Overview of the goals and objectives of the Environmental Policy and Environmental Management Plan;
- Awareness in relation to risk, consequence and methods of avoiding environmental risks as identified within the Register of Aspects and with the planning conditions;
- Awareness of roles and individual environmental responsibilities and environmental constrains to specific jobs;
- Location of and sensitivity of Special Area Conservation Special Protection Areas, protected monuments, structures etc.; and
- Location of habitats and species to be protected during construction, how activities may affect them and methods necessary to avoid impacts.

A record will be kept of a signed register on the project files of all attendees of the environmental induction.

Toolbox talks based on specific activities being carried out will be given to personnel by the nominated project representative. These will be based on specific activities being carried out and will include environmental issues, particularly due to the proposed development, including the impact on water quality namely:

- Oil/Diesel spill prevention and safe refuelling practice;
- Storage of materials including oil/diesels and cement;
- Emergency response processes used to deal with spills;
- Minimising disturbance to wildlife;
- Emergency response to include water pollution hotline to the Environmental Protection Agency (EPA) /WCCC for regulator response. Identification of registered / accredited spill clean-up company for oil etc.; and
- Consideration of importance of containment of vehicle washing, containments of concrete /cement / grout washout etc, bank protection using hessian to prevent excessive scour and mobilisation of suspended solids, maintenance of vegetation corridors etc.

3.6 Operational Control

Site works will be checked against the CEMP requirements. Any mitigation measures that have been agreed with the statutory authorities, or are part of planning conditions, will be put into place prior to the undertaking of the works for which they are required, and all relevant staff will be briefed accordingly.

Method statements that are prepared for the works will be reviewed / approved by the Client Project Manager and where necessary the relevant Environmental Specialist. All method statements for works in, near or liable to impact on a waterway must have prior agreement with Inland Fisheries Ireland (IFI).

A Quality Management System (QMS) will also be put into operation for the Project. Document control will be in accordance with this QMS and copies of all audits, consents, licences, etc will be finalised by the SEM and their team and kept on site for review at any time.

3.7 Checking and Corrective Action

Daily inspections of the site and the works will be undertaken to minimise the risk of environmental damage and to ensure compliance with the CEMP. Any environmental incidents are to be reported immediately to the Site Foreman. The SEM will undertake periodic inspections and complete an assessment of the Project's environmental performance with regard to the relevant standards/legislation and the contents of the CEMP. Following these inspections, the SEM will produce a report detailing the findings which will be provided to the Client Project Manager and reviewed at the monthly project meeting.

3.8 Environmental Control Measures

Licensing requirements will be in place and specific procedures to manage the key environmental aspects of the Project will be developed by the Contractor prior to work commencing.

3.9 Complaints Procedure

A liaison officer will be available to allow for a member of the pubic or interested parties to make complaints about the construction works. The CEMP will contain details of the complaints procedures and a monitoring system will be implemented to ensure that any complaints are addressed, and satisfactory outcome is achieved for all parties.

3.10 Compliance with Project Consents

If planning permission is granted for the proposed development, the entire contents of the planning consent, and other consents and conditions, will be appended as received.

4. ENVIRONMENTAL COMMITMENTS

Project environmental mitigation has been set out in the application documentation, in the EIAR and NIS in particular, and will be detailed in the final Construction Environmental Management Plan (CEMP), in accordance with this CEMP. The final CEMP will provide a framework for compliance auditing and inspection to ensure that these construction practices and mitigation measures, as set out in the EIAR and NIS and the conditions in the planning approval, are adhered to. It should be noted that Appendix A of this CEMP details the key mitigation measures which are outlined in the NIS, while Appendix B details the key mitigation measures which are outlined in the EIAR.

APPENDIX A

Natura Impact Statement
Mitigation Measures

5. MITIGATION

5.1 Principles and Approach

Section 4.0 of this NIS identified adverse effects likely to arise from the proposed development on the specific Attributes and Targets which define the Conservation Objectives for a number of Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC. This section (Section 5.0) prescribes measures and a protocol to ensure their full and proper implementation aimed at mitigating these adverse effects, thereby protecting the integrity of these European sites during the construction and operation of the proposed development.

The mitigation measures prescribed in this NIS have been designed according to the principle of a mitigation hierarchy, as outlined in the European Commission's guidance document *Assessment of plans and projects significantly affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC* (EC, 2001). According to this hierarchy, the following mitigation approaches were adopted, in order of decreasing preference:

1. Avoiding impacts at their source;
2. Reducing impacts at their source;
3. Abating impacts on site; and,
4. Abating impacts at their receptor.

As mitigation measures are related directly to impacts and only indirectly to receptors and as, in this case, all of the affected receptors have been identified as being affected the same set of impacts, to describe mitigation measures under the headings of the relevant receptors would lead to undue repetition. Therefore, the measures prescribed in this NIS are described under the headings of the types of impacts which they are intended to mitigate.

The mitigation measures are prescribed in Section 5.2 and a protocol to ensure their full and proper implementation is prescribed in Section 5.3. The significance of any residual effects following the inclusion of mitigation measures is evaluated in Section 5.4. As per the assessment of adverse effects in Section 4.0, this evaluation is made in view of the relevant Conservation Objectives.

5.2 Mitigation Measures

5.2.1 Habitat Loss and Fragmentation

The attachment of highly structured or bio-active pre-cast concrete cladding ("eco-cladding") to the river face of the new flood defence wall has been included as part of the ecological enhancement of the proposed development. The "rough" surface of the cladding, which will slightly reduce flow velocities immediately adjacent to the wall, safeguarding the saltmarsh habitats in the vicinity of the proposed flood wall from the effects of erosion. As the biological communities, particularly seaweeds, e.g. *Fucus* spp., develop on the cladding, the flow velocity moderation provided by the cladding will be enhanced, providing further protection against erosion.

Depending on the magnitude of this effect, over time, this may lead to an increased deposition of sediment immediately adjacent to the edge of the new riverside flood defence wall and upstream of the wall between Ch. 900 and Ch. 950, where the new alignment of the bank will form a light alcove. There is potential for this increased sedimentation to eventually lead to a slight expansion of the 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' at this location.

In order to provide further protection for 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' from disturbance during the construction stage, the areas of confirmed or potential Annex I saltmarsh habitats identified in this NIS shall not be included within the lands made available to the Contractor and it shall be made clear on all contract drawings that these areas contain sensitive habitats and shall not be disturbed. The Site Environmental Manager (SEM) and Ecological Clerk of Works (ECoW) shall also highlight the sensitivity of these habitats (and need to avoid disturbance of the same) during tool-box talks and other relevant communications with site personnel.

The flow velocity moderation provided by the cladding will also benefit small fish and other mobile species, including Twaite Shad and Otter, which are Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC. An additional benefit of this mitigation is that, once fully developed, the biological communities on the cladding would act as a source of food for a wide range of aquatic fauna in the River Suir (including Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC) and also as a reservoir of larvae or "seed" for the colonisation of other hard intertidal substrates elsewhere in the estuary.

5.2.2 Water Quality

Construction Phase

As is normal practice with infrastructure projects, an Environmental Operating Plan (EOP) and Construction Environmental Management Plan (CEMP) have been prepared for the proposed development and are included in Appendix A to this NIS. These will be developed by the Contractor to suit the detailed construction methodology and allocate responsibilities to individuals in the construction team. In doing so, the measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the current drafts of the Plans is sufficient to allow an assessment of the anticipated impacts including residual impacts.

The following will be implemented as part of this plan:

- An Incident Response Plan (see Appendix A) detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, non-compliance with any permit or license, or other such risks that could lead to a pollution incident, including flood risks.
- All necessary permits and licenses for in stream construction work for the provision of the flood defences will be obtained prior to the commencement of construction.
- Inform and consult with Inland Fisheries Ireland.

During construction, regard will be had to the following guidance documents for construction work on, over or near water.

- *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016)
- *C532 Control of water pollution from construction sites: guidance for consultants and contractors* (CIRIA, 2001)
- *CIRIA C648 C648 Control of water pollution from linear construction projects: technical guidance* (CIRIA, 2006)

- *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes* (NRA, 2006)

Based on the above guidance documents, the following principal mitigation measures will be adhered to for the construction phase:

General Measures

- Site works will be limited to the minimum required to construct the necessary elements of the proposed development.
- Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels or cut-off ditches.
- Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and bunding.
- Protection of waterbodies from silt load will be carried out through use of gully silt/sediment filters and shallow berms in hardstanding areas to provide adequate treatment of run-off to watercourses.
- Settlement tanks, silt traps/bags and bunds will be used. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap.
- The anticipated site compound/storage facility will be fenced off at a minimum distance of 5m from the top of the edge of the quay wall/river edge. Any works within the 10m buffer zone will require measures to be implemented to ensure that silt-laden or contaminated surface water run-off from the compound does not discharge directly to the watercourse. See the EOP and CEMP in Appendix A to this NIS for further detail.
- Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with NRA (2008d). All chemical and fuel filling locations will be contained within bunded areas and set back a minimum of 20 m from watercourses.
- Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner, off site, to prevent pollution.
- The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses.

Specific Measures - Concrete Works

Remedial works to the existing masonry quay wall and increasing its height will require the use of in-situ concrete. The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. As the use of concrete cannot be avoided, the following control measures will be employed:

- Sandbags or an aqua-dam will be in place for the duration of remedial works to the existing quay wall to effectively isolate the area beneath these works from the River Suir and thereby control the risk of pollutants entering the river. This mitigation shall be removed once the remedial works are complete.
- Hydrophilic grout and quick-setting mixes or rapid hardener additives shall be used to promote the early set of concrete surfaces exposed to water.

- When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used.
- Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters.
- Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW).
- The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if wet weather is forecast such that precipitation may make it difficult to maintain a dry working area.
- There will be no spills of concrete, cement, grout or similar materials hosed into surface water drains. Such spills shall be contained immediately and any run-off shall be prevented from entering the watercourse.
- Concrete waste and wash-down water shall be contained and managed on site to prevent pollution of all surface watercourses.
- On-site concrete batching and mixing activities shall only be permitted within the identified construction compounds.
- Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the manufacturer).
- Chute washout shall be carried out at designated locations only. These locations will be signposted. The concrete plant and all delivery drivers will be informed of their location with the order information and on arrival to site.
- Chute washout locations will be provided with an appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste in accordance with the Contractor's Waste Management Plan.

Operational Phase

The only potential water quality impacts associated with the operational phase relate to accidental spillage of paint which will be used in the periodic (approximately every 10 years) repainting of the exposed sections of the new sheet pile flood defence wall. In order to control this risk, the paint specified for this purpose shall not contain lead or tributyltin (TBT) or shall be otherwise approved for use near water.

5.2.3 Hydroacoustic Impacts

Fish Species

Seasonal Restrictions on Piling

As noted previously, at least one of the fish species of concern is likely to be present in significant numbers in the vicinity of the works at any time of the year, with by far the most sensitive fish hydroacoustic impacts, namely juvenile Twaite Shad, are present year-round, and other species being far less sensitive to the predicted impacts. Therefore, there is no specific benefit to or requirement for seasonal restrictions on piling activity.

Limits on Working Hours for Piling

The assessment in Section 4.2.4 above identifies a particular sensitivity with regard to night-time piling operations, which present an increased risk of impacts on juvenile Twaite Shad which are likely to shelter by the channel edge at night. This risk was also highlighted at the options appraisal stage and informed the decision to select the option which facilitated almost all piling taking place during the day. 3-4 weeks of night-time piling are still required due to other constraints, chiefly the need for railway possessions. However, as noted in Section 4.2.4, this piling will take place on land only. Based on the fact that this piling will take place on land and its short duration, it can be concluded beyond reasonable scientific doubt that it will not give rise to adverse effects on Twaite Shad or other Qualifying Interests of the Lower River Suir SAC or the River Barrow and River Nore SAC. Nonetheless, mitigation should be included to ensure that night-time piling is minimised and limited to landside works.

Breaks in Piling

There is a considerable amount of preparation required to ensure that piles are in the correct position etc. before driving begins. Therefore, once one pile is complete, it is estimated that it will take c. 35 minutes to prepare for the next pile, during which time there will be no piling noise. As detailed in Section 4.2.4 above, the area impacted by each pile drive is very small (less than the width of the channel), the impact (TTS) is of a low magnitude and fully recoverable, and fish are not stationary. Therefore, a quiet period of c. 30 minutes between periods of piling noise will be adequate to allow for recovery of fish and/or movement away from or through the affected area. This is based on a worst-case scenario of 55 minutes of continuous vibratory piling by a single piling rig or 28 minutes with two rigs operating simultaneously, or 200 strikes from an impact hammer (either one or two operating at any time). Mitigation specifying such quiet periods will be required to ensure that they are implemented.

In order to guarantee these gaps in piling noise, particularly if there is more than one piling rig in operation at the site, it shall be a requirement that all breaks between piling be of at least 30 minute's duration and, in the case of two piling rigs being operational simultaneously, that such breaks are concurrent. This mitigation will ensure that any hydroacoustic impacts will not give rise to a significant barrier to the movements of Twaite Shad or other species, or other significant effects on such species, in the Suir Estuary.

Soft-start/Ramp-up Procedure

Given the slow build-up of energy from vibratory piling, there is no requirement for the use of a soft-start or ramp-up procedure. Where impact piling is necessary to achieve the required depth for some piles, the vibratory piling preceding it will act as an effective soft-start or ramp-up procedure. Therefore, no specific measures are required to regulate the build-up of sound energy under water.

European Otter

The mitigation prescribed in this section in relation to hydroacoustic impacts are more than adequate to eliminate any risk of significant noise and vibration impacts on otters during the construction of the proposed development. Therefore, no further mitigation is required in respect of noise and vibration impacts on this species.

Summary

In short, the mitigation for hydroacoustic impacts is as follows ("piling event" means any period of continuous piling by one or two rigs; "quiet period" means any period in which there is no piling by any rig):

- Night-time piling shall be limited to the minimum number of shifts possible and shall only be permitted for landside piling.
- In-stream (riverside) piling shall be restricted to daytime shifts only.
- Vibratory piling shall be the standard method for the installation of all piles. Impact piling shall only be employed where the required depth below ground cannot be achieved by vibratory piling.
- No more than two piling rigs shall operate simultaneously at any time.
- The duration of any *vibratory* piling event shall not exceed 55 piling minutes, i.e. the duration of piling by one rig or the sum of the duration of piling by two rigs shall not exceed 55 minutes.
- The length of any *impact* piling event shall not exceed 200 strikes from one piling rig (or 200 strikes from *each* of two piling rigs, if piling simultaneously).
- Following every piling event, there shall be a quiet period of at least 30 minutes. Only following 30 minutes of no piling whatsoever can the cumulation of piling minutes be re-zeroed.
- The above limitations apply to all piling activity for the proposed development, riverside and landside, daytime and night-time, permanent and temporary.

Based on the expected time required for the installation of each pile (including ancillary processes), as described in Section 4.2.4, the limits prescribed above will not prolong the proposed programme for riverside or landside piling. Therefore, they are feasible within the proposed construction methodology and do not give rise to any additional effects on fish through extension of the total duration of impacts.

5.2.4 Lighting

Fish Species

The likely effects of artificial lighting on the migratory fish species listed as Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC are discussed in detail in Section 4.2.4 above. In summary, light spill onto the river channel during hours of darkness has the potential to form a barrier to the migration of nocturnal species and to encourage night-time activity of diurnal species, causing them to become more vulnerable to nocturnal predators.

Therefore, the following limits on construction lighting is proposed:

- Subject to any Health & Safety and/or navigational requirements, construction lighting over the river channel shall be turned off outside of working hours.
- Construction lighting shall be limited to the minimum area required to be lit and minimise light spill to areas not required for construction.
- In order to further limit any light spill, solid hoarding shall be erected around areas which will be subject to night-time construction activities.

Given the implementation of the above measures and the short duration of night-time construction activities (6-8 weeks), these works are unlikely to give rise to any impacts beyond the duration of the works and, therefore, no additional mitigation is proposed in relation to these works.

As there will be no new artificial lighting associated with the operation of the proposed development, no mitigation is proposed in relation to lighting for the operational phase.

European Otter

The mitigation prescribed in this section in relation to the impacts of artificial lighting are more than adequate to eliminate any risk of adverse effects in this regard on otters (including via prey availability) during the construction and operation of the proposed development. Therefore, no further mitigation is required in respect of lighting impacts on this species.

5.2.5 Invasive Alien Species

Terrestrial Plant Species

In order to minimise the risk of the introduction or spread of invasive alien plant species (IAPS) during construction, all land-based works shall be executed in accordance with best practice for biosecurity in construction. In particular, prior to commencement, the Contractor shall prepare a detailed Biosecurity Protocol describing his/her proposed approach to ensuring that IAPS are not imported or spread during the construction of the proposed development. The Contractor's Biosecurity Protocol shall be in accordance with *The Management of Invasive Alien Plant Species on National Roads – Technical Guidance* (TII, 2020) and subject to approval by the Ecological Clerk of Works (ECoW) prior to its acceptance and implementation. The Biosecurity Protocol shall include, as a minimum, the following measures to prevent the spread of invasive species:

- Good construction site hygiene will be employed to prevent the introduction and spread of problematic IAPS (especially Japanese Knotweed) by thoroughly washing vehicles prior to leaving any site.
- All plant and equipment employed on the construction site (e.g. excavators, piling equipment etc.) will be thoroughly cleaned down using a power washer unit prior to arrival on site to prevent the spread of IAPS.
- All washing must be undertaken in areas with no potential to result in the spread of IAPS, as detailed in the Construction Environmental Management Plan.
- Any soil and topsoil required on the site will be sourced from a stock that has been screened for the presence of any IAPS and where it is confirmed that none are present.

If possible, the known stand of Japanese Knotweed at the location of the proposed construction compound should be eradicated prior to commencement of construction. Given the proximity of this stand to habitats of conservation importance, i.e. habitats within the Lower River Suir SAC, preference should be given to physical removal rather than chemical control.

If for programme or other reasons the known stand of Japanese Knotweed cannot be eradicated prior to construction, it should be fenced off (at a distance of 7m from all visible parts of the plant) at the outside and the access prohibited except for monitoring or treatment purposes. All site staff shall be made aware of the Contractor's Biosecurity Protocol and receive training in the importance of good site biosecurity.

Pioneer Species

The invasive pioneer species Common Cordgrass (*Spartina anglica*) was previously recorded on intertidal mudflats in the River Suir within 500 m of the construction site. According to the *Saltmarsh Monitoring Project 2007-2008* (McCorry & Ryle, 2009):

> "*A general policy of active Common Cordgrass control in Irish saltmarshes is not recommended.* […] *It is recommended that instead of attempting to control or manage established populations of Common Cordgrass in Ireland, the primary*

> *policy should be that any available resources should be used to prevent the spread of this species to new sites.*"

In addition to the measures detailed below in relation to aquatic species, the following shall apply to all works on and adjacent to the mudflats:

- Vehicles, vessels, plant, equipment, PPE, construction materials or excavated material shall not be moved directly from areas known to contain Common Cordgrass, e.g. the mudflats in the vicinity of the Sustainable Transport Bridge and North Quays Development, without first having been inspected by the Ecological Clerk of Works (ECoW) and authorised by the Site Environmental Manager (SEM).
- Any material excavated from the mudflats, e.g. for the construction of drainage outfalls, shall be stored in a location where it is not at risk of colonisation by Common Cordgrass and shall be reinstated as quickly as possible.

Aquatic Species

The use of barges during the construction of the proposed development poses the risk of the introduction of invasive alien species to the aquatic environment both in the vicinity of the works and in the wider Suir-Barrow-Nore Estuary. This has the potential to significantly affect the integrity of aquatic and intertidal habitats in the Zone of Influence. In order to minimise the risk of either the introduction or spread of aquatic invasive alien species and thereby avoid negative impacts on these habitats, the owner or operator of the barge or barges shall:

- Provide documentary evidence (in the form of a completed and signed Marine Institute "*Cleaning and Disinfection Declaration Form*") that the vessel was fully de-fouled within the 6 months immediately preceding its engagement in the construction of the proposed development; and,
- Submit travel records relating to the vessel's movements during, at a minimum, the 6 months immediately preceding its engagement in the construction of the proposed development.

In order to ensure full compliance with the above, authorisation to move the vessel to the construction area shall only be granted once the Ecological Clerk of Works (ECoW) has satisfied him/herself that the vessel does not pose a significant risk of importing aquatic invasive alien species to the Suir-Barrow-Nore Estuary. He/she shall do so by:

- Boarding the vessel;
- Speaking with the skipper;
- Inspecting the relevant documents; and,
- Carrying out a final inspection of the vessel.

In relation to other construction activities, including pre-construction surveys and any other site inspections, the principles and appropriate measures in the IFI guidance document *Biosecurity Protocol for Field Survey Work* (IFI, 2010) shall be followed and shall form part of the Contractor's Biosecurity protocol.

5.2.6 Other Measures

Fish Rescue

During de-watering of temporary cofferdams for the construction of drainage outfalls, any fish remaining within the cofferdams will be collected (by netting) and released into the River Suir outside the cofferdams. These fish rescue operations shall be carried out under the supervision of IFI. Given the Health and Safety implications of working within a stell cofferdam in a partially saline environment, the use of electrofishing is not considered to be appropriate in this case.

5.2.7 Monitoring

Water Quality

Monitoring of water quality shall be undertaken in the River Suir, with samples taken, monthly for at least 6 months prior to commencement, weekly for the entire duration of construction and monthly for at least 24 months post-completion. The parameters which shall be monitored include, but are not limited to:

- Suspended solids and turbidity;
- Total hydrocarbons;
- Ammonia, nitrates, nitrites and total nitrogen;
- Phosphates and total phosphorus;
- Dissolved oxygen and biological oxygen demand; and,
- Temperature and salinity.

Samples shall be taken from at least two different locations, including at least one location at an appropriate distance upstream of the proposed development and at least one other at an appropriate distance downstream of the proposed development. The final number and location of sampling points will be determined by the Site Environmental Manager. Given the strong tidal influence at the location of the proposed development, the date and exact time at which each sample is taken, as well as the water level and direction of flow, must be recorded in order to ensure that comparative analysis of samples can control for tidal influence, as well as other variables, e.g. fluvial conditions.

The results of the water quality monitoring programme will be reviewed by the Site Environmental Manager and Ecological Clerk of Works on an ongoing basis during construction. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation shall be undertaken to identify the source of this non-compliance and corrective action will be taken where this is deemed to be associated with the proposed development.

Record of Habitats

In order to maintain an accurate and precise record of changes to intertidal and fringing habitats, particularly mudflats and saltmarshes, a photographic record shall be made of these habitats. This record shall cover both sides of the river from 50m upstream of the new flood defence wall to 50m downstream. All photographs shall be taken at low tide, every 2 months, beginning 6 months prior to commencement of construction and finishing 12 months after completion.

In addition, in order to accurately and precisely record any change in the structure and composition of biological communities of hard and soft intertidal substrates, sampling and analysis of these habitats shall be carried out at 6 months, 1 year, 2 years and 5 years post-construction. To facilitate meaningful comparative analysis and evaluation of the impacts of the proposed development, the sampling and analysis should follow the methodology employed by BEC Consultants Ltd in carrying out the pre-planning benthic surveys on 15th March 2021 (see Brophy (2021) in Appendix B).

Hydroacoustic Impacts

In order to allow for greater accuracy in the assessment of future plans and projects, it is recommended that hydroacoustic monitoring be undertaken for the duration of the proposed development's construction during which piling activities will take place. This monitoring shall establish the ambient underwater noise levels in the estuary (and the rate of sound attenuation) prior to and after construction and more accurately characterise the sound outputs in terms of SPL_{peak}, SPL_{RMS} and *SEL* at different frequencies arising from the different methods of pile driving and different types and sizes of piles. This monitoring shall be carried out by specialist underwater noise surveyors and the results will be frequently reviewed (at least fortnightly) by the Ecological Clerk of Works (ECoW).

5.3 Implementation

In order to give effect to the mitigation prescribed in this NIS, it should be a condition of any consent granted in respect of the proposed development that all of the mitigation, including monitoring and enforcement, prescribed in this NIS be binding, during the construction phase, on the Contractor and, during operational phase, on WCCC. Accordingly, all of the mitigation prescribed herein shall be transposed into the Contract Documents for the construction of the proposed development.

During construction, all works must comply with relevant legislation and guidelines in order to reduce and minimise environmental impacts and to protect all ecological receptors. In particular, there must be full compliance with the following:

- The Schedule of Commitments.
- The mitigation prescribed in Chapter 7 Biodiversity of the EIAR and in this NIS.
- Any conditions which might be attached to the proposed development's planning consent.
- Any requirements of stakeholders and statutory bodies, e.g. the NPWS and IFI, including:
    - *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016).
- All applicable legislative requirements in relation to environmental protection.
- All relevant construction industry guidelines, including:
    - *C532 Control of water pollution from construction sites: guidance for consultants and contractors* (CIRIA, 2001).
- Any biosecurity requirements arising from the preceding points.
- The Transport Infrastructure Ireland (TII) and National Roads Authority (NRA) Environmental Assessment and Construction Guidelines, specifically:
    - *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes.*
    - *Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage for National Road Schemes.*
    - *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes.*
    - *The Management of Invasive Alien Plant Species on National Roads – Technical Guidance.*

- *Guidelines for the Treatment of Noise and Vibration in National Road Schemes.*
- *Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes.*
- *Management of Waste from National Road Construction Projects.*
- *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.*

This list is non-exhaustive. All environmental commitments/requirements and relevant legislation and guidelines which are current at the time of construction will be followed.

5.3.1 Environmental Operating Plan

Appendix A of the NIS contains the Environmental Operating Plan (EOP) which shall be finalised by the Contractor, in agreement with Waterford City and County Council, prior to the commencement of the construction phase.

The EOP is a document that outlines procedures for the delivery of environmental mitigation measures and for addressing general day-to-day environmental issues that can arise during the construction phase of developments. Essentially the EOP is a project management tool. It is prepared, developed and updated by the Contractor during the construction stage and will be limited to setting out the detailed procedures by which the mitigation measures proposed as part of the EIAR and NIS and arising out of the Board's decision (if approving the proposed development) will be achieved. The EOP will not give rise to any reduction of mitigation measures or measures to protect the environment.

Before any works commence on site, the Contractor will be required to prepare an Environmental Operating Plan (EOP) in accordance with the TII/NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIAR and measures stipulated in the planning conditions. Details within the plan will include, as a minimum:

- All environmental commitments and mitigation stipulated in the planning documentation in respect of the proposed development, including sediment controls and other measures to ensure that water quality in the River Suir and Waterford Harbour is not degraded.
- Any requirements of statutory bodies such as the NPWS and IFI, including adherence to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016).
- A detailed Biosecurity Protocol.
- A list of all applicable legislative requirements in relation to environmental protection and a method of documenting compliance with these requirements.
- Outline methods by which construction activities will be managed in such a manner as to avoid, reduce or remedy potential negative impacts on the environment.

To oversee the implementation of the EOP, the Contractors will be required to appoint a person to ensure that the mitigation measures included in the EIAR, the EOP and the statutory approvals are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly.

The EOP has been appended (Appendix A). This is a preliminary document, which will be updated and finalised by the successful Contractor. Appended to the EOP are the following constituent plans, also to be finalised by the Contractor:

Appendix A: Construction Environmental Management Plan (CEMP)

Appendix B: Construction and Demolition Waste Management Plan (CDWMP)

Appendix C: Incident Response Plan (IRP)

Each of these plans is discussed in the following sections. The obligation to develop, maintain and implement the EOP and all of the above-listed plans will form part of the contract documents for the construction phase.

Construction Environmental Management Plan

Prior to any demolition, excavation or construction a Construction Environmental Management Plan (CEMP) will be produced by the successful contractors for each element of the proposed development. The CEMP will set out the Contractor's overall management and administration of the construction project. A Construction Environmental Management Plan has also been prepared, see Appendix A of this NIS. The CEMP will be developed by the Contractors during the pre-construction phase, to ensure commitments included in the statutory approvals are adhered to, and that it integrates the requirements of the Environmental Operating Plan (EOP).

The CEMP will contain the following information of general importance:

- An overview of the proposed development.
- An organisational chart illustrating the structure of the Contractor's project team and the duties and responsibilities of the various members.
- The Contractor's communications strategy.
- The contact details of relevant persons/entities, e.g. the Safety Officer, the Site Environmental Manager and the emergency services.
- A list of the documents which will have informed the CEMP, including all relevant legislation and construction/environmental guidelines.

In relation to environmental management, the CEMP will provide and full list of the Contractor's environmental commitments and will detail the Contractor's approach to the following:

- Details of working hours and days.
- Details of emergency plan - in the event of fire, chemical spillage, cement spillage, collapse of structures or failure of equipment or road traffic incident within an area of traffic management. The plan must include contact names and telephone numbers for: Local Authority (all sections/departments); Ambulance; Gardaí and Fire Services.
- Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages).
- Details of construction plant storage, temporary offices.
- Traffic management plan (to be developed in conjunction with the Local Authority – Roads Section) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic; programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements;
- Truck wheel wash details (including measures to reduce and treat runoff).

- Dust management to prevent nuisance (demolition & construction).
- Control of sediment, run-off, erosion and pollution.
- Noise and vibration management to prevent nuisance (demolition & construction).
- Landscape management.
- Management of contaminated land and assessment of risk for same by suitably qualified, trained and licenced personnel.
- Management of waste arising from construction and demolition.
- Minimisation of artificial lighting and shading.
- Management of risk from invasive alien species
- Stockpiles.
- Project procedures & method statements for:
    - Site clearance, site investigations, excavations
    - Diversion of services.
    - Excavation and blasting (through peat, soils & bedrock).
    - Piling.
    - Temporary hoarding & lighting.
    - Borrow Pits & location of crushing plant.
    - Storage and Treatment of peat and soft soils.
    - Disposal of surplus geological material (peat, soils, rock etc.).
    - Earthworks material improvement.
    - Protection of watercourses from contamination and silting during construction.
    - Works from a barge, including protection of watercourses from contamination when working in-river
- Site Compounds.
- Monitoring, inspection and auditing of the Contractor's compliance with his/her environmental commitments.

The production of the CEMP will also detail areas of concern with regard to Health and Safety and any environmental issues that require attention during the construction phase. Adoption of good management practices on site during the construction and operation phases will also contribute to reducing environmental impacts.

Construction and Demolition Waste Management Plan

The CDWMP sets out the Contractor's strategy (and measures required) to ensure that waste arising during the construction and demolition phase of the proposed development will be managed and disposed of in a way that ensures the provisions of European and Irish waste legislation (particularly the Waste Management Acts 1996 – 2011) are complied with, and to ensure that waste is managed in accordance with waste hierarchy insofar as possible.

The finalised CDWMP will contain the following information:

- Material transport routes;
- Methods by which construction works shall be managed in accordance with the relevant legislative instruments, including but not limited to:

  - An analysis of the different waste streams expected to be generated;
  - A demolition plan, with the purpose of ensuring that demolition occurs in an orderly fashion so that the re-use and recycling of the resultant materials is given due priority;
  - Details of waste storage (e.g. skips, bins, containers) to be provided for different waste streams and collection times;
  - Details of where and how materials are to be disposed of, i.e. landfill or other appropriately licensed waste management facility;
  - Details of storage areas for waste materials and containers;
  - Details of how unsuitable excess materials will be disposed of, where necessary; and
  - Details of how and where hazardous wastes, such as contaminated land, hydrocarbons and other hazardous substances, are to be stored and disposed of in a suitable manner;
- Estimates of waste management costs;
- Specific waste management objectives for the project;
- Identification of the roles and responsibilities of the relevant personnel regarding waste management;
- Procedures for communication and training in relation to on-site waste management;
- Record keeping procedures; and
- Details of an audit system to monitor implementation of the CDWMP.

The CDWMP is appended to the EOP (see Appendix A of the NIS). The plan shall be finalised by the successful Contractor, in agreement with WCCC, and in accordance with TII's guidelines on *The Management of Waste from National Road Construction Projects* (2017), the TII *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan* (2007) and the Department of the Environment, Housing and Local Government's *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects* (2006). This will be a live document, which will be amended and updated to reflect the policy context, as well as conditions on site, as the construction of the proposed development progresses.

Incident Response Plan

The Incident Response Plan (IRP) describes the procedures, lines of authority and processes that will be followed to ensure that incident response efforts during the construction stage of the proposed development are prompt, efficient, and appropriate to particular circumstances.

The Contractor will finalise the IRP prior to the commencement of the proposed works to include the following information, at a minimum:

- Contact names and telephone numbers for the local authority, i.e. WCCC (all sections and departments), An Garda Síochána and ambulance and fire services; and,
- Method statements for weather forecasting and continuous monitoring of water levels in the River Suir and Waterford Harbour. The plan must outline how the Contractor will respond to forecasted flood events, including but not limited to,

details of removal of site materials, fuels, tools, vehicles and persons from flood zones.

- The measures to be taken to avoid or reduce the incident risk potential;
- Reference to the method statement and management plans for construction activities, insofar as they are relevant for the purposes of mitigating against health and safety and pollution incidents;
- Procedures to be adopted to contain, limit and mitigate any adverse effects, as far as reasonably practicable, in the event of a health and safety or pollution incident;
- Persons responsible for dealing with incidents and their contact details;
- Procedures for alerting key staff, appropriate emergency services, authorities, the Employer's Representative and clean-up companies, where required, and contact details of same;
- Procedures for notifying relevant statutory bodies, environmental regulatory bodies, local authorities and local water and sewer providers of pollution incidents, where required, and contact details of same;
- Standby / rota systems; and
- The types and location of emergency response equipment available and appropriate personal protective equipment to be worn.

An IRP has been appended to the EOP (see Appendix A of this NIS). The document in its current form will be finalised by the successful Contractor prior to the commencement of the construction phase of the proposed development.

5.3.2 Site Environmental Manager

To ensure the successful development, implementation and maintenance of the EOP, the Contractor will appoint an independent Site Environmental Manager (SEM). He/she must possess training, experience and knowledge appropriate to the role, including a National Framework of Qualifications (NFQ) Level 8 qualification (or equivalent) or other acceptable qualification in environmental science, environmental management, hydrology or engineering. The principal functions of the SEM will be to ensure that the mitigation prescribed in this NIS, the EIAR, the CEMP, the EOP and the CDWMP, is fully and properly implemented and to monitor the construction stage from an environmental perspective. The SEM will also provide independently verifiable audit reports.

Separate from the on-going and detailed monitoring carried out by the Contractor as part of the EOP, the SEM will carry out the inspection and monitoring described below on behalf of WCCC. The results will be stored in the SEM's monitoring file and will be available for inspection or audit by WCCC, the NPWS or IFI.

- Daily reporting on weather and flood forecasting and daily reporting on the monitoring of peak water levels in the River Suir.
- Weekly inspections of the principal control measures described in the CEMP and reporting of findings to the Contractor.
- Daily inspections of surface water treatment measures.
- Daily inspections of all outfalls to watercourses.
- Daily visual inspections of watercourse to which there are discharges from the works and those in the vicinity of construction works.
- Weekly inspections of wheel-wash facilities.

- Daily monitoring of any stockpiles.
- Auditing at least six times per quarter of the Contractor's EOP monitoring results.

5.3.3 Ecological Clerk of Works

In order to ensure the successful development and implementation of the CEMP, an independent Ecological Clerk of Works (ECoW) will be appointed. The ECoW must possess training, experience and knowledge appropriate to the role, including:

- An NFQ Level 8 qualification or equivalent or other acceptable qualification in ecology or environmental biology; and,
- Demonstrable experience in the protection of European sites.

The principal functions of the ECoW are:

- To provide ecological supervision of the construction of the proposed development and thereby ensure the full and proper implementation of the mitigation prescribed in Chapter 7 Biodiversity of the EIAR and in this NIS;
- To highlight the sensitivity of 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', and the need to avoid disturbance of the same, during tool-box talks and other relevant communications with site personnel.
- To regularly review the outcome of the ongoing monitoring during construction (as described in Section 5.2.7 of this NIS);
- To carry out inspections of all vehicles, vessels, plant, equipment, PPE, construction materials or excavated materials prior to their movement from areas known to contain invasive alien species; and,
- To carry out weekly inspections and reporting on the implementation of the Contractor's Biosecurity Protocol.

During the preparation of the Contractor's EOP, the SEM may, as appropriate, assign other duties and responsibilities to the ECoW. In exercising his/her functions, the ECoW will be required to keep a monitoring file and this will be made available for inspection or audit by WCCC, the NPWS or IFI at any time.

APPENDIX B

Chapter 19 Mitigation Measures (Volume 2 of EIAR)

Chapter 19 Mitigation Measures

19.1 Introduction

Mitigation measures are the measures proposed in order to avoid, reduce or, where possible, remedy the significant adverse environmental effects of the proposed Flood Defences West. Mitigation measures have been incorporated into the design of the proposed bridge and will be applied during both the construction and operation phase where they have been assessed as necessary.

This chapter provides a summary of the mitigation measures for the Flood Defences West as contained within chapters 5 – 18 of the Environmental Impact Assessment Report (EIAR). This is a summarised version stating only the mitigation measures to be provided and does not discuss the requirement for the measure to be applied or the residual impacts. This chapter also deals only with mitigation measures to be applied to the Flood Defences West and does not address the avoidance or reduction mitigation which has been applied through the design development.

19.2 General Mitigation and Monitoring Measures

Table 19.1 General Mitigation and Monitoring Measures

No.	Description
4.1	**Piling** • The following general procedure will be followed for installation of both riverside and landside sheet pile walls: • Vibratory piling shall be the standard method for the installation of all piles. Impact piling shall only be employed where the required depth below ground cannot be achieved by vibratory piling, and shall not exceed 10 strikes in any one piling event • No more than two piling rigs shall operate simultaneously at any time. • The duration of any one piling event shall not exceed 55 piling minutes, i.e. the duration of piling by one rig or the sum of the duration of piling by two rigs shall not exceed 55 minutes. • Following every piling event, there shall be a quiet period of at least 30 minutes. • The above specifications apply to all piling activity for the proposed development, riverside and landside, daytime and night-time.
4.2	**Cladding** The section of the riverside sheet piles within the intertidal zone of the River Suir (the area between the low- and high-water mark) will be fitted with cladding in a form of an eco-seawall to enhance marine biodiversity.
4.3	**Utilities** Prior to excavation works, a segment of the ground will be surveyed via CAT scan and shallow slit trenches excavated in order to confirm the position of utilities.
4.4	**Drainage – construction of Surface Water Outfall Structures** • A dry works area will be created by placing sheet piling or similar into the river from the bank outwards to construct a cofferdam. • Prior to the commencement of any de-watering operations within the cofferdam, adequate and appropriate facilities for the treatment of silt laden water will be designed prior to discharge to ground or back to the River Suir. • Clean, debris free stone will be utilised for the creation of the stone mattress.

No.	Description
	The dry works area will remain in place until all in-stream works have been completed and all concrete material has had sufficient time to cure.
4.5	**Quarries** • Only those quarries that conform to all necessary statutory consents may be used in the construction phase by the appointed Contractor. For whatever quarry source, or sources, utilised for the fill material to be imported to the proposed road development, all will require suitable access routes for HGV traffic from their sites to the suitable main road network, in accordance with their planning approvals.
4.6	**Construction Traffic** • No construction traffic will be permitted to enter the site via Waterford City Centre. The access route to the main and the ancillary construction compound is the R448 Regional Road which has a direct connection to the N25 National Road.
4.7	**Environmental Operating Plan** The Environmental Operating Plan (EOP) shall be finalised by the Contractor, in agreement with Waterford City and County Council, prior to the commencement of the construction phase. The EOP is a document that outlines procedures for the delivery of environmental mitigation measures and for addressing general day-to-day environmental issues that can arise during the construction phase of developments. Essentially the EOP is a project management tool. It is prepared, developed and updated by the Contractor during the construction stage and will be limited to setting out the detailed procedures by which the mitigation measures proposed as part of the EIAR and NIS and arising out of the Board's decision (if approving the proposed development) will be achieved. The EOP will not give rise to any reduction of mitigation measures or measures to protect the environment. Before any works commence on site, the Contractor will be required to prepare an Environmental Operating Plan (EOP) in accordance with the TII/NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIAR and measures stipulated in the planning conditions. Details within the plan will include, as a minimum: • All environmental commitments and mitigation stipulated in the planning documentation in respect of the proposed development, including sediment controls and other measures to ensure that water quality in the River Suir and Waterford Harbour is not degraded. • Any requirements of statutory bodies such as the NPWS and IFI, including adherence to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016). • A detailed Biosecurity Protocol. • A list of all applicable legislative requirements in relation to environmental protection and a method of documenting compliance with these requirements. • Outline methods by which construction activities will be managed in such a manner as to avoid, reduce or remedy potential negative impacts on the environment. To oversee the implementation of the EOP, the Contractors will be required to appoint a person to ensure that the mitigation measures included in the EIAR, the EOP and the statutory approvals are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly.

No.	Description
	The EOP has been appended (Appendix 4.1). This is a preliminary document, which will be updated and finalised by the successful Contractor. Appended to the EOP are the following constituent plans, also to be finalised by the Contractor: **Appendix A:** Construction Environmental Management Plan (CEMP) **Appendix B:** Construction and Demolition Waste Management Plan (CDWMP) **Appendix C:** Incident Response Plan (IRP) Each of these plans is discussed in the following sections. The obligation to develop, maintain and implement the EOP and all of the above-listed plans will form part of the contract documents for the construction phase. It will be a condition of the Contract for the construction of the proposed development that the successful Contractor fully implement the EOP throughout the works. To oversee the implementation of the EOP, the Contractor will be required to appoint a responsible Site Environmental Manager (SEM) to ensure that the environmental commitments (as described above) and the EOP are fully executed for the duration of works, and to monitor whether the mitigation measures employed are functioning properly (i.e. are effectively addressing the environmental impact(s) which they were prescribed for).

19.3 Mitigation and Monitoring Measures for Traffic Analysis

Table 19.2 Mitigation and Monitoring Measures for Traffic Analysis

No.	Description
	There are no mitigation measures proposed for Chapter 5 Traffic Analysis as part of the Flood Defences West.

19.4 Mitigation and Monitoring Measures for Population and Human Health

Table 19.3 Mitigation and Monitoring Measures for Population and Human Health

No.	Description
6.1	Develop and implement all mitigation measures detailed in Chapter 4 (Description of the Proposed Development) this is to include development of Construction Environmental Management Plan (CEMP) and associated traffic management proposals to address all modes of transport including the navigational channel and will be required to be agreed with WCCC prior to construction stage. • The CEMP will be required to maximise the safety of the workforce and the public and minimise traffic delays, disruption and maintain access to properties. • The CEMP will also address temporary disruption to traffic signals, footpath access and the management of pedestrian crossing points. • The contractor shall provide an appropriate information campaign for the duration of the construction works. • The CEMP should minimise disruption to economic, marine users and residential amenities to be agreed by WCCC prior to construction and ensure access is maintained along the R448 & R680 for vehicles, pedestrians, cyclists, and economic operators at all times and ensure marine navigation is maintained. The contractor will be required to develop and implement Stakeholder Management and Communication Plan and will be required to be agreed with WCCC prior to construction stage. • All stakeholders will be required to be agreed with WCCC prior to construction commencing.

No.	Description
	Details of the general construction process/phasing will be communicated to the relevant stakeholders prior to implementation to ensure local residents and businesses are fully informed on the nature and duration of construction works.
6.2	Noise and Vibration mitigation will be provided for during construction of the development. Measures to mitigate noise and vibration impacts on sensitive receptors are detailed within Chapter 12 Noise and Vibration. The contractor will work within stringent construction limits and guidelines to protect residential and commercial amenities including the application of binding noise limits, hours of operation, along with implementation of appropriate noise and vibration control measures.
6.3	In order to minimise dust emissions during construction, a series of mitigation measures have been prepared as part of Chapter 13 Air Quality and Climate. Provided the dust minimisation measures are adhered to, the air quality impacts during the construction phase will not be significant. No further mitigation measures are required.
6.4	Emissions from the construction activities such as dust and risk of accidents were found to be potential short-term, negative impacts. It was found that noise emissions from construction activities, plant and machinery on site is likely to have a significant noise impact within the immediate area during distinct construction phases (i.e. piling activities) of the development.
6.5	Nightworks will also have a significant impact during the short duration they are required. All construction stage impacts will be temporary in nature and reduced and managed by CEMP and associated EOP and CDWMP and the range of mitigation measures of this EIAR.
6.6	All construction works will be temporary in nature and will be carried out in line with best practice thereby minimising the likely significant impacts to the community and human health impacts. The contractor will work within stringent construction limits and guidelines to protect surrounding populations and amenities.

19.5 Mitigation and Monitoring Measures for Biodiversity

Table 19.4 Mitigation and Monitoring Measures for Biodiversity

No.	Description
General Mitigation	
7.1	**Mitigation by Avoidance** The proposed development minimises land-take from ecologically sensitive areas and has been constraints-led from the initial phase, through an iterative design process, and into the final proposed development. The design of the flood defences has followed the basic principles outlined below to eliminate the potential for impacts on Key Ecological Receptors where possible, and to minimise such impacts where total elimination is not possible. The proposed development has been designed to minimise direct or indirect impacts on any habitats or species or other ecological features that were classified as being of Local Importance (Higher Value) or above. The alignment of the proposed flood wall has been designed to avoid, as far as possible, direct, indirect or secondary adverse effects on European sites and other designated sites for nature conservation.
7.2	**Mitigation by Design** The proposed development has been developed having regard to European and national legislation and all relevant guidelines and engineering best practice for the planning and construction of developments. These guidelines and best practice

No.	Description
	provide practical measures that can be incorporated into the design to minimise the impact and protect the receiving environment.
Specific Mitigation Measures – KER 1 River Suir, including Annex I 'Estuaries' This subsection describes the mitigation proposed for general impacts on biodiversity in and immediately adjacent to the River Suir. Mitigation specific to other individual Key Ecological Receptors is described separately in relation to each Receptor.	
7.3	**Habitat Loss, Fragmentation and Degradation** The principal impact of the proposed development on the River Suir relates to the direct and indirect loss, fragmentation and degradation of intertidal and shoreline habitats. The direct loss of c. 800 m^2 of intertidal habitat cannot be avoided through design. However, indirect loss can be avoided and fragmentation and degradation mitigated through the ecological enhancement of the riverside sections of the new sheet pile flood defence wall. This enhancement will be provided by the attachment of highly structured or bio-active pre-cast concrete cladding ("eco-cladding") to the intertidal river face of the riverside sheet pile section of the new flood defence wall (see photomontages in Figures 11.1 and 11.2 in Volume 3 of this EIAR). The physical structure of this cladding will mitigate these impacts as follows: • Any indirect loss of intertidal mudflats which might result from erosion associated with increased flow velocities immediately adjacent to the riverside sheet pile wall will be mitigated by the "rough" surface of the cladding, which will reduce flow velocities immediately adjacent to the wall. This will safeguard the remaining mudflats and fringing habitats from the effects of erosion. • The highly structured surface of the cladding will maximise the opportunity for biological communities of hard intertidal substrates to colonise the new wall. The structure and composition of these communities will depend on the structure of the wall and the communities already present in the River Suir, which will act as a source to "seed" the cladding with encrusting organisms, including macroalgae ("seaweeds") and bivalve molluscs. The physical structure will also provide shelter/habitat for mobile species such as crabs and small fish. • As the biological communities develop, particularly the seaweed, e.g. *Fucus* spp., the flow velocity moderation provided by the cladding will be enhanced, providing further protection against erosion for mudflats and shoreline habitats. Depending on the magnitude of this effect, over time, this may lead to an indirect recovery of a small portion of the mudflat habitat lost and, consequently, a slight increase in the area of saltmarsh (though this is unlikely to be significant). • Once fully developed, the biological communities on the cladding would act as a source of food for a wide range of aquatic fauna in the River Suir and also as a reservoir of larvae or "seed" for the colonisation of other hard intertidal substrates elsewhere in the Suir Estuary. • The flow velocity moderation provided by the cladding would also benefit fish and other mobile species, as discussed under *KER 4 Fish Species*, including Annex II migratory species. This addresses the habitat fragmentation impact. The quantum of each benefit will depend on the final specification, e.g. the roughness of the surface and whether or not the cladding incorporates ledges or "shelves" to encourage shoreline vegetation at the top and/or accumulation of narrow strips of intertidal mudflats in the upper and mid-littoral zones. Incorporation of such features would further enhance the biodiversity value of the new flood defence wall through the provision of greater habitat zonation, heterogeneity and connectivity. Assuming the specification of an appropriate cladding for the new riverside sheet pile wall, the replacement of intertidal mudflats (of high biodiversity value) and existing quay wall (of moderate biodiversity value) with a new sheet pile wall (of very low biodiversity value) would be mitigated as the cladding would increase the biodiversity of the new riverside flood defence wall to moderate-high (the as the overall value of the habitats being lost). While the loss of mudflat habitat is permanent and

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>unmitigable, there would be No Net Loss of Biodiversity within the River Suir. Similarly, there would be no adverse effect on the conservation status of Annex I 'Estuaries'.

This mitigation would also contribute to the achievement of the policies and objectives set out in the National Biodiversity Action Plan, the RSES for the Southern Region and the Waterford City Development Plan with regard to the protection and enhancement of the biodiversity value of ecological features and the provision of green infrastructure (and blue infrastructure), particularly in urbanised environments.</td></tr>
<tr><td>7.4</td><td>Artificial Lighting

Artificial lighting associated with the construction of the proposed development poses a risk of potential negative impacts on habitats and species in and adjacent to the River Suir. Therefore, the following limits on construction lighting is proposed:

• Subject to any Health & Safety and/or navigational requirements, construction lighting over the river channel shall be turned off outside of working hours.
• Construction lighting shall be limited to the minimum area required to be lit and minimise light spill to areas not required for construction.
• In order to further limit any light spill, solid hoarding shall be erected around areas which will be subject to night-time construction activities.

Given the implementation of the above measures and the short duration of night-time construction activities (6-8 weeks), these works are unlikely to give rise to significant impacts beyond the duration of the works and, therefore, no additional mitigation is proposed in relation to these works.

As there will be no new artificial lighting associated with the operation of the proposed development, no mitigation is proposed in relation to lighting for the operational phase.</td></tr>
<tr><td>7.5</td><td>Water Quality

As is normal practice with infrastructure projects, an Environmental Operating Plan (EOP) and Construction Environmental Management Plan have been prepared for the Flood Defences West and are included in Appendix 4.1 and Appendix 1.4A, respectively. These will be updated and finalised by the selected contractor to suit the detailed construction methodology and allocate responsibilities to individuals in the construction team. In doing so, the measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the Plans is sufficient to allow an assessment of the anticipated impacts including residual impacts.

The following will be implemented as part of this plan:

• An Incident Response Plan (see Appendix 4.1 C) detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, non-compliance with any permit or license, or other such risks that could lead to a pollution incident, including flood risks.
• All necessary permits and licenses for in stream construction work for provision of the flood defences will be obtained prior to the commencement of construction.
• Inform and consult with Inland Fisheries Ireland.

During construction, cognisance will have to be taken of the following guidance documents for construction work on, over or near water.

• Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016)
• Central Fisheries Board Channels and Challenges – The enhancement of Salmonid Rivers
• CIRIA C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors
• CIRIA C648 Control of Water Pollution from Constructional Sites
• Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (NRA, 2006)</td></tr>
</table>

No.	Description
	Based on the above guidance documents, the following principal mitigation measures will be adhered to for the construction phase: *General Mitigation Measures* • Site works will be limited to the minimum required to construct the necessary elements of the proposed development; • Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels or cut-off ditches; • Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and bunding; • Protection of waterbodies from silt load will be carried out through use of gully silt/sediment filters and shallow berms in hardstanding areas to provide adequate treatment of run-off to watercourses; • Settlement tanks, silt traps/bags and bunds will be used. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap; • The anticipated site compound/storage facility will be fenced off at a minimum distance of 5 m from the top of the edge of the quay wall/river edge. Any works within the 10 m buffer zone will require measures to be implemented to ensure that silt-laden or contaminated surface water run-off from the compound does not discharge directly to the watercourse. See the EOP and Construction Environmental Management Plan (CEMP) in Appendix 4.1 and 4.1 A of this EIAR for further detail. • Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with NRA (2008d). All chemical and fuel filling locations will be contained within bunded areas and set back a minimum of 20 m from watercourses. • Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner, off site, to prevent pollution; and, • The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses. *Specific Mitigation Measures - Concrete Works* Remedial works to the existing masonry quay wall and increasing its height will require the use of in-situ concrete. The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. As the use of concrete cannot be avoided, the following control measures will be employed: • Sandbags or an aqua-dam will be in place for the duration of remedial works to the existing quay wall to effectively isolate the area beneath these works from the River Suir and thereby control the risk of pollutants entering the river. This mitigation shall be removed once the remedial works are complete. • Hydrophilic grout and quick-setting mixes or rapid hardener additives shall be used to promote the early set of concrete surfaces exposed to water. • When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used; • Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters; • Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW); • The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if wet weather is forecast such that precipitation may make it difficult to maintain a dry working area.

No.	Description
	• There will be no spills of concrete, cement, grout or similar materials hosed into surface water drains. Such spills shall be contained immediately and any run-off shall be prevented from entering the watercourse; • Concrete waste and wash-down water shall be contained and managed on site to prevent pollution of all surface watercourses; • On-site concrete batching and mixing activities shall only be permitted within the identified construction compounds; • Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the manufacturer); • Chute washout shall be carried out at designated locations only. These locations will be signposted. The concrete plant and all delivery drivers will be informed of their location with the order information and on arrival to site; and, Chute washout locations will be provided with an appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste in accordance with the Contractor's Construction and Demolition Waste Management Plan.
7.6	**Operational Phase** The only potential water quality impacts associated with the operational phase relate to accidental spillage of paint which will be used in the periodic (approximately every 10 years) repainting of the exposed sections of the new sheet pile flood defence wall. In order to control this risk, the paint specified for this purpose shall not contain lead or tributyltin (TBT) or shall be otherwise approved for use near water.
7.7	**Invasive Alien Species** Mitigation relating to biosecurity and the management of the risks associated with the spread of invasive alien species described under *KER 7 Invasive Alien Species*. Given the full and proper implementation of that mitigation, the proposed development does not pose a significant risk to Biodiversity in the River Suir in terms of the introduction or spread of invasive alien species.
Specific Mitigation Measures - KER 2 Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide'	
7.8	**Habitat Loss, Fragmentation and Degradation** The direct loss of c. 800 m^2 of intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide', cannot be avoided through design. However, indirect loss can be avoided and fragmentation and degradation mitigated through the provision of a highly structured or bio-active cladding, such as that described in relation to KER 1, to the outside of the riverside sheet pile wall. While the loss of mudflat habitat is permanent and unmitigable, there would be No Nett Loss of Biodiversity with regard to the intertidal habitats at this location and the effect on the conservation status of Annex I 'Mudflats and sandflats not covered by seawater at low tide' would be imperceptible at the National level.
7.9	**Water Quality** The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the protection of water quality during the construction of the proposed development will ensure that the impact on intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide', arising from accidental pollution associated with the proposed development would not give rise to significant effects on those habitats.
7.10	**Invasive Alien Species** Mitigation relating to biosecurity and the management of the risks associated with the spread of invasive alien species described under *KER 7 Invasive Alien Species*.

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>Given the full and proper implementation of that mitigation, the proposed development does not pose a significant risk to intertidal habitats in terms of the introduction or spread of invasive alien species.</td></tr>
<tr><td colspan="2">Specific Mitigation Measures - KER 3 Fringing Habitats, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)'</td></tr>
<tr><td>7.11</td><td>Habitat Loss
A number of small areas of rough grassland habitats between the railway line and the River Suir will be lost as a result of the proposed development. Given the isolation of these habitats from the River Suir by the new flood defence wall and other habitats to the north by the railway line, it was not deemed appropriate to reinstate or improve these habitats as there is a risk to fauna, e.g. Otter, crossing the railway line to access them. Thus, the impact of the loss of these habitats is permanent, but is of low magnitude given the low biodiversity value of these habitats and their small extents.
Any direct losses of saltmarshes and other shoreline habitats of high biodiversity value, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)', have been largely avoided through the iterative design process. In particular, direct impacts on the area of 106 m^2 of Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)' has been avoided entirely through moving the western tie-in point of the new flood defence wall, which was originally to transition back behind the existing quay wall at Ch. 0+950 (within this habitat), to its new position at Ch. 900, which is 25m further east than the most westerly point of the Annex I saltmarsh. Furthermore, the proposed eco-cladding described under KER 1 River Suir, including Annex I 'Estuaries', will further safeguard saltmarsh habitats from future erosion be reducing flow velocities along the shoreline. There are no other areas of Annex I saltmarsh within the extents of the proposed development.
Other shoreline habitats include extremely narrow strips of ruderal vegetation on the existing quay wall and at the bottom of the same in places. This vegetation will be lost, but can be fully replaced through specification of an appropriate "eco-cladding" as described under KER 1 River Suir, including Annex I 'Estuaries'.</td></tr>
<tr><td>7.12</td><td>Disturbance
In order to provide further protection for 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)' from disturbance during the construction stage, the areas of confirmed or potential Annex I saltmarsh habitats identified in this EIAR shall not be included within the lands made available to the Contractor and it shall be made clear on all contract drawings that these areas contain sensitive habitats and shall not be disturbed. The Site Environmental Manager (SEM) and Ecological Clerk of Works (ECoW) shall also highlight the sensitivity of these habitats (and need to avoid disturbance of the same) during tool-box talks and other relevant communications with site personnel.</td></tr>
<tr><td>7.13</td><td>Water Quality
The measures described under KER 1 River Suir, including Annex I 'Estuaries' relating to the protection of water quality during the construction of the proposed development will ensure that the impact on fringing habitats, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)', arising from accidental pollution associated with the proposed development would not give rise to significant effects on those habitats in terms of habitat degradation.</td></tr>
<tr><td>7.14</td><td>Invasive Alien Species
Mitigation relating to biosecurity and the management of the risks associated with the spread of invasive alien species described under KER 7 Invasive Alien Species. Given the full and proper implementation of that mitigation, the proposed development does not pose a significant risk to shoreline habitats, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)', in terms of the introduction or spread of invasive alien species, especially Common Cordgrass (Spartina anglica).</td></tr>
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<tr><th>No.</th><th>Description</th></tr>
<tr><td colspan="2">Specific Mitigation Measures - KER 4 Fish Species
Mitigation measures prescribed for fish species below are relevant for nocturnal and diurnal fish species, fish of small body size and hearing specialists (fish with highly specialised auditory organs). The rationale for this mitigation is fully detailed in the NIS for the proposed development (included as part of this Planning Application).</td></tr>
<tr><td>7.15</td><td>Habitat Loss
The only fish habitat will be lost is the c. 800 m² of intertidal habitats on the left (north) bank of the River Suir where these are being reclaimed by the new flood defence wall. The mitigation which is being provided for the loss of these habitats include the provision of eco-cladding, which is described in detail above in relation to KER 1 River Suir, including Annex I 'Estuaries'. The positive effects of the eco-cladding are relevant to fish species as follows:
It will provide the physical habitat conditions for quick establishment of biological communities of hard intertidal substrates, supporting macroalgae ("seaweeds"), crustaceans and fish. The establishment of such communities and consequent production of planktonic larvae will provide food for fish, including species of conservation importance, e.g. Twaite Shad.
It will mitigate against increased flow velocities at the channel edge resulting from the presence of the new sheet pile wall, which will facilitate movement against the tide by fish, especially small fish such as juvenile Twaite Shad.</td></tr>
<tr><td>7.16</td><td>Hydraulic Impacts
Predictions made from the hydrodynamic model for the proposed flood defences show that there would be a slight increase in flow velocity immediately adjacent to a sheet piled wall. While this will not lead to significant effects in the form or erosion of habitats within or on the banks of the River Suir, the rate of deposition will be slightly decreased. The measures described under KER 2 Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide' relating to installation of eco-cladding will ensure that the impact on shoreline habitats, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)', is further reduced/made positive.</td></tr>
<tr><td>7.17</td><td>Hydroacoustic Impacts
The mitigation for hydroacoustic impacts is as follows ("piling event" means any period of continuous piling by one or two rigs; "quiet period" means any period in which there is no piling by any rig):
Night-time piling shall be limited to the minimum number of shifts possible and shall only be permitted for landside piling.
In-stream (riverside) piling shall be restricted to daytime shifts only.
Vibratory piling shall be the standard method for the installation of all piles. Impact piling shall only be employed where the required depth below ground cannot be achieved by vibratory piling.
No more than two piling rigs shall operate simultaneously at any time.
The duration of any vibratory piling event shall not exceed 55 piling minutes, i.e. the duration of piling by one rig or the sum of the duration of piling by two rigs shall not exceed 55 minutes.
The length of any impact piling event shall not exceed 200 strikes from one piling rig (or 200 strikes from each of two piling rigs, if piling simultaneously).
Following every piling event, there shall be a quiet period of at least 30 minutes. Only following 30 minutes of no piling whatsoever can the cumulation of piling minutes be re-zeroed.
The above limitations apply to all piling activity for the proposed development, riverside and landside, daytime and night-time, permanent and temporary.</td></tr>
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No.	Description
	Based on the expected time required for the installation of each pile (including ancillary processes), as described in Section 4.2.4, the limits prescribed above will not prolong the proposed programme for riverside or landside piling. Therefore, they are feasible within the proposed construction methodology and do not give rise to any additional effects on fish through extension of the total duration of impacts. Based on the detailed hydroacoustic impact assessment presented in the NIS, there is no necessity for daily/nightly or seasonal restrictions on piling activities or the use of soft-start/ramp-up procedures.
7.18	**Artificial Lighting** The measures described under KER 1 River Suir, including Annex I 'Estuaries' relating to the artificial lighting during the construction of the proposed development will ensure that the impact on fish species, including Annex II migratory species, arising from artificial lighting from with the proposed development will not give rise to significant effects on the populations of those species. There are no lighting impacts associated with the operational phase.
7.19	**Water Quality** The measures described under KER 1 River Suir, including Annex I 'Estuaries' relating to the protection of water quality during the construction of the proposed development will ensure that the impact on fish species, including Annex II migratory species, arising from accidental pollution associated with the proposed development will not give rise to significant effects on the populations of those species.
7.20	**Fish Rescue** During de-watering of temporary cofferdams for the construction of drainage outfalls, any fish remaining within the cofferdams will be collected (by netting) and released into the River Suir outside the cofferdams. These fish rescue operations shall be carried out under the supervision of IFI. Given the Health and Safety implications of working within a stell cofferdam in a partially saline environment, the use of electrofishing is not considered to be appropriate in this case.
Specific Mitigation Measures - KER 5 Otter	
7.21	**Disturbance (Lighting and Noise)** The mitigation proposed under *KER 1 River Suir, including Annex I 'Estuaries'*, for lighting impacts, and under *KER 4 Fish Species, including Annex II migratory species*, for noise impacts, are considered sufficient to eliminate any risk of significant direct and indirect disturbance of otters during the construction of the proposed development. There are no sources of disturbance to otters arising from the operational phase.
7.22	**Prey Biomass Availability** The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the protection of water quality during the construction of the proposed development will ensure that the impact on fish and other prey species for otters which might arise from accidental pollution associated with the proposed development will not lead to any reduction in the prey biomass available for otters. Furthermore, the implementation of the general mitigation of impacts on the River Suir and intertidal habitats, i.e. the proposed "eco-cladding" for the riverside flood defence wall, will likely lead to a slight increase in the total biomass available to otters in the long term.
Specific Mitigation Measures - KER 6 Bats	
7.23	**Disturbance (Lighting and Noise)** The mitigation proposed under *KER 1 River Suir, including Annex I 'Estuaries'*, for lighting impacts, and under *KER 4 Fish Species, including Annex II migratory species*, for noise impacts, are considered sufficient to eliminate any risk of significant direct

No.	Description
	and indirect disturbance of bats during the construction of the proposed development. There are no sources of disturbance to bats arising from the operational phase.
Specific Mitigation Measures - KER 7 Invasive Alien Species	
7.24	**Terrestrial Plant Species** In order to minimise the risk of the introduction or spread of invasive alien plant species (IAPS) during construction, all land-based works shall be executed in accordance with best practice for biosecurity in construction. In particular, prior to commencement, the Contractor shall prepare a detailed Biosecurity Protocol describing his/her proposed approach to ensuring that IAPS are not imported or spread during the construction of the proposed development. The Contractor's Biosecurity Protocol shall be in accordance with The Management of Invasive Alien Plant Species on National Roads – Technical Guidance (TII, 2020) and subject to approval by the Ecological Clerk of Works (ECoW) prior to its acceptance and implementation. The Biosecurity Protocol shall include, as a minimum, the following measures to prevent the spread of invasive species: • Good construction site hygiene will be employed to prevent the introduction and spread of problematic IAPS (especially Japanese Knotweed) by thoroughly washing vehicles prior to leaving any site. • All plant and equipment employed on the construction site (e.g. excavators, piling equipment etc.) will be thoroughly cleaned down using a power washer unit prior to arrival on site to prevent the spread of IAPS. • All washing must be undertaken in areas with no potential to result in the spread of IAPS, as detailed in the Construction Environmental Management Plan. • Any soil and topsoil required on the site will be sourced from a stock that has been screened for the presence of any IAPS and where it is confirmed that none are present. If possible, the known stand of Japanese Knotweed at the location of the proposed main construction compound should be eradicated prior to commencement of construction. Given the proximity of this stand to habitats of conservation importance, i.e. habitats within the Lower River Suir SAC, preference should be given to physical removal rather than chemical control. If for programme or other reasons the known stand of Japanese Knotweed cannot be eradicated prior to construction, it should be fenced off (at a distance of 7 m from all visible parts of the plant) at the outset and the access prohibited except for monitoring por treatment purposes. All site staff shall be made aware of the Contractor's Biosecurity Protocol and receive training in the importance of good site biosecurity.
7.25	**Pioneer Species** The invasive pioneer species Common Cordgrass (*Spartina anglica*) was previously recorded on intertidal mudflats in the River Suir within 500 m of the construction site (in the vicinity of the North Quays Development site and Sustainable Transport Bridge). According to the Saltmarsh Monitoring Project 2007-2008 (McCorry & Ryle, 2009): *"A general policy of active Common Cordgrass control in Irish saltmarshes is not recommended. […] It is recommended that instead of attempting to control or manage established populations of Common Cordgrass in Ireland, the primary policy should be that any available resources should be used to prevent the spread of this species to new sites."* In addition to the measures detailed below in relation to aquatic species, the following shall apply to all works on and adjacent to the mudflats: • Vehicles, vessels, plant, equipment, PPE, construction materials or excavated material shall not be moved directly from areas known to contain Common Cordgrass, e.g. the mudflats in the vicinity of the approved Sustainable Transport Bridge and North Quays Development site, without first having been inspected

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<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>by the Ecological Clerk of Works (ECoW) and authorised by the Site Environmental Manager (SEM).

Any material excavated from the mudflats, e.g. for the construction of drainage outfalls, shall be stored in a location where it is not at risk of colonisation by Common Cordgrass and shall be reinstated as quickly as possible.</td></tr>
<tr><td>7.26</td><td>Aquatic Species

The use of barges during the construction of the proposed development poses the risk of the introduction of invasive alien species to the aquatic environment both in the vicinity of the works and in the wider Suir-Barrow-Nore Estuary. This has the potential to significantly affect the integrity of aquatic and intertidal habitats in the Zone of Influence. In order to minimise the risk of either the introduction or spread of aquatic IAS and thereby avoid negative impacts on these habitats, the owner or operator of the barge or barges shall:

• Provide documentary evidence (in the form of a completed and signed Marine Institute “Cleaning and Disinfection Declaration Form”) that the vessel was fully de-fouled within the 6 months immediately preceding its engagement in the construction of the proposed development; and,
• Submit travel records relating to the vessel's movements during, at a minimum, the 6 months immediately preceding its engagement in the construction of the proposed development.

In order to ensure full compliance with the above, authorisation to move the vessel to the construction area shall only be granted once the Ecological Clerk of Works (ECoW) has satisfied him/herself that the vessel does not pose a significant risk of importing aquatic IAS to the Suir-Barrow-Nore Estuary. He/she shall do so by:

• Boarding the vessel;
• Speaking with the skipper;
• Inspecting the relevant documents; and,
• Carrying out a final inspection of the vessel.

In relation to other construction activities, including pre-construction surveys and any other site inspections, the principles and appropriate measures in the IFI guidance document Biosecurity Protocol for Field Survey Work (IFI, 2010) shall be followed and shall form part of the Contractor's Biosecurity protocol.</td></tr>
<tr><td colspan="2">Specific Mitigation Measures - KER 8 Nationally Designated Sites</td></tr>
<tr><td>7.27</td><td>As explained in the assessment of impact above, due to the distances between the proposed development and the pNHAs in the Zone of Influence, the only complete source-pathway-receptor chains are those relating to water quality impacts, invasive alien species (IAS) and migratory or highly mobile species, i.e. fish species and Otter. The mitigation measures proposed in relation to each of those is already described in detail under KERs 1, 4, 5 and 7 above and are deemed sufficient to eliminate any risk of such impacts on these sites.</td></tr>
<tr><td colspan="2">Monitoring</td></tr>
<tr><td>7.28</td><td>Hydroacoustic Impacts

In order to allow for greater accuracy in the assessment of future plans and projects, it is recommended that hydroacoustic monitoring be undertaken for the full duration of the proposed development's construction. This monitoring should establish the ambient underwater noise levels in the estuary (and the rate of sound attenuation) and more accurately characterise the sound outputs in terms of both peak and root-mean-squared sound pressure level, as well as sound exposure level, at different frequencies arising from the different methods of pile driving and different types and sizes of piles. This monitoring shall be carried out by specialist underwater noise surveyors and the results will be frequently reviewed (at least fortnightly) by the Ecological Clerk of Works (ECoW).</td></tr>
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<tr><th>No.</th><th>Description</th></tr>
<tr><td>7.29</td><td>Record of Habitats
In order to maintain an accurate and precise record of changes to intertidal and fringing habitats, particularly mudflats and saltmarshes, a photographic record shall be made of these habitats. This record shall cover both sides of the river from 150m upstream of the new flood defence wall to 300m downstream. All photographs shall be taken at low tide, every 2 months, beginning 6 months prior to commencement of construction and finishing 12 months after completion.
In addition, in order to accurately and precisely record any change in the structure and composition of biological communities of hard and soft intertidal substrates, sampling and analysis of these habitats shall be carried out at 6 months, 1 year, 2 years and 5 years post-construction. To facilitate meaningful comparative analysis and evaluation of the impacts of the proposed development, the sampling and analysis should follow the methodology employed by BEC Consultants Ltd in carrying out the pre-planning benthic surveys on 15th March 2021 (see Brophy (2021) in Appendix 7.1).</td></tr>
<tr><td>7.30</td><td>Water Quality
Water quality monitoring will be undertaken in the River Suir, with monthly samples being taken from at least 6 months prior to commencement of construction until at least 24 months post-completion. Water samples will be taken from at least two locations. The final number and location of sampling points will be determined by the Site Environmental Manager (SEM). The results of the water quality monitoring programme will be reviewed by the SEM and the ECoW on an ongoing basis during construction. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation will be undertaken to identify the source of this non-compliance and corrective action will be taken where this is deemed to be associated with the proposed development.</td></tr>
<tr><td colspan="2">Implementation</td></tr>
<tr><td>7.31</td><td>In order to give effect to the mitigation prescribed in this EIAR, it should be a condition of any consent granted in respect of the proposed development that all of the mitigation, including monitoring and enforcement, prescribed in this EIAR be binding, during the construction phase, on the Contractor and, during operational phase, on WCCC. Accordingly, all of the mitigation prescribed herein shall be transposed into the Contract Documents for the construction of the proposed development.
During construction, all works must comply with relevant legislation and guidelines in order to reduce and minimise environmental impacts and to protect all ecological receptors. In particular, there must be full compliance with the following:
• The Schedule of Commitments.
• The mitigation prescribed in Chapter 7 of the EIAR and in the NIS.
• Any conditions which might be attached to the proposed development's planning consent.
• Any requirements of stakeholders and statutory bodies, e.g. the NPWS and IFI, including:
  o Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016).
• All applicable legislative requirements in relation to environmental protection.
• All relevant construction industry guidelines, including:
  o C532 Control of water pollution from construction sites: guidance for consultants and contractors (CIRIA, 2001).
• Any biosecurity requirements arising from the preceding points.
• The Transport Infrastructure Ireland (TII) and National Roads Authority (NRA) Environmental Assessment and Construction Guidelines, specifically:
  o Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes.
  o Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage for National Road Schemes.</td></tr>
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No.	Description
	o Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes. o Guidelines on the Management of Noxious Weeds on National Roads. o Guidelines for the Treatment of Noise and Vibration in National Road Schemes. o Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes. o Management of Waste from National Road Construction Projects. o Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan. This list is non-exhaustive. All environmental commitments/requirements and relevant legislation and guidelines which are current at the time of construction will be followed.
Environmental Management Plans	
7.32	**Environmental Operating Plan** Appendix 4.1 of this EIAR contains the Environmental Operating Plan (EOP) which shall be finalised by the Contractor, in agreement with Waterford City and County Council, prior to the commencement of the construction phase. The EOP is a document that outlines procedures for the delivery of environmental mitigation measures and for addressing general day-to-day environmental issues that can arise during the construction phase of developments. Essentially the EOP is a project management tool. It is prepared, developed and updated by the Contractor during the construction stage and will be limited to setting out the detailed procedures by which the mitigation measures proposed as part of the EIAR and NIS and arising out of the Board's decision (if approving the proposed development) will be achieved. The EOP will not give rise to any reduction of mitigation measures or measures to protect the environment. Before any works commence on site, the Contractor will be required to prepare an Environmental Operating Plan (EOP) in accordance with the TII/NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIAR and measures stipulated in the planning conditions. Details within the plan will include, as a minimum: • All environmental commitments and mitigation stipulated in the planning documentation in respect of the proposed development, including sediment controls and other measures to ensure that water quality in the River Suir and Waterford Harbour is not degraded. • Any requirements of statutory bodies such as the NPWS and IFI, including adherence to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016). • A detailed Biosecurity Protocol. • A list of all applicable legislative requirements in relation to environmental protection and a method of documenting compliance with these requirements. • Outline methods by which construction activities will be managed in such a manner as to avoid, reduce or remedy potential negative impacts on the environment. To oversee the implementation of the EOP, the Contractors will be required to appoint a person to ensure that the mitigation measures included in the EIAR, the EOP and the statutory approvals are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly. The EOP has been appended (Appendix 4.1). This is a preliminary document, which will be updated and finalised by the successful Contractor. Appended to the EOP are the following constituent plans, also to be finalised by the Contractor:

No.	Description
	Appendix A: Construction Environmental Management Plan (CEMP) **Appendix B:** Construction and Demolition Waste Management Plan (CDWMP) **Appendix C:** Incident Response Plan (IRP) Each of these plans is discussed in the following sections. The obligation to develop, maintain and implement the EOP and all of the above-listed plans will form part of the contract documents for the construction phase.
7.33	**Construction Environmental Management Plan** Prior to any demolition, excavation or construction a Construction Environmental Management Plan (CEMP) will be produced by the successful contractors for each element of the proposed development. The CEMP will set out the Contractor's overall management and administration of the construction project. A Construction Environmental Management Plan has also been prepared as part of this EIAR, see Appendix A of Appendix 4.1. The CEMP will be developed by the Contractors during the pre-construction phase, to ensure commitments included in the statutory approvals are adhered to, and that it integrates the requirements of the Environmental Operating Plan (EOP). The CEMP will contain the following information of general importance: • An overview of the proposed development. • An organisational chart illustrating the structure of the Contractor's project team and the duties and responsibilities of the various members. • The Contractor's communications strategy. • The contact details of relevant persons/entities, e.g. the Safety Officer, the Site Environmental Manager and the emergency services. • A list of the documents which will have informed the CEMP, including all relevant legislation and construction/environmental guidelines. In relation to environmental management, the CEMP will provide and full list of the Contractor's environmental commitments and will detail the Contractor's approach to the following: • Details of working hours and days. • Details of emergency plan - in the event of fire, chemical spillage, cement spillage, collapse of structures or failure of equipment or road traffic incident within an area of traffic management. The plan must include contact names and telephone numbers for: Local Authority (all sections/departments); Ambulance; Gardaí and Fire Services. • Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages). • Details of construction plant storage, temporary offices. • Traffic management plan (to be developed in conjunction with the Local Authority – Roads Section) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic; programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements; • Truck wheel wash details (including measures to reduce and treat runoff). • Dust management to prevent nuisance (demolition & construction). • Control of sediment, run-off, erosion and pollution. • Noise and vibration management to prevent nuisance (demolition & construction). • Landscape management. • Management of contaminated land and assessment of risk for same by suitably qualified, trained and licenced personnel. • Management of waste arising from construction and demolition.

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>

Minimisation of artificial lighting and shading.
Management of risk from invasive alien species
Stockpiles.
Project procedures & method statements for:

Site clearance, site investigations, excavations
Diversion of services.
Excavation and blasting (through peat, soils & bedrock).
Piling.
Temporary hoarding & lighting.
Borrow Pits & location of crushing plant.
Storage and Treatment of peat and soft soils.
Disposal of surplus geological material (peat, soils, rock etc.).
Earthworks material improvement.
Protection of watercourses from contamination and silting during construction.
Works from a barge, including protection of watercourses from contamination when working in-river

Site Compounds.
Monitoring, inspection and auditing of the Contractor's compliance with his/her environmental commitments.

The production of the CEMP will also detail areas of concern with regard to Health and Safety and any environmental issues that require attention during the construction phase. Adoption of good management practices on site during the construction and operation phases will also contribute to reducing environmental impacts.
</td></tr>
<tr><td>7.34</td><td>
Construction and Demolition Waste Management Plan
The CDWMP sets out the Contractor's strategy (and measures required) to ensure that waste arising during the construction and demolition phase of the proposed development will be managed and disposed of in a way that ensures the provisions of European and Irish waste legislation (particularly the Waste Management Acts 1996 – 2011) are complied with, and to ensure that waste is managed in accordance with waste hierarchy insofar as possible.
The finalised CDWMP will contain the following information:

Material transport routes;
Methods by which construction works shall be managed in accordance with the relevant legislative instruments, including but not limited to:

An analysis of the different waste streams expected to be generated;
A demolition plan, with the purpose of ensuring that demolition occurs in an orderly fashion so that the re-use and recycling of the resultant materials is given due priority;
Details of waste storage (e.g. skips, bins, containers) to be provided for different waste streams and collection times;
Details of where and how materials are to be disposed of, i.e. landfill or other appropriately licensed waste management facility;
Details of storage areas for waste materials and containers;
Details of how unsuitable excess materials will be disposed of, where necessary; and
Details of how and where hazardous wastes, such as contaminated land, hydrocarbons and other hazardous substances, are to be stored and disposed of in a suitable manner;

</td></tr>
</table>

No.	Description
	• Estimates of waste management costs; • Specific waste management objectives for the project; • Identification of the roles and responsibilities of the relevant personnel regarding waste management; • Procedures for communication and training in relation to on-site waste management; • Record keeping procedures; and • Details of an audit system to monitor implementation of the CDWMP. The CDWMP is appended to the EOP (i.e. Appendix B of Appendix 4.1). The plan shall be finalised by the successful Contractor, in agreement with WCCC, and in accordance with TII's guidelines on *The Management of Waste from National Road Construction Projects* (2017), the TII *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan* (2007) and the Department of the Environment, Housing and Local Government's *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects* (2006). This will be a live document, which will be amended and updated to reflect the policy context, as well as conditions on site, as the construction of the proposed development progresses.
7.35	**Incident Response Plan** The Incident Response Plan (IRP) describes the procedures, lines of authority and processes that will be followed to ensure that incident response efforts during the construction stage of the proposed development are prompt, efficient, and appropriate to particular circumstances. The Contractor will finalise the IRP prior to the commencement of the proposed works to include the following information, at a minimum: • Contact names and telephone numbers for the local authority, i.e. WCCC (all sections and departments), An Garda Síochána and ambulance and fire services; and, • Method statements for weather forecasting and continuous monitoring of water levels in the River Suir and Waterford Harbour. The plan must outline how the Contractor will respond to forecasted flood events, including but not limited to, details of removal of site materials, fuels, tools, vehicles and persons from flood zones. • The measures to be taken to avoid or reduce the incident risk potential; • Reference to the method statement and management plans for construction activities, insofar as they are relevant for the purposes of mitigating against health and safety and pollution incidents; • Procedures to be adopted to contain, limit and mitigate any adverse effects, as far as reasonably practicable, in the event of a health and safety or pollution incident; • Persons responsible for dealing with incidents and their contact details; • Procedures for alerting key staff, appropriate emergency services, authorities, the Employer's Representative and clean-up companies, where required, and contact details of same; • Procedures for notifying relevant statutory bodies, environmental regulatory bodies, local authorities and local water and sewer providers of pollution incidents, where required, and contact details of same; • Standby / rota systems; and • The types and location of emergency response equipment available and appropriate personal protective equipment to be worn.

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>An IRP has been appended to the EOP (i.e., Appendix C of Appendix 4.1). The document in its current form will be finalised by the successful Contractor prior to the commencement of the construction phase of the proposed development.</td></tr>
<tr><td>7.36</td><td>Site Environmental Manager

To ensure the successful development, implementation and maintenance of the EOP, the Contractor will appoint an independent Site Environmental Manager (SEM). He/she must possess training, experience and knowledge appropriate to the role, including a National Framework of Qualifications (NFQ) Level 8 qualification (or equivalent) or other acceptable qualification in environmental science, environmental management, hydrology or engineering. The principal functions of the SEM will be to ensure that the mitigation prescribed in this NIS, the EIAR, the CEMP, the EOP and the CDWMP, is fully and properly implemented and to monitor the construction stage from an environmental perspective. The SEM will also provide independently verifiable audit reports.

Separate from the on-going and detailed monitoring carried out by the Contractor as part of the EOP, the SEM will carry out the inspection and monitoring described below on behalf of WCCC. The results will be stored in the SEM's monitoring file and will be available for inspection or audit by WCCC, the NPWS or IFI.

• Daily reporting on weather and flood forecasting and daily reporting on the monitoring of water levels in the Lower River Suir.
• Weekly inspections of the principal control measures described in the CEMP and reporting of findings to the Contractor.
• Daily inspections of surface water treatment measures.
• Daily inspections of all outfalls to watercourses.
• Daily visual inspections of watercourse to which there are discharges from the works and those in the vicinity of construction works.
• Weekly inspections of wheel-wash facilities.
• Daily monitoring of any stockpiles.

Auditing at least six times per quarter of the Contractor's EOP monitoring results.</td></tr>
<tr><td>7.37</td><td>Ecological Clerk of Works

In order to ensure the successful development and implementation of the CEMP, an independent Ecological Clerk of Works (ECoW) will be appointed. The ECoW must possess training, experience and knowledge appropriate to the role, including:

• An NFQ Level 8 qualification or equivalent or other acceptable qualification in ecology or environmental biology; and,
• Demonstrable experience in the protection of European sites.

The principal functions of the ECoW are:

• To provide ecological supervision of the construction of the proposed development and thereby ensure the full and proper implementation of the mitigation prescribed in Chapter 7 Biodiversity of the EIAR and in the NIS;
• To highlight the sensitivity of 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)', and the need to avoid disturbance of the same, during tool-box talks and other relevant communications with site personnel.
• To regularly review the outcome of the ongoing monitoring during construction (as described in Section 5.2.7 of the NIS)
• To carry out inspections of all vehicles, vessels, plant, equipment, PPE, construction materials or excavated materials prior to their movement from areas known to contain invasive alien species; and,
• To carry out weekly inspections and reporting on the implementation of the Contractor's Biosecurity Protocol.

During the preparation of the Contractor's EOP, the SEM may, as appropriate, assign other duties and responsibilities to the ECoW. In exercising his/her functions, the ECoW will be required to keep a monitoring file and this will be made available for inspection or audit by WCCC, the NPWS or IFI at any time.</td></tr>
</table>

19.6 Mitigation and Monitoring Measures for Soils and Geology

Table 19.5 Mitigation and Monitoring Measures for Soils and Geology

No.	Description
Mitigation by Design	
8.1	The construction works will be carried out with the least feasible disturbance of soils. The main flood defence elements, sheet pile wall and remedial works to the existing quay wall, directly avoid any requirement for excavation of in-situ ground and creation of waste.
8.2	The quantity of imported backfill for the gap between the sheet piles and the existing quay wall (where sheet piles are installed on the riverside), is minimised by design, as the alignment of the sheet pile wall was carefully selected as close as possible to the existing wall without compromising wall stability. Sheet piles were designed to be constructed on the landside of the existing wall wherever the width of cess allowed for safe day-time works without impact to rail operations, thus further minimising the backfill quantity.
8.3	The amount of waste from the excavations required for constructing the drainage system is minimised by reusing approximately a half of this material as a non-structural fill to even out the ground level across the site, wherever possible.
8.4	The potential impacts (ground displacement/settlement) on the Dublin to Waterford railway line have been mitigated by design, whereby the works are designed at a sufficient distance from the line, and are such that no temporary or permanent excavation in immediate proximity to the rail line is required, with the exception of shallow trenching for the construction of the drainage system. The potential impacts to the mudflats and riverbed from further deterioration of the existing masonry quay wall are also mitigated by design through the construction of the sheet pile wall and backfill in front of the quay wall at the most critical locations.
Specific Mitigation Measures	
8.5	The construction works will be carried out with the least feasible disturbance of the soils, minimising the amount of excavated soil with the inert excavated soil will be re-used on site insofar as possible.
8.6	Approximately 1,650m^3 of excavated ground material will be exported from the site. In addition to this, approximately 720 m^3 of construction and demolition waste will be generated during the demolition of the handrails and the upper parts of the existing quay wall which will be exported from site. The quantity is very small given the scale of the project, and will be disposed of by the Contractor who will ensure that all subsurface materials excavated during the construction phase of the proposed development are managed in accordance with the relevant waste management legislation. The successful Contractor will ensure that all subsurface materials are removed from the site and sent to authorised waste management facilities (i.e. which hold all relevant, valid permits / licences) which accept the corresponding types of waste. The contractor will be required to submit a Construction and Demolition Waste Management Plan (CDWMP) to the local authority for approval, which should address all types of material to be disposed of. The contractor will undertake the environmental testing of the material to be disposed of in order to determine the waste acceptability characteristics.
8.7	All imported material will be sourced from the nearest possible locations. A number of suitable active quarries with all necessary statutory consents exist across County Waterford and southwest County Wexford, such as Oaklands Quarry in Ballykelly, New Ross, Co. Wexford and Cappagh Quarry in Cappagh, Dungarvan, Co. Waterford. Both quarries are accessible from the N25 which links to the site of proposed development via the R448 Terminus Street.

No.	Description
8.8	A project-specific Construction Environmental Operating Plan (CEMP) will be prepared for the development by the Contractor for approval by WCCC. It will be maintained by the Contractor for the duration of the construction phase. The CEMP will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the site will be trained in the implementation of the procedures. As a minimum, the CEMP for the proposed development will be formulated in consideration of the standard best practice. The CEMP will include a range of site-specific measures which include: • Safety measures for working from barges in-river, including but not limited to risk of pollutants from the machinery stationed on the barge and operating with bulk materials such as backfill gravel on the barge; • Runoff will be controlled and treated to minimise impacts to groundwater and River Suir. • Temporary storage of any contaminated material on-site shall be carefully managed so as to limit any risk of contaminated surface water runoff leaving the site or infiltrating to groundwater. Runoff from the material shall be directed to a lined pond or temporary sewer/tank and the water shall be disposed of off-site for treatment at an appropriate licenced facility in accordance with the relevant waste management legislation. Alternatively, the material shall be covered while stored to remove the risk of surface water contamination. • All hazardous materials will be stored within secondary containment, designed to retain at least 110% of the storage contents. Temporary bunds for oil/diesel storage tanks will be used on the site during the construction phase. • The successful Contractor will ensure that spill kits and hydrocarbon absorbent packs are stored in the site compound, and that operators will be fully trained in the use of this equipment. • The successful Contractor will ensure that silt and sediment barriers are installed (and maintained in proper working order) at the perimeter of earthworks areas to limit transport of erodible soils to watercourses. • Where soils are being excavated and removed from site, the successful Contractor will ensure that dust generation will be avoided, by damping down material during excavation and loading onto trucks for off-site removal, if necessary. • Safe materials handling of all potentially hazardous materials will be emphasised to all construction personnel employed during construction, including the usage of appropriate PPE. The successful Contractor will prepare an Incident Response Plan (IRP) which outlines measures to be implemented to prevent and address spillages of hazardous substances.

19.7 Mitigation and Monitoring Measures for Hydrogeology

Table 19.6 Mitigation and Monitoring Measures for Hydrogeology

No.	Description
9.1	A project-specific Environmental Operating Plan (EOP) and a Construction Environmental Management Plan (OCEMP) have been prepared and appended to Chapter 4 of this EIAR (see Appendix 4.1 and 4.1A respectively). They will be maintained by the Contractor for the duration of the construction phase. The EOP will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the site will be trained in the implementation of the procedures. As a minimum, the EOP for the proposed development will be

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>formulated in consideration of the standard best practice. The EOP will include a range of site -specific measures that include:
The successful Contractor will ensure that spill kits and hydrocarbon absorbent packs are stored in the site compound, and that operators will be fully trained in the use of this equipment.
Earthworks shall be carried out such that surfaces promote runoff and prevent ponding and flooding.
Runoff will be controlled and treated to minimise impacts to surface and groundwater.
Temporary pumping of groundwater, if required, shall be treated by means of a temporary sedimentation tanks prior to discharge
All hazardous materials will be stored within secondary containment designed to retain at least 110% of the storage contents.
Temporary bunds for oil/diesel storage tanks will be used on the site during the construction phase.
Contaminated material will be disposed of off-site for treatment at an appropriate licensed facility in accordance with the relevant waste management legislation. Alternatively, the material shall be covered while stored to remove the risk of surface water contamination.
Safe materials handling of all potentially hazardous materials will be emphasised to all construction personnel employed during construction.
Mitigation measures during the construction phase will include implementing best practice during excavation works to avoid sediment entering the River Suir (refer to Chapter 10 'Hydrology' of this EIAR for details).</td></tr>
</table>

19.8 Mitigation and Monitoring Measures for Hydrology

Table 19.7 Mitigation and Monitoring Measures for Hydrology

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td colspan="2">Construction Mitigation</td></tr>
<tr><td>10.1</td><td>As is normal practice with infrastructure projects, an Environmental Operating Plan (EOP) and Construction Environmental Management Plan will be prepared for the Flood Defences West and are included in Appendix 4.1 and Appendix 1.4 A, respectively. These will be developed by the selected contractor to suit the detailed construction methodology and allocate responsibilities to individuals in the construction team. In doing so, the measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the current drafts of the Plans is sufficient to allow an assessment of the anticipated impacts including residual impacts.
The following will be implemented as part of this plan:
An Incident Response Plan (see Appendix 4.1 C) will be finalised detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, non-compliance with any permit or license, or other such risks that could lead to a pollution incident, including flood risks.
All necessary permits and licenses for in stream construction work for provision of the flood defences will be obtained prior to the commencement of construction.
Inform and consult with Inland Fisheries Ireland and Waterways Ireland.</td></tr>
<tr><td>10.2</td><td>During construction, cognisance will have to be taken of the following guidance documents for construction work on, over or near water.</td></tr>
</table>

No.	Description
	• *Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites* (Eastern Regional Fisheries Board) • *Central Fisheries Board Channels and Challenges – The enhancement of Salmonid Rivers.* • *CIRIA C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors.* • *CIRIA C648 Control of Water Pollution from Constructional Sites.* • *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (TII, 2006).* Based on the above guidance documents concerning the control of construction impacts on the water environment, the following outlines the principal mitigation measures that will be adhered to for the construction phase, in order to protect all catchment, watercourse and ecologically protected areas from direct and indirect impacts:
General Mitigation Measures	
10.3	Site works will be limited to the minimum required to undertake the necessary elements of the project.
10.4	Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels or cut-off ditches.
10.5	Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and bunding.
10.6	Protection of waterbodies from silt load will be carried out through the use of gully silt/sediment filters and shallow berms in hardstanding areas to provide adequate treatment of runoff to watercourses.
10.7	Settlement tanks, silt traps/bags and bunds will be used. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap.
10.8	The anticipated site compound/storage facility will be fenced off at a minimum distance of 5m from the top of the edge of the quay wall/river edge. Any works within the 10m buffer zone will require measures to be implemented to ensure that silt laden or contaminated surface water runoff from the compound does not discharge directly to the watercourse. CEMP has been drafted and will need to be finalised by the appointed Contactor See the EOP and Construction Environmental Management Plan (CEMP) in Appendix 4.1 and 4.1 A of this EIAR for further detail.
10.9	Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with the TII document "*Guidelines for the crossing of watercourses during the construction of National Road Schemes*". All chemical and fuel filling locations will be contained within bunded areas and set back a minimum of 20m from watercourses.
10.10	Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner, off site, to prevent pollution.
10.11	The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses.
10.12	Water quality monitoring will be undertaken in the River Suir, with monthly samples being taken from at least 6 months prior to commencement of construction until at least 24 months post-completion. Water samples will be taken from at least two locations. The final number and location of sampling points will be determined by the Site Environmental Manager. The results of the water quality monitoring programme

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>will be reviewed by the Site Environmental Manager and Ecological Clerk of Works on an ongoing basis during construction. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation will be undertaken to identify the source of this non-compliance and corrective action will be taken where the this is deemed to be associated with the proposed development.</td></tr>
<tr><td colspan="2">Specific Mitigation Measures – Concrete Works</td></tr>
<tr><td>10.13</td><td>Remedial works to the existing masonry quay wall and increasing its height will require the use of in-situ concrete. The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. As the use of concrete cannot be avoided, the following control measures will be employed:
Hydrophilic grout and quick-setting mixes or rapid hardener additives shall be used to promote the early set of concrete surfaces exposed to water;
When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used;
Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters;
Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW);
The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if inclement weather is forecast such that precipitation may make it difficult to maintain a dry working area.
There will be no spills of concrete, cement, grout or similar materials hosed into surface water drains. Such spills shall be contained immediately and runoff prevented from entering the watercourse;
Concrete waste and wash-down water will be contained and managed on site to prevent pollution of all surface watercourses;
On-site concrete batching and mixing activities will only be allowed at the identified construction compound areas;
Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the manufacturer);
Chute washout will be carried out at designated locations only. These locations will be signposted. The Concrete Plant and all Delivery Drivers will be informed of their location with the order information and on arrival to site; and
Chute washout locations will be provided with an appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste in accordance with the Contractor's Waste Management Plan.</td></tr>
<tr><td colspan="2">Flooding</td></tr>
<tr><td>10.14</td><td>The Contractor will provide method statements for weather and tide/storm surge forecasting and continuous monitoring of water levels in the River Suir and Waterford Harbour. The Contractor will also provide method statements for the removal of site materials, fuels, tools, vehicles and persons from flood zones in order to minimise the risk to persons working on the site as well as potential input of sediment or construction materials into the river during flood events.</td></tr>
</table>

19.9 Mitigation and Monitoring Measures for The Landscape

Table 19.8 Mitigation and Monitoring Measures for The Landscape

No.	Description
11.1	There are no mitigation measures proposed for Chapter 11 The Landscape as part of the Flood Defences West.

19.10 Mitigation and Monitoring Measures for Noise and Vibration

Table 19.9 Mitigation and Monitoring Measures for Noise and Vibration

No.	Description
12.1	With regard to construction activities, best practice control measures for noise and vibration from construction sites are found within BS 5228 (2009 +A1 2014) *Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2*. Whilst day-time construction noise and vibration impacts are expected to be minimal and well within the criteria set out in this document, there are night-time works that have the potential to cause a temporary, significant impact. The contractor will ensure that all best practice noise and vibration control methods will be used, where practicable in order to minimise emissions to external noise sensitive locations. In this regard, various mitigation measures can be considered and applied during the construction of the proposed development, such as: • No plant used on site will be permitted to cause an ongoing public nuisance due to noise; • The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations; • Where practicable vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order; • Compressors will be attenuated 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; • Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use; • All items of plant will be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures; Limiting the hours during which site activities which are likely to create high levels of noise or vibration are permitted
12.2	Furthermore, it is envisaged that a variety of practicable noise and vibration control measures will be employed. These may include: • Selection of plant with low inherent potential for generation of noise and/ or vibration; • Erection of good quality site hoarding on the landward side of the main works which will act as a noise barrier to general construction activity at ground level; • Situate any noisy plant as far away from sensitive properties as permitted by site constraints Erection of localised barriers as necessary or where practicable around noisy items of plant such as generators or high duty compressors, which is of particular importance during construction works that take place during the night-time.
12.3	Where practicable it is recommended that noise and vibration from construction activities to off-site residences be limited to the values set out in Table 12.2 and 12.8 of the Noise and Vibration EIAR Chapter.

No.	Description
	This may be achieved by undertaking noise and vibration monitoring at locations representative of the closest sensitive receptors. Noise monitoring should be conducted in accordance with the International Standard ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise. Vibration monitoring should be conducted in accordance with BS 6472 for human disturbance and BS ISO 4866:2010 for building damage.

19.11 Mitigation and Monitoring Measures for Air Quality and Climate

Table 19.10 Mitigation and Monitoring Measures for Air Quality and Climate

No.	Description
13.1	The proactive control of fugitive dust will ensure the prevention of significant emissions. The key aspects of controlling dust are listed below. These measures will be incorporated into the overall Construction Environmental Management Plan (CEMP) prepared in respect of the proposed development. In summary, the measures which will be implemented will include: • Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic. • Any road that has the potential to give rise to fugitive dust will be regularly watered, as appropriate, during dry and/or windy conditions. • Vehicles exiting the site shall make use of a wheel wash facility where appropriate, prior to entering onto public roads. • Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates. • Public roads outside the site will be regularly inspected for cleanliness and cleaned as necessary. • Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods. • During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions. • During any demolition processes, water suppression should be used, preferably with a hand-held spray. Only the use of cutting, grinding or sawing equipment fitted or used in conjunction with a suitable dust suppression technique such as water sprays/local extraction should be used. • Drop heights from conveyors, loading shovels, hoppers and other loading equipment should be minimised, if necessary fine water sprays should be employed. At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

19.12 Mitigation and Monitoring Measures for Archaeological and Cultural Heritage

Table 19.11 Mitigation and Monitoring Measures for Archaeological and Cultural Heritage

No.	Description
Archaeology	
14.1	In order to ameliorate any negative impacts upon the archaeological resource, a full intertidal and wade/dive survey will be carried out along the sections of the existing quay wall to be directly impacted by the works and at the location of the upgraded and proposed outfalls. The survey will include a photogrammetry survey of the wall to be demolished (from Ch.350 to Ch.900), along with the mapping and recording of the former landing stages. All timber landing stages will be avoided during the course of works. The survey will also include a metal detecting survey and all works will be carried out by a suitably qualified underwater archaeologist, under licence to the National Monuments Service of the DoHLGH.
14.2	All ground disturbances associated with the works along the River Suir will be monitored by a suitably qualified underwater archaeologist. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).
14.3	All ground disturbances associated with excavations within the car park associated with the existing train station will be monitored by a suitably qualified archaeologist. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).
Cultural Heritage	
14.4	The section of the iron railway bridge that currently occupies the works compound will be left in-situ and undisturbed by contractors.

19.13 Mitigation and Monitoring Measures for Architectural Heritage

Table 19.12 Mitigation and Monitoring Measures for Architectural Heritage

No.	Description
12.1	There are no mitigation measures proposed for Chapter 11 The Landscape as part of the Flood Defences West.

19.14 Mitigation and Monitoring Measures for Material Assets and Land

Table 19.13 Mitigation and Monitoring Measures for Material Assets and Land

No.	Description
16.1	During construction, the following mitigation measures are proposed for the Waterford Flood Defences West: • Measures to control the production of dust will be put in place by the Contractor (refer to Chapter 13 Air Quality and Climate which presents a series of measures to control dust);

No.	Description
	• Noise mitigation will be provided during construction of the development. Measures to mitigate noise impacts on sensitive receptors are detailed within Chapter 12 Noise and Vibration. The Contractor will work within stringent construction limits and guidelines to protect residential and commercial amenities. • The upgrade works to the existing drainage system along the railway corridor west of Plunkett Station will be designed to ensure that the current drainage situation will not be impacted and there will be no increased risk of flooding as a consequence of the proposed development; • Prior to any excavation works, a segment of the ground will be surveyed via a CAT scan and a shallow slit trench will be excavated in order to confirm the position of utilities. • Any services that are interfered with as a result of the proposed development will be repaired / replaced without unreasonable delay. • A site plan will be prepared showing the location of all surface water drainage lines and proposed discharge points to surface water. This will also include the location of all existing and proposed surface water protection measures, including best practice measures such as monitoring points, sediment traps, settling basins, interceptors etc. All construction works will be temporary and will be carried out in line with best practice guidelines, thus minimising the impacts to the receiving communities. The Contractor will work within stringent construction limits and guidelines to protect surrounding amenities.

APPENDIX B

Construction and Demolition Waste Management Plan

Prepared by
Roughan & O'Donovan
Arena House, Arena Road, Sandyford, Dublin 18
Tel: +353 1 2940800 Fax: +353 1 2940820
Email: info@rod.ie www.rod.ie

WATERFORD CITY PUBLIC
INFRASTRUCTURE PROJECT

Comhairle Cathrach & Contae Phort Láirge
Waterford City & County Council

FLOOD DEFENCES WEST

Construction and Demolition Waste Management Plan

October 2021

WPIP-ROD-ENV-S1_AE-RP-EN-400050_[S3-P01] W Flood Def CDWMP

Client:
Waterford City & County Council
35 The Mall
Waterford

ROD
ROUGHAN & O'DONOVAN

Waterford City Public Infrastructure Project

Flood Defences West

Construction and Demolition Waste Management Plan

TABLE OF CONTENTS

1.0 INTRODUCTION

This Construction and Demolition Waste Management Plan (CDWMP) has been developed to ensure that waste arising on-site during the construction and demolition phase of the Waterford City Public Infrastructure Project - Flood Defences West will be managed and disposed of in a way that ensures the provisions of the Waste Management Acts, 1996-2011 and associated Regulations (1996-2011) are complied with and to ensure that optimum levels of reduction, re-use and recycling are achieved.

This CDWMP has been prepared for the provision of waste management for the construction phase of the Flood Defence West, taking into account the many guidance documents on the management and minimisation of construction and demolition waste, including:

- DEHLG (2006) *Best Practice Guidelines on the Preparation of Waste Management Plans for construction and Demolition Projects*. Department of Environment, Heritage and Local Government, Dublin;
- Provisions of the Waste Management Acts, 1996-2011 and associated Regulations;
- Construction Industry Research and Information Association (CIRIA) document 133 Waste Minimisation in Construction;
- TII (2014) *Guidelines for the Management of Waste from National Road Construction Projects*. Transport Infrastructure Ireland, Dublin; and,
- National Construction & Demolition Waste Council (NCDWC) 2006 *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects.*

This plan is intended to be a working document and has been prepared to inform the Construction and Demolition Waste Management Plan which, in turn, will form an integral part of the Environmental Operating Plan (EOP) for the proposed development.

This document is preliminary in nature as it has been prepared at a stage when quantities are based on the design developed to a sufficient level of detail to inform the environmental impacts to be assessed in the Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS). However, changes may occur during detailed design stages which may alter the volumes of waste.

All materials used during construction will be imported. Minimal quantities of soils will be excavated during construction.

Prior to the commencement of construction works, a Waste Management Co-ordinator (WMC) (who may also be the Site Environmental Manager) will be appointed by the Contractor to assume responsibility for the further development of the CDWMP and the management and treatment of all waste materials created during the construction of the Flood Defences West.

The Contractor's CDWMP must contain (but not be limited to) the following measures:

- Details of waste storage (e.g. skips, bins, containers) to be provided for different waste and collection times;

- Details of where and how materials are to be disposed of, i.e. landfill or other appropriately licensed waste management facility;
- Details of storage areas for waste materials and containers;
- Details of how unsuitable excess materials will be disposed of, where necessary;
- Details of how and where hazardous wastes such as oils, diesel and other hydrocarbon or other chemical waste are to be stored and disposed of in a suitable manner; and
- Details of locations.

Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects were published in 2006 by the National Construction & Demolition Waste Council (NCDWC). These Guidelines outline the issues that need to be addressed at the pre-planning stage of a development all the way through to its completion. These Guidelines have been followed in the preparation of this report.

2.0 DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Project Description

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City, refer to Figures 1.1 in Volume 3 of the EIAR. The development extends for approximately 1km to the west and 100m to the east of the Waterford (Plunkett) Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor located to the north of the proposed development.

The proposed flood defence measures are for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval, eliminating the risk of flooding to the Transport Hub.

A design flood level of +4.0m OD (metres above Ordnance Datum Malin) is proposed for this development. The design flood level has been based on a flood with an annual exceedance probability of 0.5% and allowances for climate change and isostatic tilt as noted below.

The design (top-of-wall) level for the proposed flood protection measures is +4.30m OD (metres above Ordnance Datum Malin). The following allowances are integrated into the proposed height of the flood defence walls:

- 0.5% annual exceedance probability combined tidal-fluvial event (+3.45 m OD);
- An additional 0.55m to allow for climate change and isostatic tilt; and,
- 0.30m freeboard to the wall, including local wave wake effects.

An overview of the structural elements of the proposed development is provided from east to west below:

An overview of the structural elements of the proposed development is provided from east to west below, and should be read in conjunction with Figures 4.1 to 4.6 in EIAR Volume 3:

- Construction of c.365m of underground flood defences (an impermeable shallow trench approx. 0.35m in width and up to 3m in depth) from Ch.0.0 to Ch.365 to cut off the potential groundwater seepage during high tide events It is possible that parts of these underground flood protection measures may be omitted during detailed design (see Figures 4.2 and 4.3 in Volume 3) or may be implemented on a phased basis depending on the ongoing groundwater monitoring results.
- Total of c.185m of overground flood defences from Ch.0.40 to Ch.210 consisting of:
    - c.170m of glass flood barrier on the river side of the road edge vehicular parapets on Rice Bridge roundabout and along the 3 roundabout arms (R680 Rice Bridge, R448 Terminus St. and R711 Dock Rd).
    - c.15m of demountable flood barriers on the R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.
- Remedial works to the existing quay wall from Ch.285 to Ch.360 by raising its height by 0.6m to 1.2m to conform with the design top-of-wall level of +4.30m OD.
- Construction of a sheet pile flood defence wall from Ch.360 to Ch.1090, with the top of wall at +4.30 mOD, to protect against overground flooding and underground groundwater seepage:
    - From Ch.360 to Ch.900 the sheet pile wall will be installed within the foreshore from the riverside, 1m from the front face of the existing quay wall. The space between the sheet pile wall and the front face of the existing quay wall will be filled with clean imported granular fill. The intertidal zone of the riverside sheet pile wall will be fitted with pre-cast concrete cladding material ("eco-seawall").
    - From Ch.900 to Ch.1090, the sheet pile wall will be installed on land from the landside, 1m behind the existing quay wall.
    - The demolition of minor localised section of existing quay wall (max length of 3m) will be required in order to connect the in-river sheet piles with the landside sheet pile walls at Ch.900.
- Construction of c.20m of underground isolation structure at Ch.1090, consisting of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event.

Drainage works will be carried out for the entire extents of the proposed flood defence measures i.e., from Ch.0.0 to Ch.1090 as shown in Figure 4.7 to Figure 4.11 in EIAR Volume 3:

- Remedial measures to the existing drainage outfalls to the River Suir from Ch.0.0 to Ch.1090 by extending them to reach an outlet within the new sheet pile wall, or to be retrofitted to pass through the new sheet pile wall, into the River Suir.
- In the vicinity of Plunkett Station, from Ch.0.0 to Ch.470, new trackside drainage and groundwater drains are included in the upgraded drainage works,

which will include a pumping station (at approx. Ch.390) and a new surface water outfall structure in the River Suir at Ch.390.

- From Ch.370 to Ch.1090, new drainage system will be installed for trackside drainage and also to allow groundwater cut -off behind the sheet pile wall to drain to the River Suir with 2 No. new outfalls to the River Suir terminating at the front face of the proposed flood defence sheet pile wall (at Ch 550 and Ch.900). The works will also include the construction of pumping stations at Ch.390 and Ch.550 respectively.
- Existing surface water outfalls at Ch.470 and Ch.490 which extend into the riverbed will be demolished to allow installation of the new flood defence wall; these will be replaced by new surface water outfall structures in the River Suir.
- Demolition of the existing quay wall to approximately 800mm below the existing ground level and removal of handrails from Ch.360 to Ch.900 where it is level with or above, the existing ground level. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level will be required in order to facilitate the construction of a surface water pumping station at Ch.380 (as shown in Figure 4.18 in EIAR Volume 3).
- All drainage outfalls (new and existing) will be fitted or retrofitted with non-return valves to prevent tidal water ingress.

Table 2.1 Overview of Proposed Flood Defences West

Chainage	Proposed Works
Ch.0.0 to Ch.365	Construction of an impermeable trench
Ch.0.40 to Ch.210	Construction of overground flood defences at Rice Bridge Roundabout.
Ch.285 to Ch.360	Remediation of existing quay wall
Ch.360 to Ch.1090	Construction of sheet pile flood defence wall
Ch.0.0 to Ch.1090	Drainage works

2.2 Construction Stage

It is anticipated that the construction of the proposed development will be progressed as a single construction contract with the construction phase lasting approximately 30 to 35 weeks.

2.3 Construction Procurement

It is envisaged that the construction of the proposed development will be tendered under a Public Works Contract for Civil Engineering Works Designed by the Employer.

3.0 WASTE MANAGEMENT STRAGETY

3.1 Scope

The Contractor will develop a CDWMP that will detail:

- Licensing of Waste Disposal;
- Site clearance;
- Excavations and disposal of materials;
- Measures to protect water quality;
- Importation, stockpiling and placing of fill;
- Management of drainage works to ensure no pollution of the River Suir;
- Construction vehicle management; and,
- Dust and noise abatement measures.

3.2 Waste and Recycling Management

The management of construction and demolition waste will reflect the waste management hierarchy, with waste prevention and minimisation being the first priority, followed by reuse and recycling. During site clearance and construction works, there are numerous opportunities for the beneficial reuse and recycling of materials. The subsequent use of recycled materials in reconstruction works also reduces the quantities of waste which ultimately needs to be consigned to landfill sites.

The Contractor will develop and implement a plan and manage all waste with a goal of achieving the waste hierarchy in accordance with the relevant statutory provisions as shown in Figure 3.1.

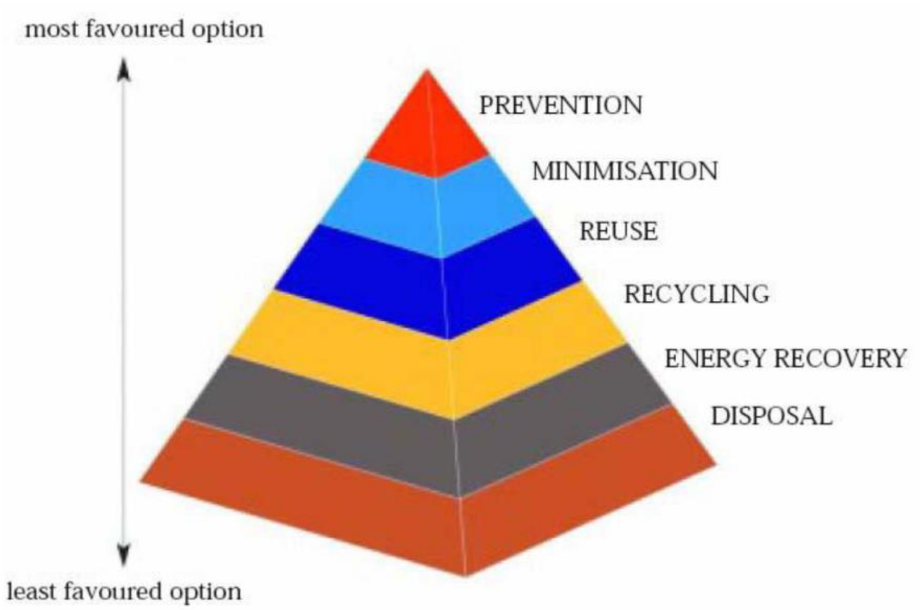

Figure 3.1 The Waste Management Hierarchy [DEHLG (1998) *Changing Our Ways*. Department of the Environment, Heritage and Local Government, Dublin]

Source Segregation

Wastes generated on the construction site will be identified and segregated according to their respective categories, as described by the European Waste Catalogue (EWC). Where possible, metal, timber, glass and other recyclable material will be segregated and removed off-site to a permitted/licensed facility for recycling.

In order to achieve this, designated waste storage areas will be created at the construction compound or other suitable locations for the storage of segregated wastes prior to transport for recovery/disposal at suitably licensed/permitted facilities. Suitably sized containers for each waste stream will be provided within the waste storage area and will be supervised by the WMC, who will be appointed by the Contractor. This will be the person responsible for the management of waste during the construction of the Flood Defences West. The number and sizing of containers will be agreed with Waste Contractors in advance of construction works commencing. Source segregation of waste will result in cost savings to the project as well as providing an environmentally sound route for the management of all construction and demolition wastes.

Re-use

Possibilities for re-use of clean, non-hazardous excavation material as fill on the site or in landscaping works will be considered following appropriate testing to ensure material is suitable for its proposed end use. During Ground Investigations (GI), samples were taken from exploratory holes and were tested at the Chemtest Accredited Laboratory in the UK. All samples have been classified as non-hazardous, falling within either inert WAC limits or increased inert WAC limits for non-hazardous landfills, except two samples which exceeded inert WAC limits and would classify for hazardous landfill. Some localised elevated levels of total organic carbon (TOC), chloride and heavy metals (Antimony, Mercury) were recorded, in specific locations close to rail tracks and the old landing stages. Asbestos was detected in a single sample with level detected <0.001% which is Non-Hazardous. Where excavated material is not to be reused within the works, the Contractor will endeavour to send material for recovery or recycling so far as is reasonably practicable. The Contractor will ensure that, if required, any off-site interim storage facilities for excavated material have the appropriate waste licences or waste facility permits in place.

Material Management

In order to prevent and minimise the generation of waste, the Contractor will be required to ensure that raw materials are ordered so that the timing of delivery, the quantity delivered, and the storage is not conducive to the creation of unnecessary waste. The Contractor, in conjunction with the material suppliers, will be required to develop a programme showing the estimated delivery dates and quantities for each specific material associated with each element of construction and demolition works. Following a "just-in-time" approach improves cash flow, better utilises storage space, reduces risk of environmental pollution events and reduces potential loss to theft and accidental damage as well as making the site safer.

It is essential that the planning, construction and demolition works are undertaken in close collaboration with waste management contractors, in order to determine the best techniques for managing waste and to ensure a high level of recovery of materials for recycling. The Contractor will be required to continuously seek to improve the waste management process on-site during all stages of construction and maximise opportunities for re-use and recycling where they exist. For example, in relation to waste packaging, the Contractor will seek to negotiate take-back of as much packaging waste as possible at source to ensure maximum recycling. The

CDWMP will be included as an agenda item at the weekly construction meetings. In addition, the plan will be communicated to the whole team (including the Client) at the monthly meetings. This will include any updates to earlier versions of the document.

Waste Auditing

The Contractor will record the quantity (in tonnes) and types of waste and materials leaving the site during the construction phase. The name, address and authorisation details of all facilities and locations to which waste and materials from the construction phase are delivered will be recorded along with the quantity of waste (in tonnes) delivered to each facility. Records will show all material recovered and disposed of.

The waste management strategy for the project will follow the accepted waste hierarchy and the Contract will implement the following types of measures to reduce waste and maximize opportunities for recycling:

- Wherever possible, materials for construction activities will be ordered as to require the minimum possible storage time;
- Materials will be ordered, where possible, in sizes to prevent wastage;
- Appointment of a WMC, who will be responsible for handling, storage and delivery of materials to the proposed development;
- Ensure that stored material is protected from damage from plant and environmental factors such as rain and wind;
- Secure storage areas to prevent unauthorised access;
- Establish a waste management compound to handle incoming waste from construction activities – this should facilitate the segregation of key waste streams to maximise the opportunity to re-use, recycle and return wastes generated on-site;
- Provide a separate secured area for dealing with hazardous waste; and,
- Provide separate facilities for the storage of fuels and chemicals.

3.3 Waste and Recycling Targets

The Contractor's CDWMP, waste handling and proposed construction methods should endeavour to achieve the following targets

- The re-use of all earthworks materials on site where possible;
- 100% recycling of surplus reinforcement and other metals, where possible; and,
- No contamination of skips.

3.4 Waste and Recycling Opportunities

The Contractor will seek opportunities, wherever possible, to reduce the amount of waste generated on site and maximize the potential for recycling materials in accordance with the waste hierarchy through the following:

- Storing materials in designated areas and separate from wastes to minimise damage;
- Returning packaging to the producer where possible;
- Segregating construction and demolition wastes into reusable, recyclable and non-recyclable materials;

- Reusing and recycling materials on site during construction where practicable;
- Recycling other recyclable materials through appropriately permitted/licensed contractors and facilities; and,
- Disposing of non-recyclable wastes to licensed landfills.

4.0 WASTE DISPOSAL LICENSING

4.1 Licensing Requirements

Under the Waste Management (Collection Permit) (amended) Regulations, 2016, a waste collection permit for appropriate EWC Code(s) and designations is required by a waste haulier to transport waste from one site to another. Compliance with the Waste Management (Shipments of Hazardous Waste in Ireland exclusively) Regulation, 2011 is also required for the transportation of hazardous waste by road. The export of waste from Ireland is subject to the requirements of the Waste Management (Shipment of Waste) Regulations, 2007. The Contractor will ensure that the transport and movement of all waste is carried out in compliance with these requirements.

Waste may only be treated or disposed of at facilities that are licensed to carry out that specific activity, *e.g.* chemical treatment, landfill or incineration, for a specific waste type. Records of all waste movements and associated documentation will also be held on-site. Generally, operators of waste management sites will facilitate a site visit and inspection of documentation if deemed necessary. Prior to any on-site recovery process, including the operation of mobile plant, an operator must apply to the governing local authority for a waste facility permit under the Waste Management (Facility Permit and Registration) Regulations, 2007. It is planned that waste activities at the site will comprise of source segregation, storage and collection and, therefore, it is highly unlikely that any waste licensable or waste permissible activity will be undertaken.

4.2 Exclusion from Legislation

The Directive on Waste contains a number of exclusions which make clear that certain materials are not subject to its requirements. A key exclusion affecting construction projects such as this development is set down in Article 2(1)(c). This states that the requirements of the EU legislation do not apply to:

"uncontaminated soil and other naturally occurring material excavated in the course of construction activities where it is certain that the material will be used for the purposes of construction in its natural state on the site from which it was excavated"

This provision is repeated in the Waste Management Acts, as amended by the European Communities (Waste Directive) Regulations, 2011 (SI No. 126/2011). Should materials generated by construction activities fall within this provision, they are not then subject to the other requirements of the EU or national waste legislation. This means that, for example, such materials are not defined as "waste", do not need to be handled by duly authorised waste collectors and do not need to pass to disposal or recovery facilities that are subject to waste licences or other equivalent form of statutory authorisation. In addition, the requirements of the Waste Hierarchy do not apply.

5.0 PROPOSED CONSTRUCTION METHODOLOGY AND MATERIAL USAGE

5.1 Site Preparation

The construction of the Flood Defences West will require site clearance as part of the development, mostly for setting up the temporary compounds. Any site clearance works will however be minimal as the works area typically consist of levelled rail cess and built-up area (car parks). Also, a significant portion of works includes driving sheet piles in river/mudflats for which minimal site preparation is required. For the construction of impermeable trench at Plunkett station, the works may include minor diversion or protection works of services and utilities, such as public lighting, power services, watermains, rising main, storm water, electricity, telecommunications, gas mains and traffic light services. Due to the nature of works it is envisaged that it will only be possible during the main construction works.

The Contractor's CDWMP will take the following into account:

- The extent of the areas to be cleared and the potential types and volumes of arisings;
- Statutory requirements; and
- Specific environmental requirements and seasonal requirements, e.g. in respect of Shad, Salmon and Lamprey.

5.2 Site Offices, Construction Compounds and Security

A construction compound will be required in the vicinity of the proposed development and is proposed and assessed as being located in the widened rail cess area approximately 300m northwest of the flood defences' westernmost point, in vicinity of the rail level crossing. An ancillary compound is proposed at the Sally Park depot under ownership of Iarnród Éireann. The location, size and suitability of the compound will ultimately be at the discretion of the contractor once it is located within the project boundary and site access is approved by the Local Authority. For the purpose of the Environmental Impact Assessment Report (EIAR), it has been anticipated that the construction compound will be located in the widened rail cess area as described above. The location and layout of the construction compound selected by the contractor will however have to incorporate the protection and mitigation measures outlined in the EIAR and conform to the requirements outlined in the Natura Impact Statement (NIS) and planning conditions.

The compound will include stores, offices, material storage areas, plant storage and parking for site and staff vehicles. This site is proposed to remain in place for the duration of the contract but may be scaled up or down during particular activities on site.

The storage of fuels, other hydrocarbons and other chemicals within the construction compounds will not be permitted within 10m of the River Suir. All fuel storage areas will be bunded to 110% of storage capacity to prevent spills and provide sufficient additional capacity in the event of rainfall occurring simultaneously. The compounds will also have appropriate levels of security to limit potential vandalism, theft and unauthorised access within the compounds.

Following completion of construction, the compound will be cleared and reinstated in the original form. Temporary buildings and containers, parking areas and waste material such as rubble, aggregates and unused construction materials will not be permitted to remain exposed on these sites and will need to be removed and disposed of appropriately.

5.3 Material Quantities

Table 5.1 below provides the estimated material quantity requirements for the proposed Flood Defences West.

Table 5.1 Resources to be used During Construction

Element	Resources
Earthworks	Installation of a sheet pile wall will not require excavation of waste material. Imported material to fill the gap between the sheet pile wall and the existing quay wall will be clean granular material Class 6, totalling approximately 2000m^3. Approximately 2,500m^3 of clean imported granular fill material Class 6, will also be required for drainage works.
Structural Works	The project will require import of steel sheet piles for construction of new flood defence walls as well as material for in-situ concrete for remedial works on the existing quay wall. Total length of sheet pile wall will be approximately 770m, with height of piles between 10 and 21m. The total surface of the sheet piles is assumed to be approximately 11,000m^2 with the total tonnage of approximately 1,400 tonnes. Approximately 1,500 m^3 of precast concrete eco-seawall panels (with depth of approximately 13 cm) will be attached to the riverside sheet pile wall. Approximately 50 m^3 of concrete will be used for remedial works (raising) to the existing quay wall. Minor quantity of reinforcement steel will also be imported. Up to approximately 350m^3 of lean mix concrete / grout will be required to infill the impermeable trench.
Drainage	Drainage pipes (approx. 1,310m), valves, manholes, 2 No. precast pumping chambers, 3 No. precast headwalls, handrails, riprap, stone mattresses etc. 70m^3 fill of concrete surround for pump chambers of the proposed pumping stations will be required.
Construction and Demolition Waste	The removal of the upper section of the existing wall to the level of 800mm below existing ground level will generate approximately 600 m^3 of waste. Material excavated during demolition of a small section of the quay wall for the purpose of joining the riverside and landside sheet piles, will amount to approximately 50m^3. Another approximately 100 m^3 of wall will be demolished during the construction of a pumping station. Up to c.350m^3 of waste material will be generated during shallow excavations for the impermeable trench. Approximately 2,600m^3 of in-situ ground and ballast will be excavated during the drainage outlet remediation works and other drainage works such as installation of filter drains, with approximately half of it expected to be used again as a backfill across the site for ground levelling purposes. As such, approximately 1,300m^3 of surplus excavation will be generated.

5.4 General Construction and Demolition Works

Quantities of general construction and demolition wastes are made up of waste such as wood, packaging, metals, plastics, bricks, blocks, canteen waste, some hazardous waste, *e.g.* oils, paints and adhesives. Site clearance and residual waste will be generated during the construction phase, primarily from the construction of the proposed development. A detailed estimate of the anticipated quantities of these materials will be provided in the detailed CDWMP following appointment of the Contractor at construction stage. The majority of the waste material generated on site of proposed development, however, will be reused.

An overview of the methods to manage the primary waste streams expected is presented below. The main types of construction waste produced will be:

Excavated material

Where short-term temporary storage is unavoidable, the method of storage of material will be key to its potential use as certain types of materials mud are likely to degrade if left uncovered in wet weather due to its low plasticity and silty nature.

Concrete

Waste concrete is likely to arise during the construction phase of the Flood Defences West, primarily through the demolition of a section of an existing masonry flood defence wall. It is proposed that waste concrete generated will be returned to the supplier for re-use. For every tonne of concrete waste that is recycled for aggregate in new concrete, significant savings are made in energy and carbon dioxide emissions. It also saves money by avoiding disposal costs, which continue to increase. Residual concrete waste will be source segregated and stored in designated containers at the waste storage area for subsequent separation and recovery at a remote facility.

Metals

Metal waste has a significant scrap value. Although it is now common practice for sites to segregate metals for reuse and recycling, there are still sites where metal is thrown away with general rubbish. One of the primary sources of metal waste is steel reinforcement. Wastage of steel reinforcement will be reduced by ordering made to measure steel from the manufacturer and detailed scheduling of all reinforced concrete structural elements. Steel reinforcement requirements are likely to be limited for the proposed development.

Skip hire companies may provide free skips for the storage of scrap metal on sites and this will be investigated prior to construction commencing. When metal storage containers are full, they will be removed by the waste storage contractor and sent to a metals recycling facility.

Timber

Timber waste will be stored separately as it is readily contaminated by other wastes and if it is allowed to rot will reduce the recyclability of other stored wastes. Any pallets will be returned to the supplier for re-use. Off-cuts and trimmings will be used in formwork where possible. A container for waste wood will be covered where possible and will be placed in the waste storage area. The waste wood will be collected by a waste contractor who will forward it to a wood recycling facility for chipping.

Treatment of timber with chemicals and the overuse of nails will be minimised and avoided as this will make it difficult to reuse/recycle the timber afterwards. The utilisation of reclaimed timber products will also be investigated.

Packaging and Plastic

Packaging waste can become a major problem on construction sites. Double handling will be avoided by segregating packaging wastes immediately after unwrapping. Many suppliers are now prepared to collect their own packaging for recycling, and this will also be investigated prior to works commencing. It is intended that, where possible, materials with recycled packaging will be purchased. Waste packaging will be segregated and stored in separate containers, preferably covered, in the waste storage area for collection by the waste management contractor and distribution to packaging recycling facilities.

Blocks, Bricks and Tiles

The careful storage of these raw materials will significantly reduce the volume of these wastes arising on site. The most likely wastes produced will be off-cuts, trimmings and waste arising from breakages. Every effort will be made to use broken bricks and off-cuts

Hazardous Wastes

All of the waste generated from construction phase of proposed development is likely to be of a non-hazardous origin, however there is potential to encounter hazardous waste on site due to the industrial history of the area. One area with potential for being characterised as hazardous is the excavated material below the car park, which will be excavated for the purpose of constructing the impermeable trench.

Prior to removal from the site, any hazardous waste identified will undergo a comprehensive waste assessment and classification by a suitably qualified person in accordance with the European Waste Catalogue and Hazardous Waste List. It should be noted that if non-hazardous waste becomes contaminated with hazardous waste the entire load will be considered hazardous. It is, therefore, critical to ensure that waste segregation areas are provided and are used properly to separate out hazardous, non-hazardous and inert waste arising. Hazardous wastes will be identified, removed and kept separate from other construction and demolition waste materials in order to avoid cross-contamination. Specific method statements detailing the necessary mitigation measures required during excavation, handling transportation and disposal of hazardous wastes encountered on the site will be prepared as required.

The likely disposal/treatment options for any hazardous wastes available to the Contractor will depend on the nature of the hazardous material and the concentration of parameters of concern. The costs associated with treatment and disposal will similarly vary depending on the concentration of parameters of concern and on the tonnage involved. There are several operators/facilities in operation within Ireland that could potentially accept the contaminated material depending upon the results of the Waste Acceptance Criteria testing or assist in the export of the material abroad for special treatment where required. Full details of the disposal route for hazardous wastes will be provided in the detailed CDWMP following the appointment of the contract and completion of the further investigations required.

Hazardous Liquids (Oils, Paints, Chemicals)

Hazardous liquid waste arising from the construction process will require careful handling. Oils, paints, bitumen, adhesives and chemicals will be kept in a separate contained storage area which will be locked when not in use. Hazardous liquids will be stored at least 10m from the River Suir. Lids will be kept on containers in order to avoid spillage or waste by evaporation. Waste oils, paints and chemicals, including the containers, will require careful handling and disposal. These will be stored in a containment tray with a capacity to contain 110% of the volume of the largest container.

Fuels and chemical will be stored in double-skinned containers or within a bund, i.e. an impervious structure with the capacity to contain 110% of the volume of the largest tank stored within it. All containers will be carefully labelled.

Food Wastes

Site staff generate food waste and packaging waste. Designated receptacles will be provided to allow for the segregation and storage of individual waste streams. These will include receptacles for food waste, *e.g*. brown bin for waste foods and peelings, dry recyclables, *e.g*. green bin for packaging, plastics, metals, wood, paper, cardboard and tetrapack, and residual bin, *e.g*. black bin for mixed food and packaging waste. Separate receptacles for the recyclable fractions may be provided such as plastics, metals, glass and this will be designed and detailed by the WMC in consultation with the selected waste management contractor.

Other Wastes (Residual)

Waste material other than those outlined above can constitute a significant proportion of the total waste generated by a construction site. This waste is normally made up of residual, non-recyclable waste such as soiled paper, cloth, cardboard or plastics, as well as food waste and general waste found on the site, including plastic bottles, bags, cans *etc*. Given the heterogeneous nature of this material, it is most important that residual waste is kept separate from the other waste streams to avoid contamination. This material will be stored in a dedicated container in the waste storage area. Container size and collection frequency will be assessed with waste management contractors as works proceed. All residual wastes will be dispatched to a suitably licensed facility for disposal. Other construction and demolition waste material will be collected in receptacles with mixed construction and demolition waste materials for subsequent separation and disposal at a segregation facility.

6.0 ASSIGNMENT OF RESPONSIBILITIES

A WMC will be appointed who will have overall responsibility for waste management on the site. The Employer (Waterford City and County Council) will receive summaries of any audit reports, which will be completed within three months of the end of each calendar year. The effectiveness and accuracy of the documentation may also be monitored on a regular basis via routine site visits. Following appointment of the preferred Contractor, the CDWMP will be updated in accordance with the final design and copies of the plan will be distributed to the Employer, the Site Manager and the site sub-contractors. The WMC appointed by the Contractor will be appropriately trained and experienced in all aspects of waste management. In addition he/she and the site crew must be in a position to:

- Distinguish reusable materials from material suitable for recycling;
- Ensure maximum segregation at source;
- Co-operate with site manager on best locations for stockpiling reusable material;
- Separate material or recovery; and,
- Identify and liaise with operators of recovery outlets.

The WMC will be responsible for educating all site staff, sub-contractors and suppliers about the available alternative to conventional waste disposal. Training will also be given to all site staff in materials management on sites. The WMC will continually identify waste minimisation actions on sites and this will be updated in the plan.

7.0 TRAINING

Copies of the CDWMP will be made available to all personnel on-site. All site personnel and sub-contractors will be instructed about the objectives of the plan and informed of the responsibilities that fall upon them as a consequence of its provisions. This is traditionally carried out during the induction process for new staff members. Where source segregation and material re-use techniques apply, each member of staff will be given instructions on how to comply with the CDWMP. Site notices will be designed to reinforce the key messages within the plan and will be displayed prominently for the benefit of staff.

8.0 WASTE RECORDS

When establishing the system for managing the details of all arisings, movement and treatment of construction and demolition waste in the CDWMP, the use of electronic tools should be considered to provide for convenient recording of information in a useful format such as "Smart – waste".

The Contractor will be required to arrange for full details of all arisings, movements and construction and demolition waste to be recorded during all stages of the proposed development. Each consignment of construction and demolition waste removed from the site will be documented in the form of a Waste Movement Record form, which will ensure full traceability of the material to its final destination. Separate record forms will be completed in respect to each waste transfer that takes place. The Contractor will also receive printed documents/records from waste disposal companies employed, quantifying the exact amount of waste material removed from site. The sheet from the disposal company also identifies how much material went to landfill and how much went for recycling. All such records will be retained in a designated location and made available for auditing of the CDWMP.

9.0 SUMMARY OF THE CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT PLAN

Waste will inevitably be generated during the construction and demolition phase of the Flood Defences West. It is intended that all steel and concrete will be imported for use within the project area. At this stage, it is anticipated that there will be excavated material for re-use on-site.

Other than spoil material from excavations, waste arisings during the construction phase will be minimised by the purchasing manager, who will time the ordering of materials so as to reduce the likelihood of over-purchase or damage during storage. Construction and demolition waste fractions will be segregated and stored on-site in designated areas or containers in the waste storage area prior to transport by licensed hauliers to facilities for segregation recycling and disposal.

A WMC will be appointed to ensure that the CDWMP is followed. Training will be given to all staff so that they are aware of the CDWMP and know their responsibilities.

Records will be kept to trace the inputs and outputs of the construction works at the site and this should allow the Employer to make informed decisions regarding waste management in the future. These records will be made available to the relevant local authorities and the EPA should it be required.

The design and implementation of the detailed CDWMP, in conjunction with the EOP for the Flood Defences West, will provide for the optimum planning/management and handling of waste generated by the project and will ensure that there will be no worse than a neutral or imperceptible impact from waste management practices during construction.

The contractor appointed to undertake the construction of the Flood Defences West will develop their own CDWMP based on their detailed plans, the requirements of this plan, the requirements of the EIAR, the requirements of the NIS and any commitments given as part of the project approval process and the Employer's requirements and specifications for executing the Flood Defences West.

APPENDIX C

Incident Response Plan

Prepared by
Roughan & O'Donovan
Arena House, Arena Road, Sandyford, Dublin 18
Tel: +353 1 2940800 Fax: +353 1 2940820
Email: info@rod.ie www.rod.ie

WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT

FLOOD DEFENCES WEST

Incident Response Plan

October 2021

WPIP-ROD-ENV-S1_AE-RP-EN-400055_[S3-P01] W Flood Def IRP

<u>Client:</u>
Waterford City & County Council
35 The Mall
Waterford

Waterford City Public Infrastructure Project

Flood Defences West

Incident Response Plan

TABLE OF CONTENTS

1.0 INTRODUCTION

This Incident Response Plan (IRP) describes the guidelines for procedures, lines of authority and processes that should be followed to ensure that incident response efforts are prompt, efficient, and appropriate to particular circumstances. It has been developed to provide the information that each employee may need to respond to an emergency and to handle it effectively.

2.0 OBJECTIVE OF PLAN

The primary objective of this document is to:

- Ensure the health and safety of workers and visitors along the site;
- Minimise any impacts to the environment and to ensure protection of the water quality and the aquatic species dependant on it;
- Protect property and operations at the proposed site and to minimise the impact on the continuity of business; and,
- Establish procedures that enable personnel to respond to incidents with an integrated multi-departmental effort and in a manner that minimises the possibility of loss and reduces the potential for affecting health, property and the environment.

3.0 RESPONSIBILITY

It is the responsibility of the Environmental Manager to maintain and update this IRP as required.

This IRP will be reviewed on an ongoing basis and amended, as necessary, when one or more of the following occur:

- Applicable regulations are revised;
- The Plan fails in an emergency;
- The project changes in its design, construction, operation, maintenance, or other circumstance in a way that materially increases the potential for impacts on the environment, workers or visitors to the site; and/or,
- Amendments are required by a regulatory authority.

4.0 OTHER PLANS

In 2019, Health Service Executive (HSE) prepared an Emergency Plan for the South East Region in accordance with the Government's Major Emergency Management Framework which include counties of Carlow, Kilkenny, Tipperary, Wexford and Waterford. This plan is available ONLINE at:

https://www.hse.ie/eng/services/list/3/emergencymanangement/area-mep/hse-emergency-management-area-5-emergency-plan.pdf

It details the initial contact that should be made in case of an emergency incident as well as those responsible for following up once an emergency event is declared. This plan may be referred to during both the construction and operation phases.

5.0 OUTLINE INCIDENT RESPONSE PLAN

Name and address of the Client:

Waterford City & County Council

35 The Mall

Waterford

The contact within the Client organisation is Peter Keane (tel. 0761 10 2788).

Site Location:

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City (see Appendix A Figure 1).

Overview of the activities on site:

The construction programme for the proposed development is 30 – 35 weeks.

An overview of the structural elements of the proposed development is provided from east to west below, and should be read in conjunction with Figures 4.1 to 4.6 in EIAR Volume 3:

- Site Setup and establishment of construction compounds within IÉ lands;
- Relocation of underground utilities, where required.
- Construction of c.365m of underground flood defences from Ch.0.0 to Ch.365
- Construction of c.185m of overground flood defences from Ch.0.40 to Ch.210 consisting of:
    - c.170m of glass flood barrier on the river side of the road edge vehicular parapets on Rice Bridge roundabout and along the 3 roundabout arms (R680 Rice Bridge, R448 Terminus St. and R711 Dock Rd).
    - c.15m of demountable flood barriers on the R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.
- Remedial works to the existing quay wall from Ch.285 to Ch.360 by raising its height by 0.6m to 1.2m.
- Construction of a sheet pile flood defence wall from Ch.360 to Ch.1090:
    - From Ch.360 to Ch.900 the sheet pile wall will be installed within the foreshore from the riverside, 1m from the front face of the existing quay wall. The space between the sheet pile wall and the front face of the existing quay wall will be filled with clean imported granular fill. The intertidal zone of the riverside sheet pile wall will be fitted with pre-cast concrete cladding material (“eco-seawall”).
    - From Ch.900 to Ch.1090, the sheet pile wall will be installed on land from the landside, 1m behind the existing quay wall.
    - The demolition of minor localised section of existing quay wall (max length of 3m) will be required in order to connect the in-river sheet piles with the landside sheet pile walls at Ch.900.
- Construction of c.20m of underground isolation structure at Ch.1090, consisting of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event.

Drainage works will be carried out for the entire extents of the proposed flood defence measures i.e., from Ch.0.0 to Ch.1090 as shown in Figure 4.7 to Figure 4.11 in EIAR Volume 3:

- Remedial measures to the existing drainage outfalls to the River Suir from Ch.0.0 to Ch.1090 by extending them to reach an outlet within the new sheet pile wall, or to be retrofitted to pass through the new sheet pile wall, into the River Suir.
- In the vicinity of Plunkett Station, from Ch.0.0 to Ch.470, new trackside drainage and groundwater drains are included in the upgraded drainage works, which will include a

pumping station (at approx. Ch.390) and a new surface water outfall structure in the River Suir at Ch.390.

- From Ch.370 to Ch.1090, new drainage system will be installed for trackside drainage with 2 No. new outfalls to the River Suir terminating at the front face of the proposed flood defence sheet pile wall (at Ch 550 and Ch.900). The works will also include the construction of pumping stations at Ch.390 and Ch.550 respectively.
- Existing surface water outfalls at Ch.470 and Ch.490 which extend into the riverbed will be demolished to allow installation of the new flood defence wall; these will be replaced by new surface water outfall structures in the River Suir.
- Demolition of the existing quay wall to approximately 800mm below the existing ground level and removal of handrails from Ch.360 to Ch.900. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level to facilitate the construction of a surface water pumping station at Ch.380 (as shown in Figure 4.18 in EIAR Volume 3).
- All drainage outfalls (new and existing) will be fitted or retrofitted with non-return valves to prevent tidal water ingress.
- All ancillary works.

Description of the proposed development and surrounding area:

The proposed development is located within the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny along the north bank of the River Suir in Waterford City, Co. Waterford. The R680 Rice Memorial Bridge and the Waterford railway station, Plunkett Station are located at the easternmost extent of the site of proposed development, while the Iarnród Éireann (IÉ) rail corridor and the Sallypark industrial site bound the development to the north. The River Suir and the existing quay wall run along the south of the site.

The proposed development consists of flood defence measures for the protection of critical infrastructure including the existing Plunkett Train Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval. The design flood level of the proposed flood protection measures is +4.0m OD (metres above Ordnance Datum), with the top-of-the-wall flood protection measures of +4.30m OD.

An overview of the structural elements of the proposed development is provided from east to west below, and should be read in conjunction with Figures 4.1 to 4.11 in EIAR Volume 3.

Chainage	Proposed Works
Ch.0.0 to Ch.365	Construction of an impermeable trench
Ch.0.40 to Ch.210	Construction of overground flood defences at Rice Bridge Roundabout.
Ch.285 to Ch.360	Remediation of existing quay wall
Ch.360 to Ch.1090	Construction of sheet pile flood defence wall
Ch.0.0 to Ch.1090	Drainage works

Potential Incidents:

Potential incidents requiring emergency response procedures:

- Fuel and oil spills;
- Road traffic accidents involving chemical or biological spills;
- Rail accidents whilst carrying out landside sheet pile installations within the Waterford to Dublin rail corridor
- Earth slippages;
- Extreme rainfall events, causing swelling of the River Suir

<table>
<tr><td colspan="3">

- Fires;
- Activities resulting in noise and vibration, air pollution, hazardous substances or impacts on water;
- Working within and in vicinity of River Suir
- Waste management; and,
- Discharge of effluent.

The Contractor will update the list of potential incidents based on their proposed construction methods and programme for the development of Flood Defences West and include, as a minimum, the following:

- The measures to be taken to reduce the risk potential;
- Procedures to be put in place to deal with the risk;
- Person responsible for dealing with incidents;
- Procedures for alerting key staff;
- Standby/rota systems;
- Clearly defined roles and responsibilities;
- Names of staff and contractors trained in incident response;
- The types and location of emergency response equipment available and appropriate personal protective equipment to be worn;
- A system of response coordination;
- Off-site support; and,
- Particular emergency service or persons to be notified in case of incident.

</td></tr>
<tr><td>Date and version of the plan:
April 2021</td><td colspan="2">Name or position of person responsible for compiling/approving the plan:
Barry Corrigan
Roughan & O’Donovan</td></tr>
<tr><td>Review Date:</td><td colspan="2">Date of next exercise:</td></tr>
<tr><td colspan="3">Objectives of the IRP:
To carry out the construction works in such a way as to avoid injury, health hazards or pollution incidents. However, should any such incident occur, procedures and measures will be implemented to contain, limit and mitigate the effects as far as reasonably practicable.</td></tr>
<tr><td colspan="3">List of external organisations consulted in the preparation of the IRP:
TBC by Contractor when preparing IRP</td></tr>
<tr><td colspan="3">Distribution of the IRP</td></tr>
<tr><td>Recipient</td><td>No. of copies</td><td>Version</td></tr>
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</table>

6.0 EXTERNAL CONTACTS

External Contacts		
Contact	**Office Hours**	**Out of Hours**
Waterford City Fire Station	(051) 849 982	(051) 849 982
Gardaí: Emergency	999 / 112	999 / 112

External Contacts		
Contact	**Office Hours**	**Out of Hours**
Gardaí: Waterford Divisional Headquarters Garda Station	(051) 305 300	(051) 305 300
University Hospital Waterford	(051) 848 000	(051) 848 000
EPA Regional Inspectorate Kilkenny	(056) 779 6700	-
Waterford City and County Council Emergency Planning Department	076 102020	0761 102020
ESB Networks	(021) 238 6555	1850 372 999
Bord Gáis	051 302 500 / 1850 20 50 50	1850 20 50 50
Waste Management Contractor	TBC	
Specialist Advice	TBC	
Specialist Clean up Contractor	TBC	
Waterford City and County Council	076 110 2020	0761 102020
Inland Fisheries Ireland		To be agreed with IFI
National Parks & Wildlife Service		To be agreed with NPWS

7.0 INTERNAL (CONTRACTORS) CONTACTS

Internal Contacts		
Contact	**Office Hours**	**Out of Hours**
Names and positions of staff authorised/trained to activate and coordinate the IRP	TBC	
Other Staff	TBC	
Managing Director	TBC	
Site Manager	TBC	
Health & Safety Manager	TBC	

8.0 CHEMICAL PRODUCT AND WASTE INVENTORY

Inventory of Chemical Products and Wastes						
Trade Name / Substance	**Solid / liquid / gas or powder**	**UN number**	**Maximum amount**	**Location marked on site plan**	**Type of containment**	**Relevant health and environmental problems**

Inventory of Chemical Products and Wastes						
Trade Name / Substance	**Solid / liquid / gas or powder**	**UN number**	**Maximum amount**	**Location marked on site plan**	**Type of containment**	**Relevant health and environmental problems**

9.0 POLLUTION PREVENTION EQUIPMENT INVENTORY

Inventory of Pollution Prevention Equipment (on- and off-site resources)			

10.0 DRAWINGS

Drawings of the proposed development are included in **Appendix A**.

Site Plan
Figure 4.1 - Location Plan

11.0 RESPONSE PLANNING

11.1 Incident Response Plan

The Contractor's Environmental Operating Plan (EOP) will include an Incident Response Plan, which will detail the controls to be adopted to manage the risk of pollution incidents and procedures to be followed in the event of any pollution incidents.

11.2 The Incident Response Plan will include the following, as appropriate:

- Reference to the Method Statements and Management Plans for other construction activities, insofar as they are relevant for the purposes of mitigating against health and safety and pollution incidents;
- Procedures to be adopted to contain, limit and mitigate any adverse effects, as far as reasonably practicable, in the event of a health and safety or pollution incident;
- Details of spill clean-up companies appropriate to deal with pollution incidents associated with the materials being used or stored on site.

- Procedures to be followed and appropriate information to be provided in the event of any incident, such as a spillage or release of a potentially hazardous material;
- Procedures for notifying appropriate emergency services, authorities, the Employer's Representative and personnel on the construction site;
- Procedures for notifying relevant statutory bodies, environmental regulatory bodies, local authorities and local water and sewer providers of pollution incidents, where required;
- Maps showing the locations, together with address and contact details, of local emergency services facilities such as police stations, fire authorities, medical facilities and other relevant authorities; and,
- Contact details for the persons responsible on the construction site and within the Contractor's organisation for pollution incident response.

11.3 Monitoring

The Contractor will investigate and provide reports on any health and safety or pollution incidents to the Employer's Representative, including, as appropriate:

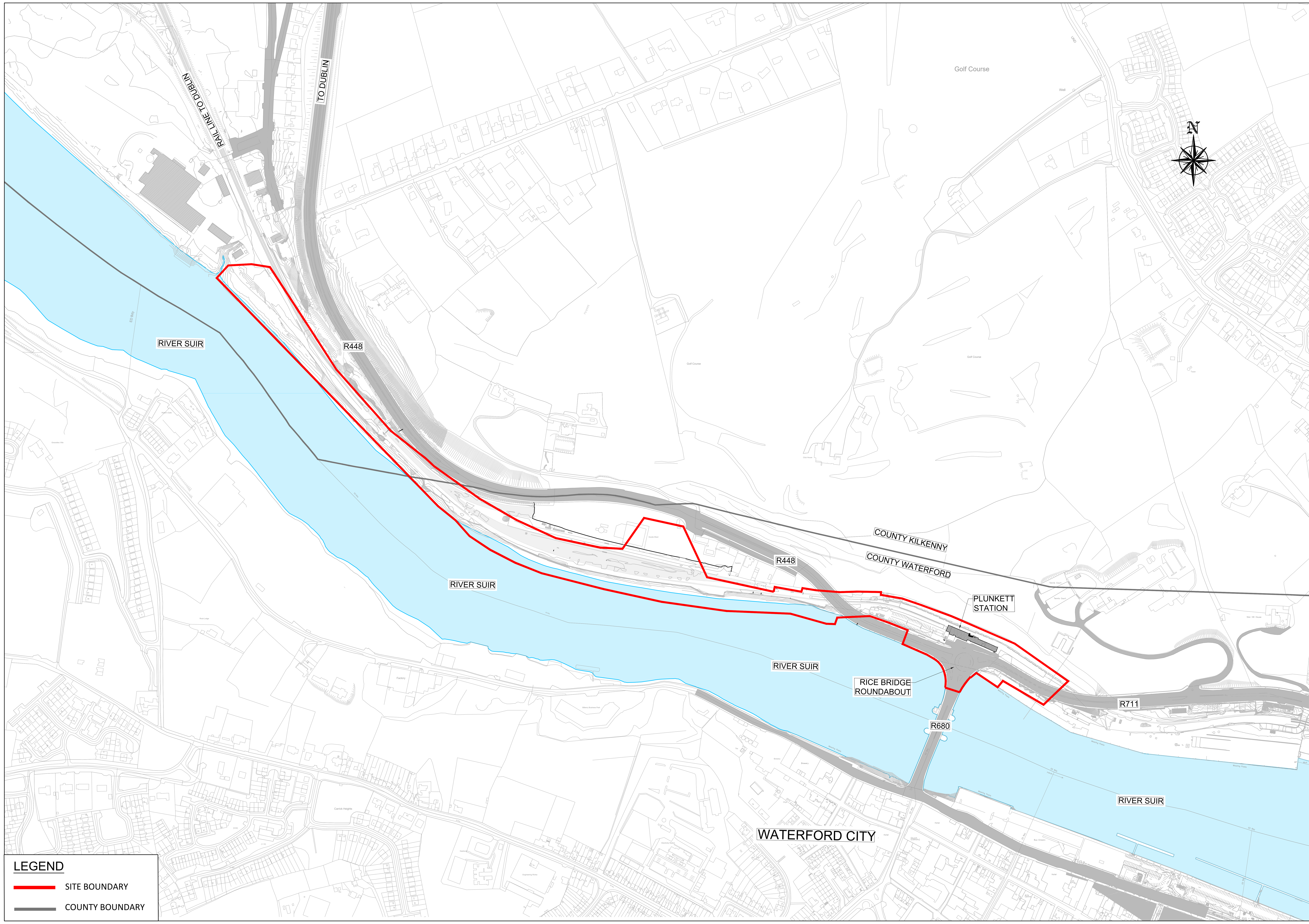
- A description of the incident;
- Contributory causes;
- Adverse effects;
- Measures implemented to mitigate adverse effects; and,
- Effectiveness of measures implemented to prevent pollution.

The Contractor will undertake appropriate monitoring of the procedures and measures set out in the management plans for construction activities required to prevent health and safety or pollution incidents to ensure they are being adequately implemented.

The Contractor will monitor the effectiveness of the procedures and measures implemented in the event of an incident and the effectiveness of the response procedures set out in the Incident Response Plan to identify any areas where improvement is required.

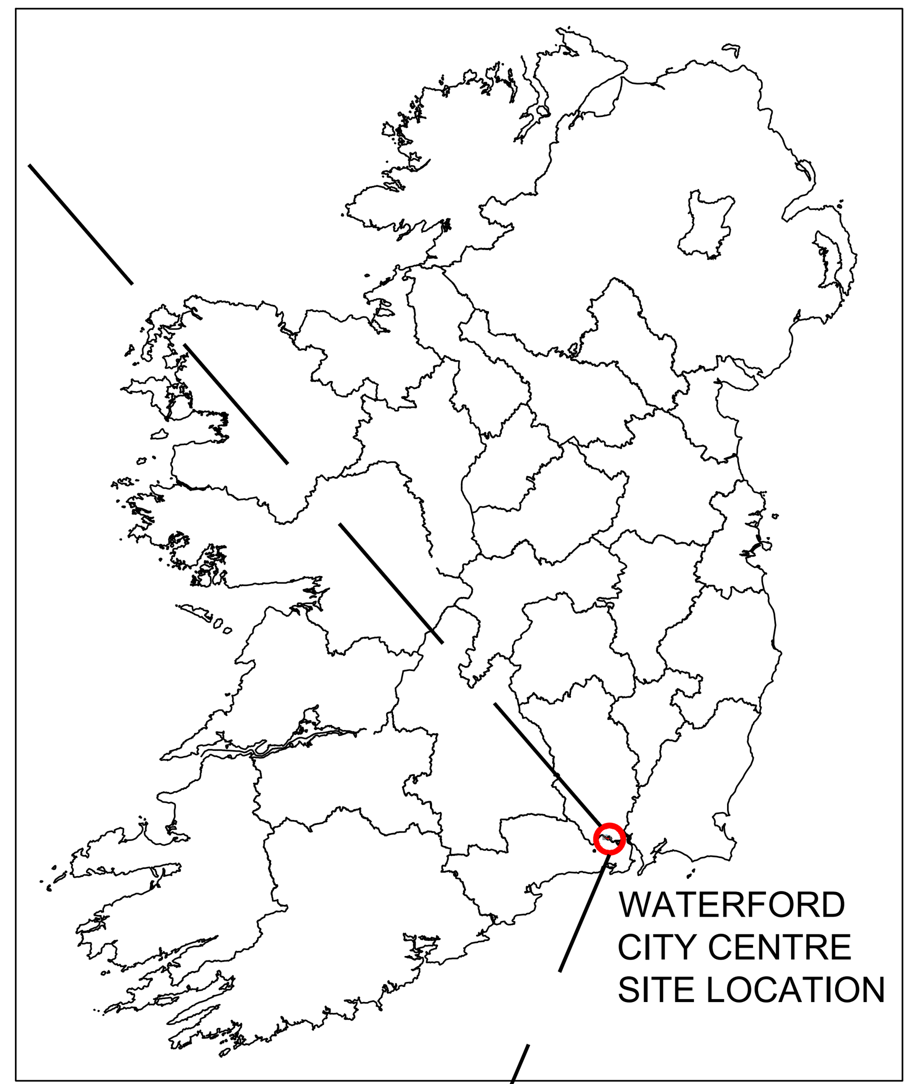
APPENDIX A

Figure 1



LOCATION PLAN

A1 SCALE 1:7000
A3 SCALE 1:3500



LOCATION MAP

N.T.S.

EIAR NOTE:

The design has been developed to a stage to permit a fully informed Environmental Impact Assessment to be carried out on the proposed development. Modifications may be made to avail of opportunities to improve the design at the detailed design stage in light of experience on the ground or other innovations, provided this has no significant adverse environmental impacts over and above those considered in the current Environmental Impact Assessment.

Project Ireland 2040 Building Ireland's Future

Comhairle Cathrach & Contae Phort Láirge Waterford City & County Council

NTA Údarás Náisiúnta Iompair National Transport Authority

Iarnród Éireann Irish Rail

ROD ROUGHAN & O'DONOVAN
Consulting Engineers
Civil - Structural - Transportation - Environmental

Arena House, Arena Road, Sandyford, Dublin 18, Ireland
t +353 (0) 1 294 0800
f +353 (0) 1 294 0820
www.rod.ie

Project Title: WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT FLOOD DEFENCES WEST

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Drawing Title: Location Plan of Proposed Development

Designed:	YB	File:		Status:	E.I.A.R.
Drawn:	IM	Job No:	18.141		
Checked:	BC	Scale:	AS SHOWN	Drawing No:	FIG 1.1
Approved:	TD	Date:	OCTOBER 2021	Rev:	-

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

Chapter 5
Traffic Analysis

Chapter 5 Traffic Analysis

5.1 Introduction

This chapter considers and assesses the potential traffic and transportation impacts associated with the construction phase of the proposed Flood Defences West for the protection of critical infrastructure including the existing Plunkett Train Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout.

5.2 Methodology

The chapter has been prepared in line with the following documents:

- Waterford City Development Plan, 2013 – 2019;
- Traffic and Transport Assessment Guidelines, (TII, 2014).

Data relating to any collisions in the vicinity of the development site during the 12-year period between 2005 and 2016 was collected from the Road Safety Authority (RSA) online mapping tool and analysed.

A manual classified junction turning count survey was carried out at the Rice Bridge / R448 Junction on Wednesday the $12^{th\ of}$ June 2019. The survey took place for 12 hours between 7am and 7pm. This survey data is used to analyse the traffic impact of the proposed development.

This traffic assessment determines the additional traffic loading resulting from the construction stage of the proposed development and considers the potential impact on the surrounding road network and traffic conditions. Appropriate traffic management measures are then identified.

5.3 Description of Receiving Environment

5.3.1 Road Infrastructure

The site of proposed development is located along the north bank and within the foreshore of the River Suir, extending approx. 100m to the east and c.1.1km to the west from the Rice Bridge roundabout in front of Plunkett Station. The proposed works will be carried out on both the riverside and the landside of the existing quay wall which currently bounds the River Suir. With the exception of the overground flood defence measures proposed for the Rice Bridge roundabout, the landside works will be carried out within the Iarnród Éireann (IÉ) lands. The site area is bounded to the north by Terminus Street (R448) - a regional road dual carriageway connecting Waterford City Centre with the N25 and the N9, located 3km to the northwest - and by the Dock Road (R711) – a regional road dual carriageway connecting Waterford City Centre with the N29, located 4.7km to the northeast, and the Rice Bridge connecting into the City Centre, as presented in Plate 5.1.

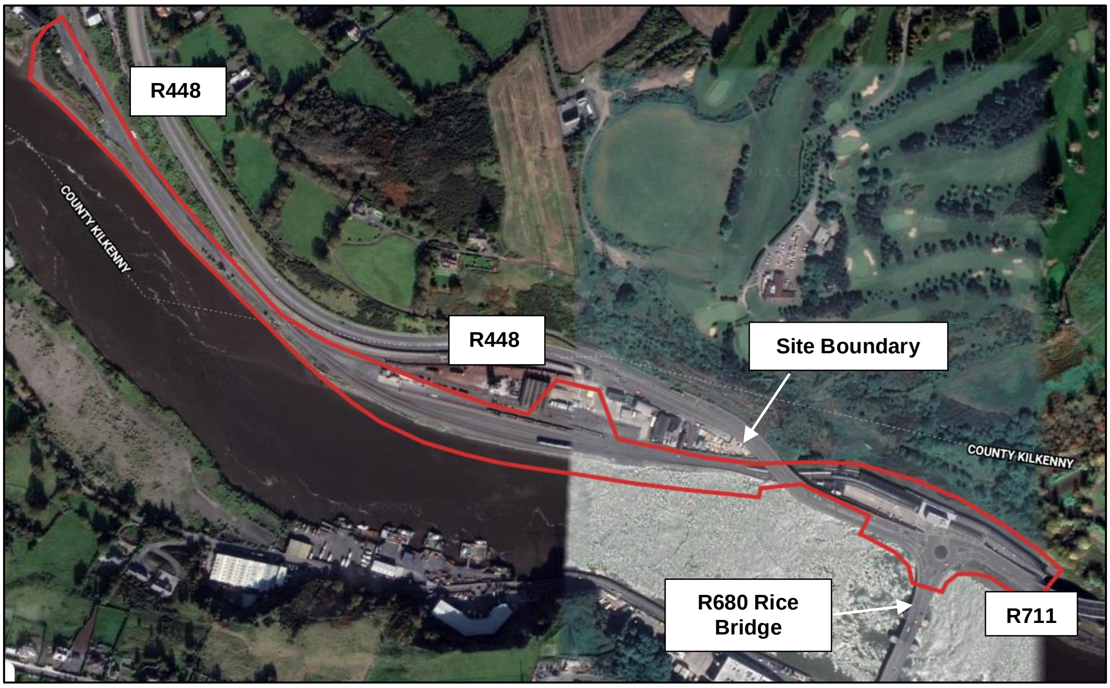


Plate 5.1 **Surrounding road network around the site boundary: R448 (Terminus St.), R711 (Dock Road) and Rice Bridge.**

The R711 Dock Road is a dual carriageway road, with a posted speed limit of 50km/hr. There are continuous footpaths on both sides of the R711, with an average width of between 2m and 3m. There are no facilities for cyclists provided, as presented in Plates 5.2 and 5.3.

The R448 Terminus Street is a dual carriageway road, with a posted speed limit of 60km/hr running to the north of the proposed development. There are continuous footpaths on both sides of the R448, with an average width of between 2m and 3m. There are no facilities for cyclists provided, as presented in Plates 5.4 and 5.5.

Plate 5.2, 5.3 **Views of R711 Dock Road looking east and west respectively**

Plate 5.4, 5.5 Views of R448 Dock Road looking west and east respectively

5.3.2 Public Transport Facilities

On the south side of the River Suir, Waterford Bus Station is situated on the R680, Merchants Quay and is serviced by both Bus Eireann and private operators. Local bus services operate to and from Waterford city area: 3 routes are available, with the nearest bus stop (Clock Tower) located on the south side of the River Suir, 770m from the site as shown in Plate 5.6 and 5.7. Waterford Plunkett Train Station which is located within the site boundary, is served by the Waterford – Dublin Heuston and Waterford – Limerick Junction trains.

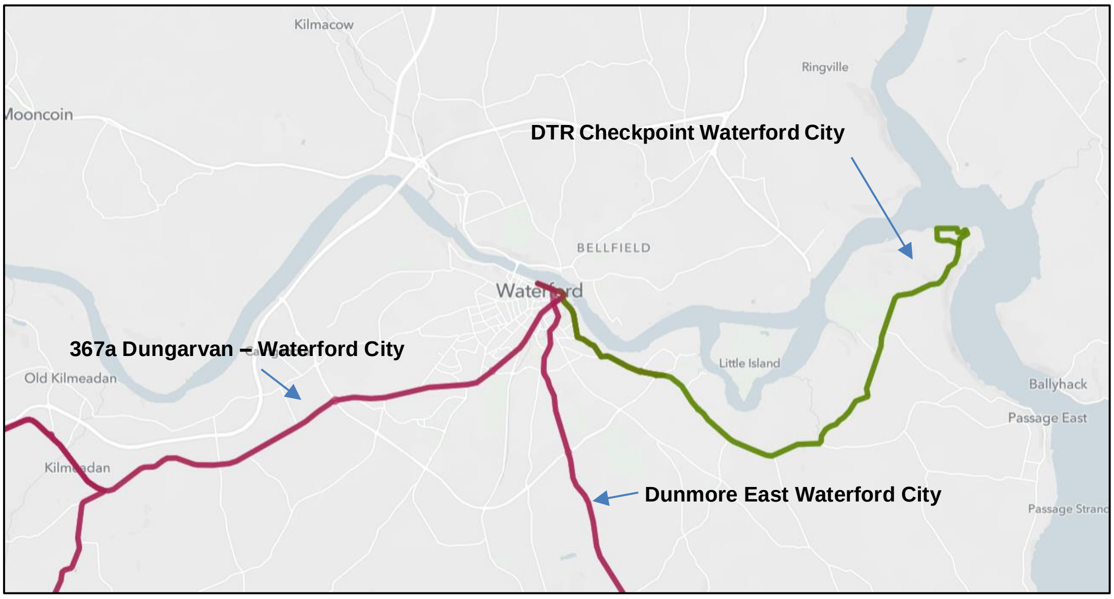


Plate 5.6 Views of the local routes serving Waterford area: DTR Checkpoint Waterford City, Dunmore East Waterford City and 367a Dungarvan – Waterford City

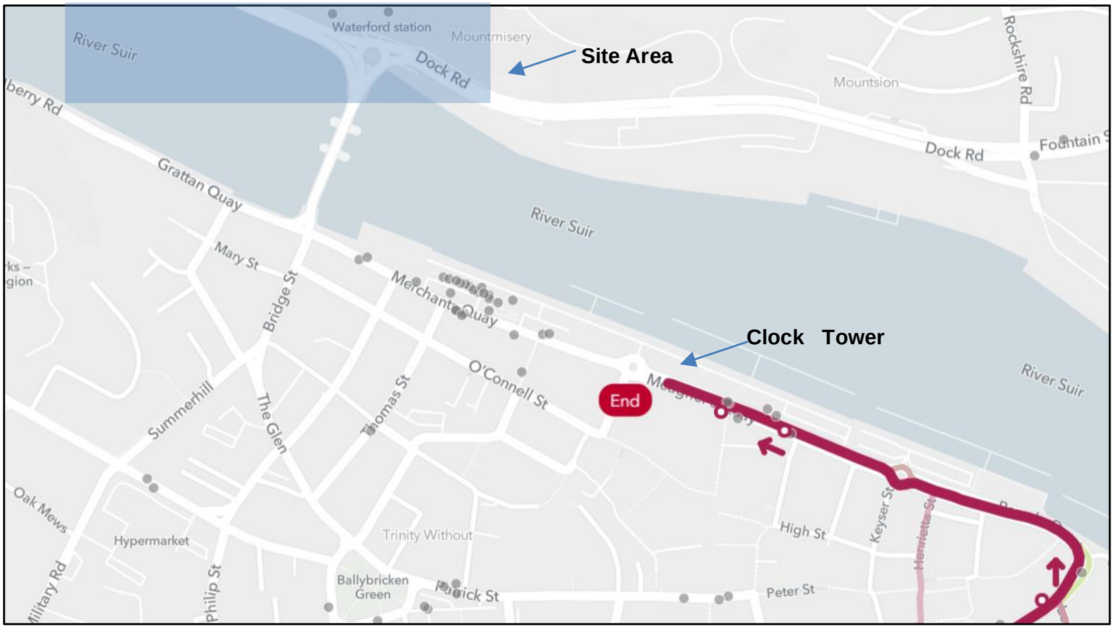


Plate 5.7 **Views of the nearest bus stops to the site area: Clock Tower stop**

5.3.3 Road Safety

Between 2005 and 2016 a total of 16 accidents were recorded in the vicinity of the site area, on Dock Road (R711) and Terminus St. (R448): 14 of them classified as minor, 1 classified as serious and 1 accident which was fatal.

The locations of the collisions on the road network near to the development site are indicated in Plate 5.8 and a summary of the collisions in the area is provided in Table 5.1.

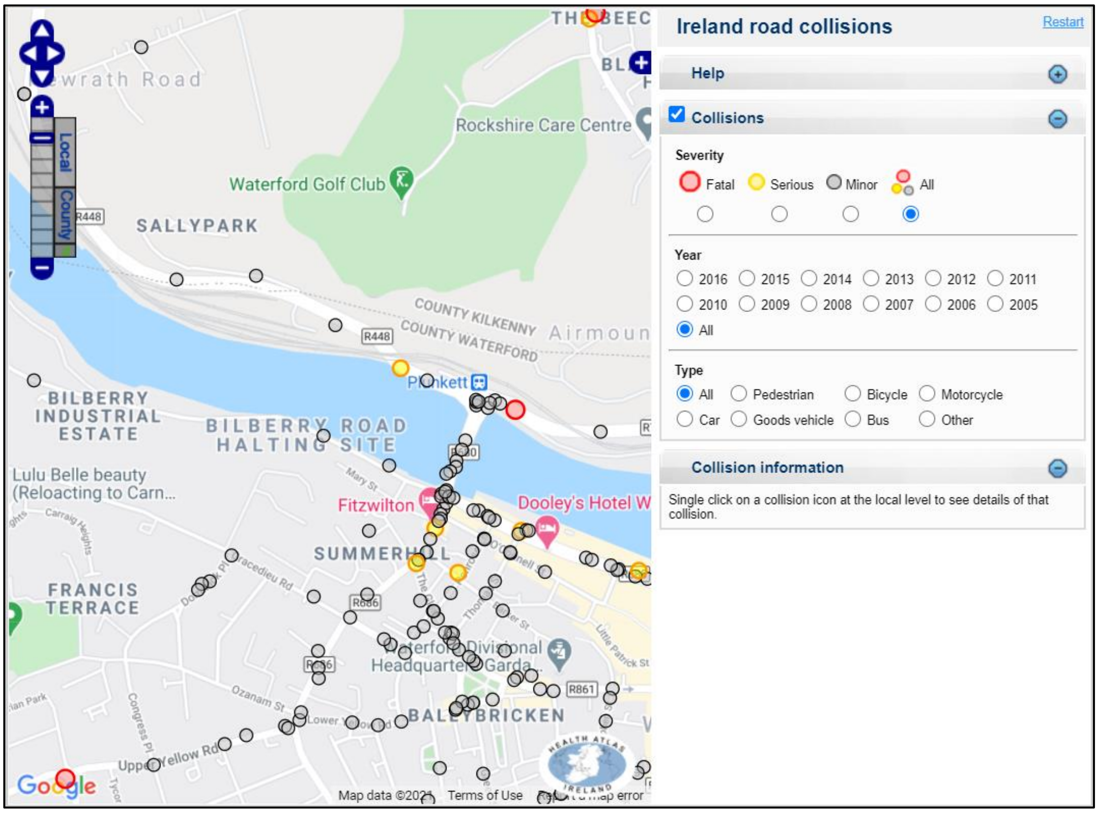


Plate 5.8 **Road Collision Data from RSA**

Two of the accidents to date in the area have involved a pedestrian, these collisions were classified as fatal and minor. Two further accidents involved a bicycle or motorcycle, both of which were minor accidents.

Table 5.1 Summary of Road Collision Data along R711 and R448

Classification	Location	Year	Vehicle Involved	Pedestrian Involved?	Day & Time	No. Casualties
Minor	Dock Road	2005	Car	No	Saturday, 10:00 – 16:00	2
Fatal	Dock Road	2016	Car / Pedestrian	Yes	Wednesday, 16:00 – 19:00	2
Minor	Dock Road	2014	Car	No	Monday, 10:00 – 16:00	1
Minor	Dock Road	2011	Bus	No	Wednesday, 19:00 – 10:00	1
Minor	Dock Road	2012	Car	No	Friday, 07:00 – 10:00	1
Minor	Dock Road	2014	Bicycle	No	Saturday, 16:00 – 19:00	1
Minor	Terminus St.	2012	Car	No	Sunday, 23:00 – 03:00	1
Minor	Terminus St.	2014	Car	No	Tuesday, 23:00 – 03:00	1
Minor	Terminus St.	2007	Car	No	Tuesday, 07:00 – 10:00	1
Minor	Terminus St.	2008	Goods vehicles	No	Wednesday, 10:00 – 16:00	1
Minor	Terminus St.	2006	Undefined	No	Friday, 16:00 – 19:00	1
Serious	Terminus St.	2015	Car	No	Sunday, 23:00 – 03:00	2
Minor	Terminus St.	2008	Car	No	Monday, 07:00 – 10:00	2
Minor	Terminus St.	2010	Car / Pedestrian	Yes	Sunday, 19:00 – 20:00	1
Minor	Terminus St.	2016	Motorcycle	No	Monday, 16:00 – 19:00	1
Minor	Terminus St.	2006	Car	No	Monday, 10:00 – 16:00	2

5.3.4 Existing Traffic

The peak hours for traffic near to the development are as follows:

- Weekday AM Peak: 08:00 – 09:00
- Weekday PM Peak: 17:00 – 18:00

The flows in the AM and PM peak, with the total traffic shown as passenger car unit (PCU) per hour and the Average Annual Daily Traffic (AADT) along the R448, R711 and R680 Rice Bridge are detailed in Table 5.2. The AM and PM peak and the AADT for HGVs on the aforementioned road network are presented in Table. 5.3.

Table 5.2 AM and PM Peak Flows on the R448, R711 and Rice Bridge

	Link	To Roundabout (PCU*)	From Roundabout (PCU)	Two-way (PCU)	AADT (PCU)
AM	R448 Terminus St	1,106	486	1,592	19,249
	R711 Dock Road	670	520	1,190	14,396
	Rice Bridge	964	1,720	2,683	32,451
PM	R448 Terminus St	577	917	1,494	15,458
	R711 Dock Road	760	1,116	1,875	19,403
	Rice Bridge	1,921	1,254	3,175	32,852

Table 5.3 HGVs AM and PM Peak Flows on the R448, R711 and Rice Bridge

	Link	To Roundabout	From Roundabout	Two-way	AADT
AM	R448 Terminus St	54	79	133	1,608
	R711 Dock Road	27	33	60	726
	Rice Bridge	60	71	131	1,584
PM	R448 Terminus St	21	80	101	1,045
	R711 Dock Road	26	19	45	466
	Rice Bridge	34	39	73	755

The highest level of traffic load is recorded along onto Rice Bridge during AM and PM peak.

5.4 Description of Potential Impacts

5.4.1 Construction Phase Impacts

Construction Traffic Access Routes

The main proposed construction compound area is situated at Newrath approximately 1,300m northwest of Rice Bridge Roundabout, and is accessed via the L3408 via a level crossing over the railway line to a site located between the River Suir and the Railway. The land is in the ownership of Córas Iompair Éireann (CIÉ) and is operated by Iarnród Éireann (IÉ). It is envisaged that the sheet piles for the flood defences will be loaded by crane over riverbank to a pontoon at this location before being moved for installation.

An ancillary site compound is proposed in the Iarnród Éireann's Sally Park yard, currently used for material storage, which is accessed via R448 Terminus Street approximately 450m west of Rice Bridge Roundabout. The proposed ancillary site compound has direct access to R448 Terminus Street as showed in Plate 5.9.

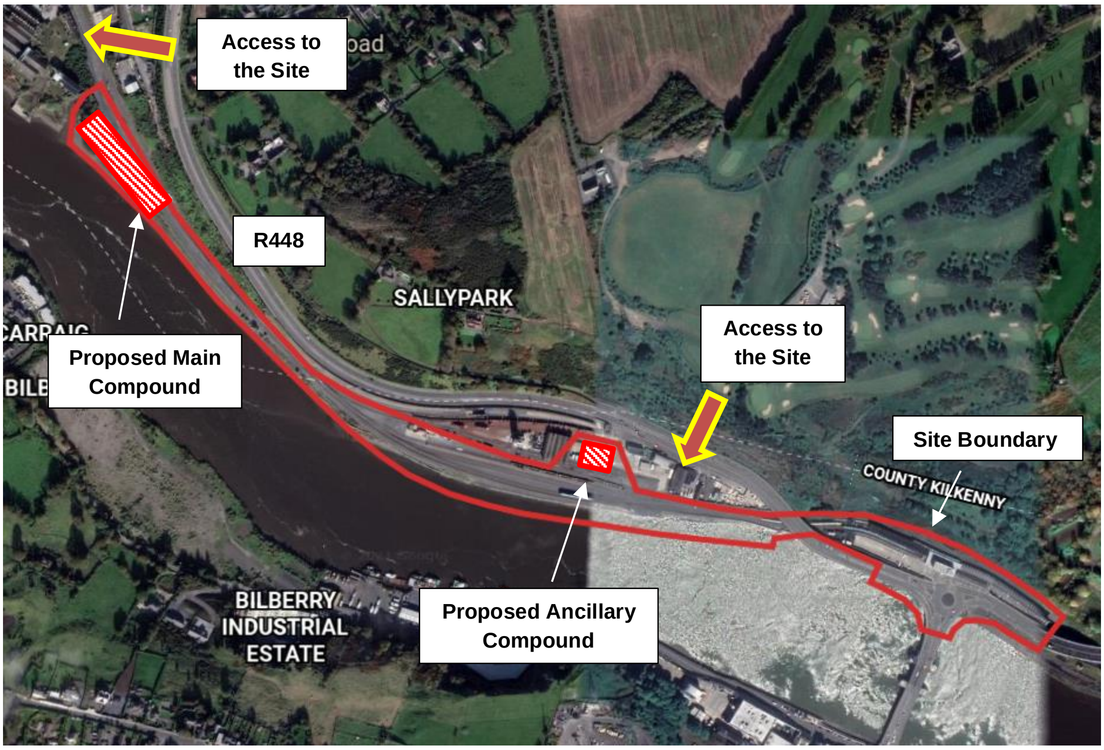


Plate 5.9 View of access to the ancillary compound to Terminus St. (R448) and to the main compound via public level crossing

Any traffic travelling to/from the site will use the R448: traffic will include vehicles transporting the steel sheet pile elements, construction vehicles including cranes and other general construction traffic.

Operational phase will have no traffic impact: routine maintenance is not expected to create any relevant HGVs traffic load: only occasional accesses are envisaged.

5.4.1.1 Main construction phases

The main activities during the construction stage of the Flood Defences West involve remedial works to the existing masonry wall, the construction of a sheet pile flood defence wall, upgrading the existent drainage network and upgrading the existing drainage outfalls. With the exception of the construction of overground flood protection measures for the Rice Bridge roundabout, the proposed works will be located strictly between the River Suir and the rail lines (from Ch.0.0 to Ch.1090 as shown on Figures 4.1 to 4.6 in Volume 3 of this EIAR): part of the proposed works will extend on to the riverside, with part on the landside area. A brief description of the proposed works has been provided below (see Chapter 4 of this EIAR for detailed description):

- **Remedial Works on concrete/ masonry wall**: Remedial works to existing masonry quay wall to increase its height by between 0.6m and 1.2m to achieve the design (top-of-wall) level of +4.30mOD. The remedial works will likely involve the construction of a reinforced concrete wall add-on to prevent the seepage through the deteriorating existing masonry wall. The estimated duration of the construction works is 4 weeks.
- **Flood defences in front of the Plunkett Station:** Construction of c.365m of underground flood defences in the form of an impermeable shallow trench (approx. 1m in width and up to 3m in depth) within the car parking areas of Plunkett Station. The construction duration is approximately 2.5 months (10

weekends) and 2 weeks at the eastern and western car parking areas respectively.

- **Overground Flood Defences** consisting of c.170m of glass flood barrier on the river side of the road edge vehicular parapets on Rice Bridge roundabout and along the 3 roundabout arms (R680 Rice Bridge, R448 Terminus St., and R711 Dock Rd). c.15m of demountable flood barriers are also proposed on the R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone. The estimated duration for the construction works is approximately 6-8 weeks.
- **New sheet pile flood defence walls:** The new flood defence wall will be constructed on the landside in IÉ lands and within the foreshore (riverside) of the River Suir. The total length of the wall is approximately 730m. Precast concrete cladding ("eco-wall") will be fitted to the intertidal zone of the new riverside sheet pile wall from the riverside. The estimated duration for the construction works is approximately 12 weeks for the new flood defence wall and 2-3 weeks for attaching cladding to the sheet pile wall.

  Landside sheet piling will include the construction of a new landside sheet pile wall and a 20m long underground isolation structure. The estimated construction duration is 7-8 weeks.

  Drainage: Part of the proposed works will be carried out on the landside within IÉ lands and within the foreshore of the River Suir. The drainage works will include:

  - Remedial measures to the existing drainage outfalls to the River Suir
  - Construction of new trackside drainage, groundwater drains, and outfall structures to the River Suir.
  - Construction of 2 no. pumping stations.

  The estimated duration of drainage works is approximately 22-24 weeks.

The total construction phase for the proposed development is approx. 30 – 35 weeks. All construction works described above will be undertaken during normal working hours, 6 days per week, Monday to Saturday. Night-time works will also be required to construct the underground isolation structure, sections of drainage landside sheet pile wall, where rail possession is required. Night-time works will be carried out for 5 days a week, from Monday evening to Friday morning.

5.4.1.2 Construction Stage Traffic

Remedial Works on concrete/ masonry wall

The proposed remedial works to the existing quay wall will require approximately 50m^3 of imported concrete. The amount of exported material is negligible.

Based on a standard construction dump truck volume capacity of 9m^3 and since the importing / exporting of this material should be carried out for 6 days per week, for approx. 4 weeks, this will generate 2 HGVs movements per day.

Flood defences in front of the Plunkett Station

The construction of the impermeable trench in front of the Plunkett Station will require 350 m^3 of imported concrete. The excavated soil to be exported has been estimated at 350 m^3 which will be disposed of at a suitably licensed facility.

Considering a standard construction dump truck volume capacity of 9 m^3 and 10 weeks timeframe to import/ export this material, 6 days per week, this will generate 4 HGV movements per day.

Overground Flood Defences

Approximately 120 glass barriers will be imported to provide overground flood defences for Rice Bridge roundabout and the three roundabout arms (as described above). The approximate total weight of the glass barriers is 8.16 tonnes and considering that works will be carried out over six weeks, 6 days each, 2 extra flatbed trucks will be required per day.

Sheet Pile Wall

Approximately 2,000m^3 of imported fill material is required to backfill the area between the existing quay wall and the landside sheet pile wall.

Approximately 720m^3 of waste will be generated during the demolition works of the existing quay wall which will be exported off-site and disposed at an appropriate licenced facility.

A total amount of material to be imported / exported has been estimated at 2,720m^3. Based on a standard construction dump truck volume capacity of 9m^3, 295 loads will be necessary, resulting in the total of 590 two-way HGV movements. Since the importing / exporting of this material will be carried out over 6 days per week, for 12 weeks, this will generate 3 HGV movements per day.

The proposed development will also require the import of pre-cast cladding material ("eco-wall") to be attached to the installed riverside flood defence sheet pile wall. Approximately 1,500 m^3 of this material will be needed and imported over a timeframe of 2 weeks, 6 days per week, resulting in 6 extra flatbed trucks per day.

The proposed development will also require the import of steel sheet piles for construction of the new sheet pile flood defence wall. Approximately 1,400 tonnes of steel sheet piles, equating to approximately 1,043 individual sheet piles will be required to construct the proposed flood defence wall, requiring 73 flatbed trucks. This will result in 146 two-way HGV movements to deliver the steel sheet piles. Daily delivery of materials to construction compounds is not expected to be required, however for the purposes of the traffic analysis, it is assumed that delivery will occur for 12 weeks as the worst-case scenario. Based on deliveries for 6 days per week, this therefore equates to approximately 3 HGV movements/day during that timeframe.

Drainage Elements

Drainage works will need a further 2,570m^3 of imported material. Approximately 1,300m^3 of surplus excavation will also be generated, which will have to be disposed off-site at a suitably licensed facility.

A total amount of imported / exported material has therefore been estimated at 3,870 m^3 for the drainage elements of the proposed development. The delivery of materials to construction compounds for drainage works will occur intermittently over 22 to 31-weeks.

When all of the delivery times are combined, it is assumed that a total of 16 weeks, based on a 6-day week, will be required for materials transport. As the worst-case scenario, it anticipated that 6 to 10 HGV movements/day will be required for the drainage elements.

In relation to the pumping stations, the proposed development requires 3 pumping chambers and smaller valve chambers: it has been assumed that 4 HGV movements/day will be required over a timeframe of 9 weeks.

To upgrade the existing drainage network, 1,309m of pipes will be required: considering 9 weeks to carry out works over 6 days per week, 2 HGV movements in total will be required.

Peak Construction Traffic Movements

Considering the phases sequence for the proposed works, the peak of the HGV traffic load is estimated to occur for a total of 7 weeks of the 30-35-week construction programme. The peak loads are associated with the coinciding construction timeframes for construction of the impermeable trench, the sheet pile wall, installation of cladding and drainage works which will result in an increase in the number of HGVs on the existing road network of between 26 and 32 HGV movements/day over 7 weeks.

At the peak of the construction stage, the proposed development will result in an 0.1% increase in total traffic movements and an increase of 1.2% in HGV movements over the course of a working day on the R448 Terminus Street. This is likely to have *negative, temporary, not significant* impacts on the existing road network.

Lower construction traffic movements are expected during the remainder of the construction programme, ranging from 4 to 20 HGV movements per day.

5.4.2 Operation Phase Impacts

There are no predicted impacts on traffic as a result of the operational stage. Periodic maintenance works will be required during the operation phase of the proposed development however these works are not likely to generate significant volumes of traffic. As such, due to the nature of the proposed development it will not generate traffic and will not impact permanently on the current road network.

The proposed development will protect the existing rail and road infrastructure within the site boundary from future flood events, which will have a *positive, permanent* impact on transport.

5.5 Mitigation & Monitoring Measures

No mitigation measures are deemed necessary as no significant impacts are predicted as standard best practice measures are incorporated into the project design.

5.6 Residual Impacts

The residual impacts of the proposed development will result in a positive effect to the existing transport network, providing flood protection to the railway line and train station, road network and surrounding lands.

5.7 Difficulties Encountered

No difficulties were encountered in undertaking this traffic and transport assessment.

5.8 References

Waterford City Development Plan, 2013 – 2019.

NRA 'Traffic and Transport Assessment Guidelines', 2014.

RSA Road Collision Data from www.rsa.ie

Chapter 6
Population and Human Health

Chapter 6 Population and Human Health

6.1 Introduction

This chapter addresses the potential population and human health impacts relating to the construction and operational phases of the Flood Defences West project referred to hereafter as "the proposed development". Actual and perceived impacts of the proposed development on the population and human health may arise from various aspects of the proposed development. These impacts are dealt with throughout this Environmental Impact Assessment Report (EIAR). In particular, interactions may occur with effects described in a number of chapters and require specialists input as provided in Table 6.1.

Table 6.1 Population and Human Health Interactions and Specialist Contributions

Relevant Aspects	Chapter & Specialists Contributor
Traffic	Chapter 5: Traffic Analysis: Roughan & O'Donovan
Contaminated Land	Chapter 8: Soils and Geology: Roughan & O'Donovan
Noise and Vibration	Chapter 12: Noise and Vibration: AWN
Air Quality and Climate	Chapter 13: Air Quality and Climate: AWN
Water Quality and Flooding	Chapter 10: Hydrology: Roughan & O'Donovan
Material Assets and Land	Chapter 16 Material Assets and Land: Roughan & O'Donovan
Cumulative Impacts	Chapter 17: Interactions and Cumulative Impacts
Major Accidents and Emergencies	Chapter 18: Major Accidents and Disasters Outline Environmental Operating Plan (Appendix 4.1): Roughan & O'Donovan

This chapter sets out the methodology used for the population assessment and human health assessment (Section 6.2), then describes the receiving environment (Section 6.3) and sets out the potential impacts of the proposed development on population and human health aspects (Section 6.4). The mitigation measures are set out that are (Section 6.5) recommended to be incorporated into the design of the proposed development. A conclusion and a summary of the assessment are provided in Section 6.7. A list of reference material used to compile this chapter is contained in Section 6.8.

6.2 Methodology

This population and human health impact assessment has been undertaken in accordance with Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, as amended in turn by Directive 2014/52/EU and transposed into Irish Law through Regulations S.I. No. 296 of 2018. The methodology devised is based on established best practice with cognisance given to all relevant guidelines and legislation listed in section 6.2.1.

6.2.1 Relevant Guidelines

The following guidelines have influenced the preparation of this chapter:

- Draft Guidelines on information to be contained in the Environmental Impact Assessment Report, (EPA, 2017);
- Draft Advice Notes for preparing environmental impact statements (EPA, 2015);
- Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2002);
- Advice notes on current practice (in the preparation of Environmental Impact Statements) (EPA, 2003);
- Guidelines on the treatment of Tourism in an Environmental Impact Assessment (Fáilte Ireland, 2011);
- Additionality Guide (Homes and Communities Agency (UK), 2014);
- Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report (European Commission, 2017);
- Health Impact Assessment Resource and Tool Compilation (US EPA, 2016);
- Health Impact Assessment (Institute of Public Health Ireland, 2009)
- Framework for Human Health Risk Assessment to Inform Decision Making (United States Environmental Protection Agency (USEPA), (2016))

6.2.2 Study Area

There is no national guidance available on an appropriate study area to focus the assessment of population and human health. The study area has been defined with reference to the potential for impact from the proposed development using professional judgement and based on availability of relevant information.

The primary study area is defined by the Electoral Divisions (EDs) that are wholly and/or partially contained within 500m of the proposed development. It is recognised that the development of flood defences measures could affect activities across a wider area, particularly in terms of land use considerations. For this reason, a study area of 1km is also included. The EDs wholly and / or partially contained within the 500m study area and the 1km 'context' study area are listed in Table 6.2 and presented in Plate 6.1.

Table 6.2 Electoral Divisions (EDs) Wholly and / or Partially Contained within the Study Area

Electoral Divisions (EDs)	Location (north or south of the River Suir)
Primary Study Area (500m)	
Aglish	North
Ferrybank	North
Kilculliheen	North
Custom House B	South
Centre A	South
The Glen	South
Bilberry	South
Military Road	South
Cleaboy	South

Electoral Divisions (EDs)	Location (north or south of the River Suir)
Primary Study Area (500m)	
Gracedieu	South
Wider Study Area (1km)	
Dunkitt	North
Shortcourse	South
Ballybricken	South
Custom House A	South
Centre B	South
Mount Sion	South
Morrison's Avenue East	South
Morrison's Avenue West	South
Morrison's Road	South
Newport's Square	South
Park	South
Slievekeale	South

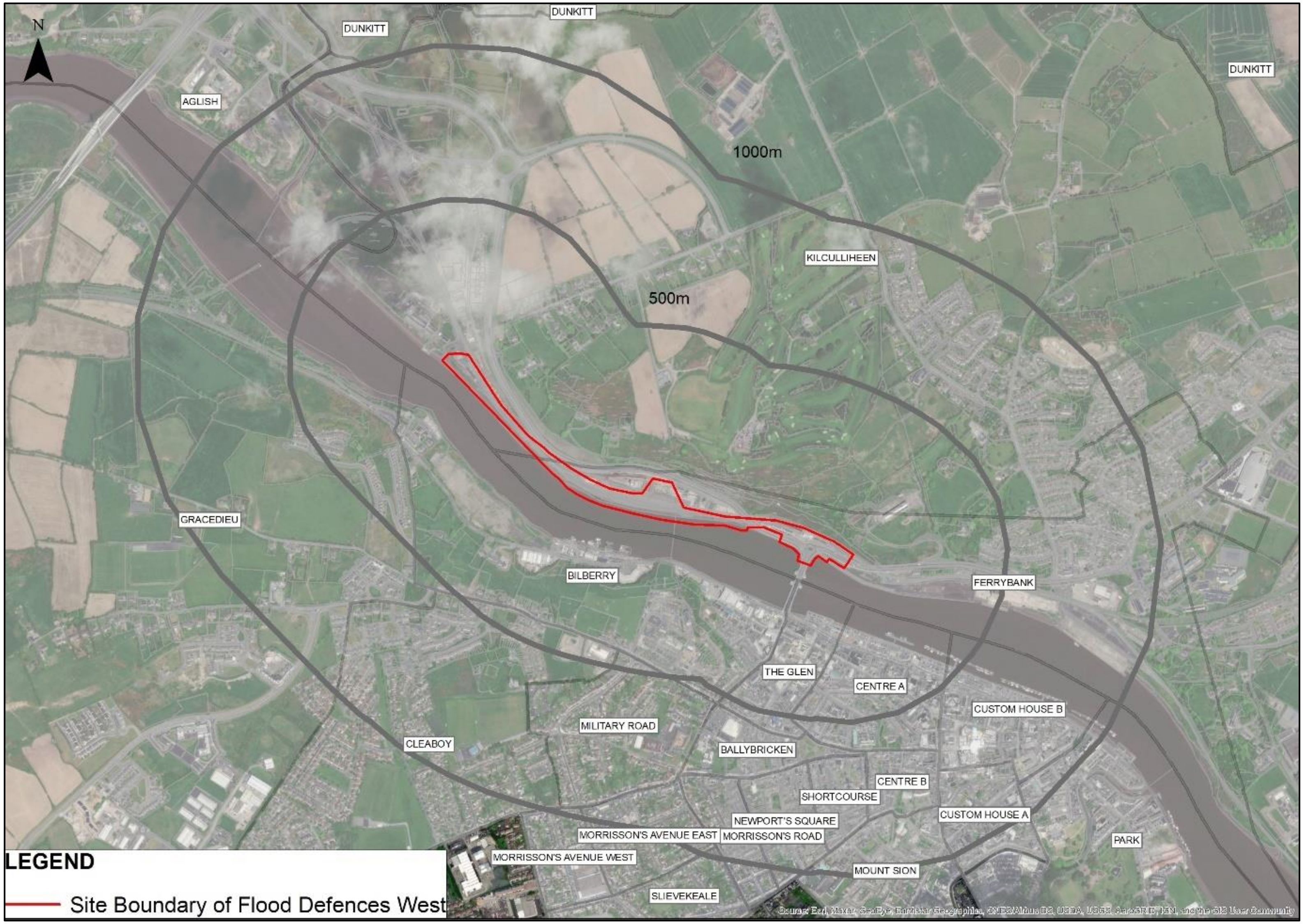


Plate 6.1 Study Area for Population and Human Health Assessment

The human health study area is related to the potential impacts of any emissions as a result of the proposed development. Generally, the closer to the works, the greater the potential for impacts. The most significant environmental impacts are likely to be confined within 50-100m of the proposed development. Some impacts such as noise, air quality and traffic may have a wider study area, and these are defined and considered as part of the respective specialist chapters as part of this EIAR that inform this assessment. Where population or human health information is not specifically available for the defined EDs within the 500m, information relating to the Waterford City and/ or environs is relied upon. The study area also includes the marine environment - the River Suir, in terms of potential for economic impact on boating, and tourism from the proposed development.

6.2.3 Data Collection Methods

The data collection methods include a mixture of primary and secondary data collection and analysis. Initially a desk-based assessment determined the existing receiving environment (in terms of population and human health), including the existing population, future population projections, existing and future economic activity in the area, employment, community infrastructure, tourism, and recreation amenities. Mapping and aerial photography were also used to inform and validate the baseline description.

6.2.4 Data Sources

Data sources consulted include:

- Population, demographic and health data from Census 2011 and 2016 by the Central Statistics Office (CSO);
- Pobal and Institute of Public Health (IPH);
- Health Service Executive (HSE); and
- Other relevant environmental data considered during the various environmental assessments, particularly traffic, noise, air and climate, water, land and soil as listed in Table 6.1.

A range of policy documents that may affect existing and future populations were also reviewed including:

- Project Ireland 2040 – National Planning Framework 2040 and National Development Plan 2018-2027;
- Southern Regional Spatial and Economic Strategy (2020);
- South East Region Employment Action Plan 2011;
- South East Economic Development Strategy (SEEDS) 2013-2023;
- Kilkenny City and Environs Development Plan 2014-2020;
- Kilkenny City and County Development Plan 2021- 2027;
- Waterford City Development Plan 2013- 2019 (as extended) (incorporates the Housing Strategy);
- Draft Waterford City and County Development Plan 2022 – 2028;
- Waterford County Development Plan 2011-2017 (as extended);
- North Quays Strategic Development Zone Planning Scheme (adopted February 2018);
- Ferrybank- Belview Local Area Plan 2017 – 2023;
- One Waterford: Local Economic & Community Plan 2015-2020;

- Report of the Waterford Re-Organisation Implementation Group and Economic Strategy for Waterford City and County, One Waterford – Delivering Jobs, Efficiency and Growth (2013);
- Waterford Children & Young People's Services Committee Children & Young People's Plan 2015-2018;
- Waterford City & County Council Corporate Plan 2014-2019;
- Waterford City Retail Strategy (2012);
- Strategic Plan 2014 – 2017 Waterford – Active People, Active Place;
- Waterford City Centre Urban Renewal Scheme (2015);
- Waterford Planning, Land Use and Transportation (PLUTS) Study (2004);
- Transforming Waterford Integrated Transport Proposals; and
- Literature review – bridges, sustainable transport bridges.

6.2.5 Difficulties Encountered

No particular difficulties were encountered in preparing the population assessment. In terms of the human health assessment, there are uncertainties in relation to assessing impacts on individuals or communities due to the lack of available health data and the difficulty in predicting effects, which could be based on a variety of assumptions.

6.2.6 Population Impact Assessment Categories

6.2.6.1 Overview

The purpose of the population assessment is to identify the likely significant impacts as they might affect users of the proposed development and the local community. It usually follows that impacts of a population and human health nature are a function of:

- The location and character of the local environment;
- The sensitivity of the local population and its capacity to absorb change;
- The nature of the environmental effect;
- The scale or extent of the effect in terms of area or population affected;
- The duration and frequency of an effect; and,
- The probability of an impact's occurrence and possibility of effectively reducing the effects (mitigation).

The description of the quality, significance, extent (magnitude), probability and duration of effects outlined within this assessment are based on the definitions set out within Section 3.7 Impact Assessment of the 'Guidelines on information to be contained in Environmental Impact Assessment Reports' (EPA, Draft 2017), and outlined in Table 6.3.

Impacts result from direct, indirect, secondary and cumulative effects on existing environmental conditions. Effects can be *positive, neutral* or *negative*. Significance of an effect depends on, among other considerations, the nature of the environmental effect, the timing and duration of an effect and the probability of the occurrence of an effect. The significance of an effect is described as *imperceptible, slight, moderate, Significant*, *Very Significant* or *Profound*. The impacts may be short-term, medium-term or long-term. The duration of an effect may be *momentary, brief, temporary, short-term, medium-term, long-term, permanent or reversible* in accordance with the timescales detailed in Table 6.3. The frequency of that effect can also influence significance i.e. if the effect will occur once, rarely, occasionally, frequently, constantly

– or hourly, daily, weekly, monthly, annually. For example, disruption to a road for a few hours could be described as having an *imperceptible, negative, brief* impact versus the complete closure of a road for a number of months which could be described as a *very significant, negative*, *temporary* impact.

Table 6.3 Criteria used to describe population effects (adapted from the EPA, 2017)

Quality of Effects:	
Positive	A change which improves the quality of the environment.
Neutral	No effects, or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
Negative	A change which reduces the quality of the environment.
Describing Significance of effect:	
Imperceptible	An effect capable of measurement but without significant consequences on population.
Not significant	An effect which causes noticeable (*Note 1*) changes in the character of the population environment without affecting its sensitivities.
Slight effects	A small effect which causes noticeable changes in the population and character of the environment without affecting its sensitivities.
Moderate effects	An effect that alters the character of the population environment in a manner that is consistent with existing and emerging baseline trends.
Significant effects	An effect which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the population environment.
Very significant Effects	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the population environment.
Profound effects	An effect which obliterates sensitive characteristics.
Describing the Extent and Context of Effects:	
Extent	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Describing the Probability of the Effects:	
Likely effects	The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
Unlikely effects	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measure are properly implemented.
Describing the Duration and Frequency of Effects:	
Momentary effects	Effects lasting from seconds to minutes
Brief effects	Effects last less than a day
Temporary effects	Effects lasting less than a year
Short-term effects	Effects lasting one to seven years

Medium-term effects	Effects lasting seven to fifteen years
Long-term effects	Effects lasting fifteen to sixty years.
Permanent effects	Effects lasting over sixty years
Reversible effects	Effects that can be undone, for example through remediation or restoration.
Frequency of effects	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hour, daily, weekly, monthly, annually).
Note 1:	*for the purposes of planning consent procedures*

In accordance with the draft EPA Guidelines (2017), the relevant components of this chapter will examine the attributes and characteristics associated with:

- Land use and social considerations, including effects on general amenity, journey characteristics, severance, amenity uses of the site or of other areas in the vicinity;
- Economic activity including employment and tourism; and
- Human health, considered with reference to and interactions with other environmental receptors contained in corresponding chapters such as air, noise, traffic, flooding, as appropriate.

The above-listed topics are discussed in terms of their relevance to the assessment in the following sections.

6.2.6.2 Land Use Change

Land use changes can affect populations in different ways. Planning policy plays an important role in guiding and facilitating approximate changes in land use which can influence settlement as well as transportation patterns. Planning policy ensures these changes are managed sensitively and are appropriate to the unique, existing and emerging social, economic and environmental conditions. The primary consideration relating to land use change is to assess whether the proposed development conforms with land use policy and to identify if the proposed development is likely to change the intensity of patterns, types of activities and land uses. Therefore, a review of planning policy was carried out as part of this assessment as well as an assessment of the existing and emerging baseline and its capacity to absorb predicted changes.

6.2.6.3 Journey Characteristics

Journey length refers to the distance associated with a journey, whilst duration is the time taken to make the journey. Average walking speed for pedestrians is taken to be 5 km/h. Average cycling speed is assumed at 20 km/h. Impacts on journey amenity and community severance are described below. There are obvious interactions between each of these categories and with economic impacts and therefore the assessment is combined with positive impacts resulting from a decrease in journey length/ time and negative impacts resulting from an increase in journey length/time. In addition, new transport facilities can improve accessibility or connectivity through the combined effect of reduced journey time and reduced severance.

6.2.6.4 Journey Amenity and General Amenity

The assessment of journey amenity relies on the significance categories given in Table 6.3 and is supported by cross-reference where necessary with the relevant Chapters. The level of traffic on a road, the proximity and separation of footpaths and cycle-paths, the nature of any crossings/junctions to be negotiated, the legibility of a journey (including signage), visual intrusion (including sightlines) and safety for equestrians, are amongst the factors relevant to the assessment of amenity, as are the number and types of people affected. The principal concern is with pedestrians and cyclists, but journey amenity impacts also apply to drivers; for example, due to safety and anxiety associated with the crossings of major roads. There are interactions, too, with the assessment of journey characteristics and community severance.

6.2.6.5 Severance

The definition of severance is not precise. Severance is an impact of transport infrastructure development such as roads or bridges. Its effect is to discourage community interaction and it occurs where access to community facilities or between neighbourhoods is impeded by a lengthening of journey time or by the physical barrier. For example, construction of a road can result in a physical barrier but can also create further severance affecting communities due to high traffic volumes or perimeter fencing.

Sensitive groups are identified specifically where they comprise a higher proportion of pedestrian journeys or where specific amenities are associated with these groups. Sensitive groups can include young and older population cohorts, the mobility impaired and people at risk of social isolation. Relevant facilities include schools, surgeries, hospitals, churches, post offices and shops.

Table 6.4 provides a guide to criteria used in the assessment of severance. Where the assessment varies from these definitions due to the context in which the impact occurs, the reasons for the assessment are discussed in the text. There may also be potential for interactions with journey amenity.

Table 6.4 Criteria Used in the Assessment of Severance

Impact Level	Significance Criteria
Imperceptible	No noticeable consequences for journey patterns
Not significant	Some minor effects on connectivity but present journey patterns are maintained.
Slight	Slight effects on connectivity but journey patterns are maintained with some hinderance to movement.
Moderate	Moderate effects on connectivity. Some moderate hinderance to movement is likely to be experienced by some populations but journey patterns maintained.
Significant	Significant effects on connectivity i.e. changes could dissuade/ promote populations from making particular journeys or result in requirement for alternative route to origin and destination.
Very Significant	Very significant effects on connectivity i.e. dramatic changes could dissuade/ promote populations from making particular journeys or result in requirement for alternative route to/from origin and destination.
Profound	Profound changes to connectivity. Populations are likely to be required to completely alter journey patterns.

6.2.6.6 Economic Impacts

Economic and employment impacts occur at both the regional and local scale and can be either positive or negative. Economic impacts are assessed at a community level however development may affect identifiable local business. In this case, impacts on individual companies are discussed where relevant. Other economic impacts could affect the wider community, for example where a number of businesses are affected, tourism, or where the retail or business environment of a City/town is impacted.

6.2.7 Human Health Impact Assessment Categories

This section describes the methodology relating to the assessment of human health effects. Health, as defined by the World Health Organization (WHO), is *"a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."* The United States Environmental Protection Agency (USEPA) Human Health Risk Assessment is a useful framework for considering potential human health impacts. It includes four basic steps to inform decision making detailed in the Table 6.5 below.

Table 6.5 Framework for considering potential human health risk/impacts. (informed by USEPA)

Step 1 – Hazard Identification	Examines whether a stressor has the potential to cause harm to humans and/or ecological systems, and if so, under what circumstances. For example, in the case of transport infrastructure project one might consider an emission such as noise or air pollutants and examine its potential for harm.
Step 2 – Dose Response Assessment	Examines the numerical relationship (emission standards) between exposure and likely human health response/effects. For example, typically when the dose/ emission increases the response/health effect increases. Some individuals may have a different dose response/ health effect than others e.g. vulnerable groups such as the old, very young or sick.
Step 3 – Exposure Assessment	Examines what is known about the frequency, timing, and levels of contact with a stressor (e.g. emission). For example, estimating human exposure to an emission/agent in the environment or estimating future exposure of an agent that has not yet been released/ present in the environment.
Step 4 – Risk Characterisation	Examines how well the data support conclusions about the nature and extent of the risk from exposure to environmental stressors. A risk characterisation conveys the risk assessor's judgment as to the nature and presence or absence of risks, along with information about how the risk was assessed, and where assumptions and uncertainties still exist. (This includes cross-referencing with the other environmental chapters of this EIAR).
Note: Informed by USEPA	

6.2.7.1 Significance of Health Effects

The assessment of significance relates to the identification and assessment of potential human health effects on the community. It does not assess effects on an individual basis. It is recognised that some individuals may have a different response to effects than others. Examples might include vulnerable groups, such as the elderly, very young or the sick.

The EPA Revised Draft Guidelines on the information to be contained in Environmental Impact Statement (August 2017) states, *"The evaluation of effects on these pathways is carried out by reference to accepted standards (usually international) of safety in dose, exposure or risk. These standards are in turn based upon medical and scientific investigation of the direct effects on health of the individual substance, effect or risk. This practice of reliance upon limits, doses and thresholds for environmental pathways,* *such as air, water or soil, provides robust and reliable health protectors [protection criteria] for analysis relating to the environment."*

The significance criteria to assess human health effects is defined in Table 6.6 (as per EPA revised Guidelines). The quality of impact (*positive, negative or neutral*), the probability, duration and timing of effects that are used to qualify the type of human health impact are defined in Table 6.6.

Table 6.6 Criteria Used in the Assessment of Human Health Impacts (adapted from the EPA)

Impact Level	Significance Criteria
Imperceptible	An effect capable of measurement but without significant human health consequences.
Not significant	An effect which causes noticeable changes in the character of the environment without affecting the community human health sensitivities.
Slight	A slight/ small effect which causes noticeable changes in the reported symptoms of the population without affecting the community human health sensitivities (morbidity or mortality).
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging community's human health baseline trends.
Significant	An effect which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the environment affecting human health (morbidity or mortality).
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters **most o**f a sensitive aspect of the environment affecting the community's human health (morbidity or mortality).
Profound	An effect which changes a sensitive characteristic of the environment that profoundly affects the human health status of the community.

6.2.7.2 Health Based Standards

Health based standards are set by bodies such as World Health Organisation (WHO) and the European Union (EU). The standards are environmental health thresholds set for a range of environmental parameters to ensure no adverse health effects on the most vulnerable in society. For example, air quality and noise levels are set at levels to protect the vulnerable, not the robust (see Chapter 12 Noise and Vibration and Chapter 13 Air Quality and Climate for the relevant standards). These standards are set to ensure scientific analysis (i.e., modelling) is undertaken on the baseline environment which includes an analysis of the likely changes in the receiving/baseline environment as a result of the proposed development to predict potential human health effects. This results in a level of certainty in relation to the potential effects (positive or negative) before a project is developed. This scientific analysis provides decision makers with a clear methodology outlining what information was used, data gaps and any assumptions that were made in order to provide a comprehensive assessment of impacts on human health.

Regardless of the methodology, psychological effects or well-being effects are difficult to measure as these effects are more subjective in nature. It must also be recognised that there are uncertainties in relation to assessing impacts on individuals due to availability of health data about individuals and the difficulty in predicting effects on individuals, which could be based on a variety of assumptions. Subsequently, the existing receiving environment and relevant health-based standards assessment are relied upon to arrive at conclusions relating to likely human health effects.

6.2.7.3 *Identification of Vulnerable Groups*

The population baseline characteristics or the community profile is required to inform the assessment of the proposed development on human health and this informs the identification of potential vulnerable groups in the environment. Children and adolescents constitute a vulnerable group as they lack the experience and judgement displayed by adults. Studies also show that they may be more sensitive than adults to noise and air pollution and other environmental impacts.

Older people also constitute a vulnerable group, but this can vary depending on a number of factors including level of income, education, deprivation and individual preferences or genetics. However, an assumption can be made that older populations move slower than their younger counterparts, particularly when moving around in traffic and public places. Older persons are also more vulnerable to health conditions occurring than their younger counterparts. Ease of access to medical and community facilities become very important in maintaining health and quality of life outcomes for all cohorts. Vulnerable groups in general have greater sensitivity to air pollution and potential effects on the respiratory system and cardiovascular system. There are many reasons for this including the possible presence of other medical conditions such as respiratory or cardiovascular disease. Some subtle changes in the environment have the potential to have an adverse effect that would not be experienced by a younger more resilient person. Other vulnerable groups also include the mobility impaired or psychologically ill.

6.2.7.4 *Hazard Identification*

Human health impacts related to transport infrastructure can arise as a result of a variety of factors and interactions across environmental receptors e.g. traffic accidents or safety issues, air and noise pollution, impacts on water quality, flooding, etc. which have the potential to cause a threat to the health of populations and the wider environment. Therefore, all aspects of the environment influence human health to some degree or another.

A literature review was performed and identified recognised health effects of road and bridge construction and operations on human health. Transport can affect health outcomes both directly and indirectly. For example, directly through air pollution or traffic accidents and indirectly, as a result of supporting an increase in car-based transport which in turn increases the fossil fuelled vehicles on roads, thereby increasing carbon emissions into the atmosphere and contributing to climate change.

Although somewhat outdated, the information contained in the Institute of Public Health (IPH) published *Health Impacts of Transport* (2005) is still relevant today where it analysed the pathways from transport to health, as presented in Plate 6.2. The main impacts can be summarised as: road traffic injuries, air pollution, noise pollution, effects on physical activity, effects on community (social networks, social capital on health) and social inclusion (effect on access and social inclusion).

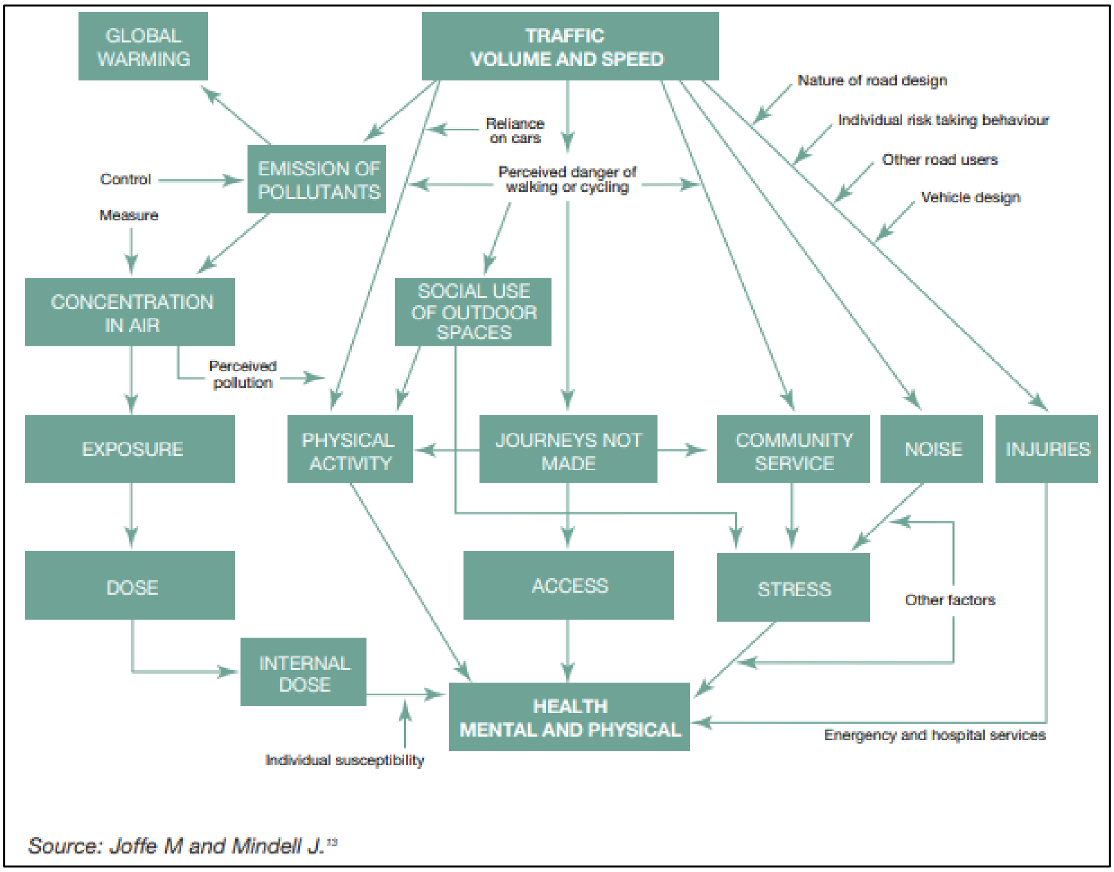


Plate 6.2 Pathways from transport policy to health outcomes (IPH, 2005)

Hazards to human health that can be classified under four headings: physical, psychosocial, chemical and biological hazards and are summarised in Table 6.7.

Table 6.7 Four Main Hazards to Human Health

Physical Hazards	Psychosocial Hazards	Chemical Hazards	Biological Hazards
The main physical hazards identified are: • Noise (including nuisance/ disturbance, noise induced hearing impairment, interference with speech communication, sleep disturbance, hypertension and cardiovascular disease), • Vibration (including nuisance) • Air quality (including construction dust, carbon monoxide, fine particles, etc.), • Water quality (including effects due to contaminated land); • Soils (contamination of land); • Traffic – including collisions, injuries or worst-case fatalities);	The main hazards identified include: • Nuisance • Anti-social behaviour	The main hazards identified include: • Heavy metals, • Contaminants.	The main biological hazards identified are: • Surface water and ground water (including water contamination) • Aspergillus (A fungi with potential for human health impacts) • Rodent-borne diseases e.g. Leptospirosis

Physical Hazards	Psychosocial Hazards	Chemical Hazards	Biological Hazards
• Other physical hazards e.g. radon			

6.2.7.5 *Impact of Emissions to Air*

Air quality is generally classified as good in Ireland. However, traffic is a key pressure on air quality and is the main cause of air quality problems in our larger towns and cities (EPA, 2016). Vehicles emit a range of air pollutants including nitrogen oxides (NOx), particulate matter (PM_{10} and $PM_{2.5}$), black carbon and volatile organic compounds (VOCs) particularly present in urban areas and areas with high congestion levels. There are significant human health impacts from particulate matter (PM) and nitrogen oxides (NOx) emissions, which include cardiovascular disease, lung disease and heart attacks (EPA, 2015).

National standards for ambient air pollutants in Ireland have generally ensued from Council Directives enacted in the EU. In order to reduce the risk to health from poor air quality, National and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Chapter 13, Table 13.1 and Appendix 13.1 Ambient Air Quality Standards 2011 and Dust Deposition Limits of this EIAR). Institute of Air Quality Management (IAQM) guidelines (IAQM 2014) for assessing the impact of dust emissions from construction and demolition activities based on the scale and nature of the works and the sensitivity of the area to dust impacts are the basis for the human health assessment.

6.2.7.6 *Impact of Noise and Vibration Emissions*

Noise is measured using the standard decibel scale (dBA). The "A" represents a weighting that mimics human hearing. It is important to note that because the decibel is a logarithmic scale i.e. non-linear scale, therefore the figure can be somewhat confusing. An increase in 3bdB means a doubling of the sound intensity in energy terms. However, the human ear does not normally perceive this degree of increase in volume. Normally, a 10dB increase in noise levels equates to a subjective doubling in audible sound.

According to the WHO, noise is the second greatest environmental cause of health problems, after air quality. Excessive noise can seriously harm human health, affect mental health and people's daily activities including in sensitive receptors such as residential properties, schools, workplace and during amenity or leisure time. EPA, 2016 states that "*noise can disturb sleep, cause cardiovascular and psychophysiological effects, reduce performance and provoke annoyance responses and changes in social behaviour".*

EPA, 2016 also states that "*a study commissioned by the European Commission on the health implications of road, railway and aircraft noise in the European Union (RIVM, 2014) found that exposure to noise in Europe contributes to:*

- *about 910,000 additional prevalent cases of hypertension;*
- *43,000 hospital admissions per year;*
- *at least 10,000 premature deaths per year related to coronary heart disease and stroke*." (EPA, 2016)

The assessment and management of noise from the infrastructural transport sources (roads, rail, and airports) are governed by the Environmental Noise Directive and associated 2006 Environmental Noise Regulations (S.I. 140 of 2006).

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. In lieu of statutory guidance, an assessment of significance has been undertaken as per British Standard BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise.

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded at this location, indicates a significant noise impact is associated with the construction activities.

BS 5228-1:2009+A1:2014 sets out guidance on permissible noise levels relative to the existing noise environment. Table 12.1 of Chapter 12 sets out the values which, when exceeded, signify a significant effect at the façades of residential receptors (replicated in Table 6.8).

Table 6.8 Example Threshold of Potential Significant Effect at Dwellings

Assessment category and threshold value period	Threshold value, in decibels (dB) ($L_{Aeq, T}$)		
	Category A[A]	Category B[B]	Category C[C]
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
Evenings and weekends [D]	55	60	65
Night-time (23:00 to 07:00hrs)	45	50	55

[A] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

[B] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.

[C] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.

[D] 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

For the appropriate assessment period (i.e. daytime in this instance) the ambient noise level is determined through a logarithmic averaging of the measurements for each location and then rounded to the nearest 5dB. If the construction noise exceeds the appropriate category value, then a significant effect is deemed to occur.

Table 6.9 presents the DMRB (2011) likely impacts associated with change in traffic noise level. The corresponding significance of impact presented in the '*EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EIAR), Draft, August 2017 is presented alongside this for consistency in wording and terminology for the assessment of impact significance.

Table 6.9 Likely Impact Associated with Change in Traffic Noise Level

Change in Sound Level DMRB, 2011 (dB L_{A10})	Subjective Reaction DMRB, 2011	Impact Guidelines for Noise Impact Assessment Significance (Institute of Acoustics)	Impact Guidelines on the Information to be contained in EIAR (EPA)
0	No change	None	Imperceptible
0.1 – 2.9	Barely perceptible	Minor	Not Significant
3.0 – 4.9	Noticeable	Moderate	Slight, Moderate
5.0 – 9.9	Up to a doubling or halving of loudness	Substantial	Significant
10.0 or more	More than a doubling or halving of loudness	Major	Very Significant, Profound

The criteria above reflect the key benchmarks that relate to human perception of sound. A change of 3 dB(A) is generally considered to be the smallest change in environmental noise that is perceptible to the human ear. A 10dB(A) change in noise represents a doubling or halving of the noise level. The difference between the minimum perceptible change and the doubling or halving of the noise level is split to provide greater definition to the assessment of changes in noise level.

What determines its significance is the amount of the exceedance. The other factor that needs to be considered is the baseline. If the change from the current baseline is 3dB or less, even if the absolute levels are above 55dB the change is likely to be imperceptible.

It is assumed that average noise levels in a building with windows open will be at least an estimated 15dB less than outside. Average sound inside a building with the windows closed can be greater than 35dB, depending on the building fabric. Accordingly, the attenuation can vary depending on the size of windows, building type and other factors. The potential health impacts due to noise include:

- Noise-Induced Hearing Impairment
- Interference with speech communication
- Disturbance at schools
- Sleep disturbance
- Hypertension and cardiovascular disease

In terms of the health effects of environmental noise there is some limited evidence of effects on blood pressure, cardiovascular risk, school performance and in relation to sleep disturbance. Any effects demonstrated are more likely at higher noise levels. Many effects are only demonstrated with ambient noise in excess of 70 dB. Whilst noise levels are often quoted with respect to potential effects on health and they are used in the significance assessment, it should be noted that the differences in significance between the different levels are relative rather than absolute.

6.2.7.7 Impact of Emissions to Hydrology and Hydrogeology

Emissions standards and pathways that affect human health relating to hydrology and hydrogeology include water quality and flood risk. From a human health perspective these pathways are discussed below.

Water quality

Construction and operational (fuel spillages, etc) activities pose a risk to watercourses, particularly contaminated surface water runoff from construction activities entering the watercourse. Impacts to sources of drinking water are also sensitive and should be considered as part human health issue in this context.

Flood Risk

Hydraulic structures such as flood defences, bridges, culverts, channel diversions and outfalls can, if not appropriately designed, impact negatively on upstream water levels causing potential increased flood risk.

6.2.7.8 Impacts of Emissions to Soil

Consideration of likely emissions to and from a project relating to contamination of soil or the potential to uncover contaminated land based on previous land uses (e.g. landfill, industrial, manufacturing uses) have the potential to affect human health. During construction activities there is potential to unearth or uncover previously buried materials or contaminants and depending on the nature of the contamination may have the potential to effect human health if not appropriately addressed.

Radon is a naturally occurring radioactive gas that originates from the decay of uranium in rocks and soils. It is colourless, odourless and tasteless and can only be measured using special equipment. Radon rises up through the ground to disperse in the air and only becomes a health hazard when it is trapped in buildings.

6.2.7.9 Psychosocial Impacts

Consideration of likely negative psychosocial hazards relating to the new developments include; nuisance, anti-social behaviour and suicide. On the contrary, there could also be positive psychosocial impacts on the community due to improved connectivity particularly for pedestrians and cyclists and as a result of regeneration associated with landuse changes and increased economic prosperity. Due to the subjectivity relating to psychosocial effects it is not possible to use a standard based approach in this assessment.

Demolition and property acquisition can also have impact on both the occupants themselves but also at community level due to impact on community ties and amenity of residents, local economy, etc.

6.3 Description of Receiving Environment

6.3.1 Introduction

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City, refer to Figures 1.1 in Volume 3 of this EIAR. The development extends for approximately 1km to the west and 100m to the east of the Waterford (Plunkett) Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor located to the north of the proposed development.

The proposed flood defence measures are for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval, eliminating the risk of flooding to the Transport Hub.

A design flood level of +4.0m OD (metres above Ordnance Datum Malin) is proposed for this development. The design flood level has been based on a flood with an annual exceedance probability of 0.5% and allowances for climate change and isostatic tilt as noted below.

The design (top-of-wall) level for the proposed flood protection measures is +4.30m OD (metres above Ordnance Datum Malin). The following allowances are integrated into the proposed height of the flood defence walls:

- 0.5% annual exceedance probability combined tidal-fluvial event (+3.45 m OD);
- An additional 0.55m to allow for climate change and isostatic tilt; and,
- 0.30m freeboard to the wall, including local wave wake effects.

The proposed flood protections measures will consist of:

- Construction of overground flood defences in the form of c.170 of glass flood barriers for the Rice Bridge Roundabout and the three roundabout arms (R680 Rice Bridge, R448 Terminus Street and R711 Dock Road) and c.15m of demountable flood barriers on the R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.
- Remedial Works to c.75m of existing quay wall by raising its height by 0.6m to 1.2m to conform with the design top-of-wall level of +4.30m OD.
- Construction of c.365m underground impermeable trench within the car parking areas in front of the Plunkett Station;
- Construction of c.730m of new sheet pile flood defence wall consisting of:
  - c.540m of sheet pile wall within the foreshore, 1m from the front face of the existing quay wall.
  - c.190m of sheet pile wall will be installed on Iarnród Eireann land, 1 m behind the existing quay wall. Construction of a c.30m underground isolation structure composed of underground sheet piles and of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event.
- Drainage works consisting of:
  - Remedial works to the existing drainage outfalls to the River Suir by extending them to reach an outlet within the new sheet pile wall and/or retrofitted to pass through the new sheet pile wall, and installation of non-return valves.
  - Construction of new trackside drainage and groundwater drains to include 2 no. pumping stations and 3 no. surface water outfalls to the River Suir.

Context

The proposed development is located on the periphery of Waterford City along the northern bank of the River Suir. The proposed development will defend lands which are primarily utilised for industrial and commercial uses from flooding, in extreme flood events. This includes the rail line servicing Waterford City and the Port of Waterford. Passenger rail services currently terminate at Plunket Station which serves the city. An integrated multi-modal transport hub is also planned to be developed along the Dock Road which received planning approval as part of a Part 8 Planning Application. The proposed development will ensure that rail infrastructure is protected, promoting resilience in extreme events. The rail line is bounded to the north by Plunkett Station, Irish Rail / industrial yards and the R448 regional road. The proposed development is consistent with the planning policy of the Waterford City Development Plan 2013-2019 regarding promoting sustainable transport use.

Character

Waterford City has a rich, historical and maritime past. Waterford City has a strong historical urban centre, rich in architectural heritage and supports a range of commercial and mixed-use developments serving the City and south east region population. The River Suir still influences the character of the city with national and international boats berthed on the six pontoons that line the south quays year-round. Meagher's Quay on the south of the River Suir is the location of extensive carparking area servicing the everyday carparking needs of people working and/ or visiting the City. The main road access to the city centre is via the R680 over Rice Bridge and along the south quays.

The site of the proposed Flood Defences West project is located to the northwest of the city centre on the northern edge of the River Suir, to the west of Rice Bridge. It is located approximately 0.7-1.5km northwest / west of Waterford city centre (Broad St / Barrow St). The site extends for approximately 1.0km and is oriented generally east - west. The land uses are industrial, focused on the Irish rail infrastructure. The development site is narrow as it follows the existing quay wall south of the IÉ train tracks, widening out at the eastern side, south of Plunkett Station to almost 100m, where it encompasses the existing railway station and the Rice Bridge roundabout. Most of the landuse within the footprint of the site is infrastructure. There are no trees or significant landscape vegetation within the site.

Significance

Waterford City is the key city in the south east region and the National Planning Framework (NPF) focuses on supporting its continued growth and development. The NPF supports ambitious growth targets to enable Waterford City along with Cork, Limerick and Galway to grow by at least 50% to 2040 and to enhance their significant potential to become cities of scale. The rail line that terminates at Plunket Station links Waterford City to the national rail network. The rail line and Plunket Station are currently vulnerable to flooding in extreme events.

Sensitivity

There are no schools, childcare facilities/ créches, sports grounds, libraries and community centres located within 500m of the proposed development lands.

Sensitive receptors present in the immediate study area (within 500m) on the south of the city include: Waterford Marina Hotels (Granville Hotel, Dooley's Hotel), Waterford Bus Station and bus stops, banking services and shops. A range of retail and commercial units, tourism facilities and services operate along the south quays and in the wider city centre area.

Sensitive receptors present on the north of the city (within 500m) include a number of residential areas associated with the Ferrybank residential areas, Plunkett Station and a range of neighbourhood facilities including shops. The Waterford Golf Club is located on elevated lands to the north of the R448 across from the road from the proposed development.

Other examples of sensitive community facilities in the wider 1km study area include: a range of schools, medical, religious and cultural and institutions, leisure centres, gyms, GAA, rugby and soccer clubs. Waterford City has rich tourism and amenity offer including historical sites in the city, nature walks and tours along the River Suir and surrounding landscape. The city has many supporting services including hotels, hostels, café, restaurants, etc. Due to the urban location and mixed-use city centre nature of the area, populations in these areas are considered to be more adaptable and less sensitive to change than their rural counterparts.

The River Suir serves an important function from an amenity, recreation and well-being perspective for city dwellers and visitors alike. It is currently used as a river walk on the south quays of the city and is deemed to be a sensitive natural and ecological resource. It is sensitive from an amenity, landscape and visual perspective and from a cultural heritage perspective as the South quays are designated as an Architectural Conservation Area (ACA). Public access to the River Suir is restricted for the general public from lands within the proposed development as they are privately controlled and utilised by Iarnród Éireann.

There has been a consistent decline in unemployment rates in the South East region which is a good indicator of increasing economic activity. Although, Waterford City unemployment rates are improving but are still high (18.8% when compared with the State 12.9%) Census 2016. In terms of demographics, Waterford City has a very young and ageing population, and both of these cohorts are considered to be vulnerable from a health perspective. The HP Pobal deprivation scores (Table 6.) indicate that the majority of the study area is either 'marginally below average' affluence or 'disadvantaged'.

A more detailed description of the baseline environment including sensitivities is presented under the following sections to include:

- Land use and Social considerations: including population, deprivation levels, age profile, amenity and community infrastructure;
- Economic Activity including tourism; and
- Human health aspects.

6.3.2 Land Use and Social Considerations

The proposed development site is characterised by its industrial land uses immediately to the north, and the River Suir directly to the south. The Iarnród Éireann (IÉ) lands to the north consist of Plunkett Station, railway and associated yards. The railway constitutes strategic infrastructure connecting Waterford City to the rest of Ireland. The lands are wholly owned by IÉ with public access limited to the existing Plunkett Station (see Chapter 16 Material Assets and Land for further information regarding land ownership). The River Suir is a navigation channel and is a source of ecological, recreation, amenity and economic value. Furthermore, the site of proposed development is located directly to the west of the North Quays Strategic Development Zone (SDZ).

6.3.2.1 NQ SDZ Planning Scheme (2018)

The NQ SDZ Planning Scheme was adopted by elected members in February 2018. The Waterford North Quays SDZ Planning Scheme 2018 aims to promote the expansion of the City Centre to the north of the River Suir in a manner that enhances and supports balanced and sustainable growth in Waterford City and encourages its vitality and viability and to create a sustainable urban environment, which respects it's natural, historic and cultural heritage, whilst providing sustainable solutions that address and manage the risk of flooding and climate change.

The Vision for the area is to provide for the development of the sustainable, mixed use, modern compact extension to the city centre and a regeneration catalyst for the city that includes a multi modal transport hub. Plate 6.3 illustrates the location of the transport hub and access strategy provisions required to support the SDZ.

Plate 6.3 Transport Hub and Access Strategy (Source NQ SDZ Planning Scheme)

The improved location of the train station in the Transport Hub development will enhance access to the site for those using active modes or public transport. This will positively impact travel to and from Waterford, providing a better connection to a wider catchment of people outside of Waterford City and providing better connectivity for tourists arriving by train to the city. This would complement Irish Rail's long-term strategic plan for Waterford, to provide an hourly service to Dublin in addition to a peak hour commuter service to Carlow & Kilkenny.

Planning approval for the SDZ Transport Hub was granted in September 2019 as part of a Part 8 planning application. Flood defence measures, Flood Defences East have been proposed as part of this planning application that will protect the SDZ lands, including the area to the east of the Rice Bridge roundabout. The proposed Flood Defences West will connect with the Flood Defences East and will provide flood protection for the entire north quays area of Waterford City. The proposed development will protect the existing rail infrastructure and will facilitate the development of future rail services as part of the SDZ Transport Hub.

6.3.3 Population

Census 2016 reports that there was a total population of 48,216 persons in City Waterford. Waterford City and Suburbs had a population of 53,504. The population of Waterford City and suburbs increased by 3.85% between 2011 and 2016 which is largely in line with the population growth of the State.

The proposed development is located in the two Electoral Divisions (EDs) (Ferrybank and Kilculliheen). In 2016 census, the total combined population residing within these EDs was 6,104 persons. Due to the nature of the existing land uses there are no properties within 100m of the proposed development, however there are a number of residential properties along the Dock Road that are located within close proximity. The Ferrybank ED reported a 53-person decline (-5.3%) between 2011 and 2016 with a total of 858 persons residing there in 2016. In contrast, Kilculliheen increased by 9% to a total of 5,246 persons over the same period. Together, both EDs comprise the Waterford City suburbs north of the River Suir. Refer to Plate 6.1 Study Area for Population and Human Health Assessment.

There have been consistent increases in the population of Waterford City in the study area except in the Ferrybank area which has experienced consistent population decline as detailed in Table 6.9. The population in County Waterford is higher than in the City – a trend similar to other Counties across Ireland however the County has been experiencing a decline in population since the last census period which could be attributed to the economic decline and subsequent migration patterns to urban areas across Ireland or abroad.

Table 6.9 Population Change in the Study area by Electoral Division, City and County (Census, 2016, 2011)

Study Area (500m) Electoral District	Population 2011	Population 2016	% change 2011-2016
Aglish	871	883	1.4
Ferrybank	911	858	-5.8
Kilculliheen	4811	5246	9.0
Custom House B	213	269	26.3
Centre A	679	791	16.5
The Glen	566	742	31.1
Bilberry	718	802	11.7
Military Road	821	763	-7.1
Cleaboy	2576	2556	-1
Gracedieu	1234	1662	34.7
EDs within 1km Study Area	**Population 2011**	**Population 2016**	**% change 2011-2016**
Dunkitt	1058	1015	-4
Shortcourse	274	301	9.9
Ballybricken	130	145	11.5
Custom House A	287	353	23.0
Centre B	233	236	1.3
Mount Sion	747	849	13.7
Morrison's Avenue East	560	510	-8.9
Morrison's Avenue West	295	300	1.6
Morrison's Road	508	490	-3.5
Newport's Square	556	543	-2.3
Park	1382	1520	10.0
Slievekeale	592	593	0.2
Waterford City	**46,732**	**48,216**	**3.17**

Study Area (500m) Electoral District	Population 2011	Population 2016	% change 2011-2016
Waterford County	**69,444**	**67,960**	**-2.14**

6.3.3.1 Age profile and dependency ratio

Waterford City has a young population profile relative to the national average as can be seen from the age profile graph in Plate 6.4. The majority of the population in Waterford is between the 20 to 39 years age group cohorts. The largest cohort is 35-39 reflecting the last 'baby boom' of the early 1980s. The age profiles illustrate the large increase in fertility (birth) rates and increase in the number of older (over 65+) population reflective of the national trend whereby people are living longer.

Age dependency ratio is the population ratio of those typically not in the labour force (0-14 and 65+) and those typically in the labour force (15-64). It indicates the pressure on the productive population to support services for younger and older age cohorts of the population. The age profile indicates that there is a high older dependency ratio across the study area with 16% of the population 65 years of age or over. The average age dependency ratio for the study area is very high at 31.30. This figure indicates that there is currently pressure on the population and a higher potential for pressure to occur on productive population to support the younger and older age cohorts now and into the future. This will also have pressure on landuse and services to support the changing needs of the population over time such as medical care, social, education and community services.

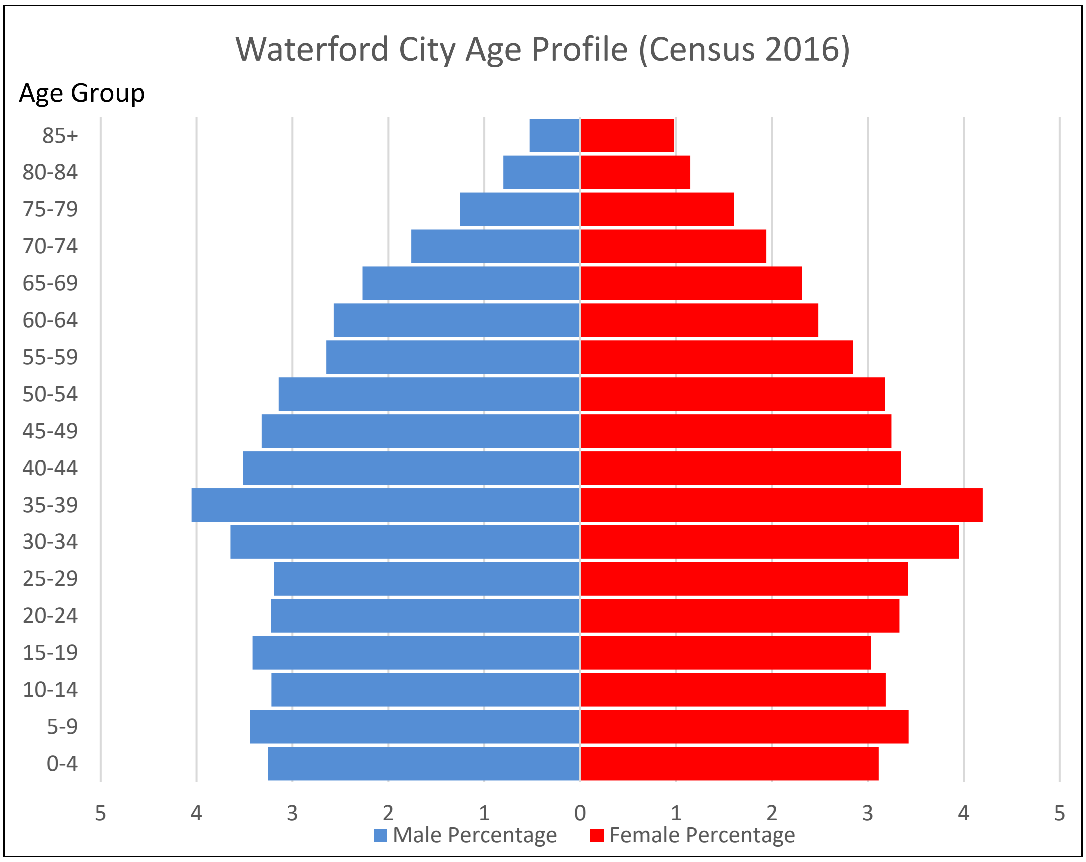


Plate 6.4 Waterford City Age Profile

6.3.3.2 Households and household formation

In 2016, there were 18,958 households in Waterford City with 8,066 within the study area. Waterford City largely comprises 1 or 2 person households with the next biggest category being 4 and 3 person households respectively. There is approximately 20% of the population in the study area in local authority rented accommodation.

6.3.3.3 Education

Education levels have greatly improved across Ireland, particularly over the last two decades. In 2016, 42% of people in the State had a third level education compared with 13.6% in 1991. Waterford City census 2016 report 12,801 persons attained a secondary education, 7,944 attainted a third level education (bachelor's degree or over) and 4,073 had a primary education. An additional 6,570 persons attained a technical, vocational or advanced higher certificate/ apprenticeship. 607 people had no formal education.

6.3.3.4 Travel to work, school or college

Census 2016 results for primary means of travel to work, school or college for Waterford City and Suburbs is set down in Table 6.10. Census figures show the majority of population travels either by 'car driver' or 'car passenger' with a combined total of 21,214 people. The second largest mode of transport is by foot with a total of 6,000 people walking. Travel by train is not a popular mode of travel in Waterford City, with only 75 persons utilising it as their primary means of travelling to work, school or college.

Table 6.10 Population aged 5 years and over by means of travel to work, school or college Waterford City and Suburbs (Census 2016)

Means of Travel	Work	School or College	Total
Car driver	12,557	670	13,227
Car passenger	1,549	6,438	7,987
On foot	2,632	3,368	6,000
Not stated	1,155	669	1,824
Bus, minibus or coach	501	866	1,367
Van	823	17	840
Work mainly at or from home	522	6	528
Bicycle	399	121	520
Motorcycle or scooter	78	12	90
Train, DART or LUAS	53	22	75
Other (incl. lorry)	43	2	45
Total	**20,312**	**12,191**	**32,503**

Census 2016 also reports on the travel time and indicates that the majority (13,715) of people within Waterford City and Suburbs travel under 15 minutes to work, school or college. This Census also reports that most people leave home between the hours of 08.01-08.30am (8,136) and 8.31-9.00am (7,984) as presented in Table 6.11. These times would correspond with the increase in traffic conditions/ congestions patterns witnessed during site visits along the south quays during these periods. More details on traffic movements in the area can be found in Chapter 5 Traffic Analysis of this EIAR.

Table 6.11 Population aged 5 years and over by time leaving home to travel to work, school or college Waterford City and Suburbs (Census 2016)

Time Leaving Home (am)	Persons
Before 06:30	1,927
06:30-07:00	1,601
07:01-07:30	1,855
07:31-08:00	3,916
08:01-08:30	8,136
08:31-09:00	7,984
09:01-09:30	1,866
After 09:30	2,643
Not stated	2,047
Total	**31,975**

6.3.3.5 Community Infrastructure

Community infrastructure is far reaching and can include a range of physical, social and economic infrastructure. Community infrastructure includes places where people can relax and enjoy public spaces such as parks or the various seating areas located along the south quays. There are a wide range of community and social services available in Waterford City and its environs. These include education and religious facilities including, primary, secondary and third level, places of worship, community centres. Community facilities include parks, sports grounds and other sports and youth centres/ clubs that are located across the study area. All of these community facilities are considered to be significant and sensitive receptors within the study area.

No community facilities were identified within 500m of the study area (with the exception of Plunkett Station. Community facilities within Waterford City and the wider urban area include: Garda stations, post offices, libraries, the City Hall and the newly refurbished courthouse. There are also a number of public spaces throughout the city / the study area including William Vincent Wallace Plaza located on the south quays, the Peoples Park, Ballybricken Green and Red Square. The recently refurbished Apple Market is a key public space which is also located in the study area.

Education facilities

Educational facilities are a significant local and regional resource and are considered sensitive receptors. Waterford City has a range of education facilities from early education (créches) to third level. Waterford Institute of Technology (WIT) is a significant education facility in the city and region. WIT is located approximately 2.5km south west of the study area and has approximately 10,000 students. No educational facilities are present within the study area (500m). However, a large number are located in the wider study area and are listed below:

North of the River Suir:

- Abbey Community College and Ferrybank Secondary School; and
- St. Mary's Boy School.

South of the River Suir:

- St. Stephen's De La Salle Primary School;
- St. Joseph's Special School;
- Mount Sion CBS Secondary School;
- Mount Sion Primary School;
- Calvary School of Ministry;
- Our Lady of Mercy Secondary School;
- Our Lady of Mercy Senior National School;
- Presentation Primary and Secondary School;
- St. Declan's National School;
- Christchurch National School;
- Waterpark, De La Salle College;
- Newtown School;
- St. John of God, Newtown Junior School;
- Christchurch National School; and
- Waterford College of Further Education

Similarly, there are no childcare facilities present within the study area (500m). However, a large number are located in the wider study area and are listed below: Bumble Bees Creche & Playgroup, FerryFun childcare and Afterschool centre, Jeanes Montessori school, Mercy Preschool Ltd., Mount Sion play/preschool, Nurture and Grow, Play Together, St Brigid's Children's Centre, St Declan's pre-school, St Joseph's Childcare Centre, St Stephens Preschool, The Children's House Montessori School, Waterford Montessori school, Waterford Women's Centre Childcare Service. Ferrybank Library is located to the north of the city and Waterford City and County library is located on Lady Lane in the south of the city centre.

Transport infrastructure

Road Infrastructure

The road transport network within the study area consists of the R680 Regional Road which carries traffic across the River Suir via Rice Bridge to and from Waterford South Quays. The Rice Bridge roundabout located on the north quays provides a connection to the regional road network between the city and the wider area. To the east of the roundabout, the R711 Dock Road serves the Ferrybank/Belview area before joining the N29. The R448 Terminus Street is a dual carriageway and comes towards the Rice Bridge roundabout from the west and carries traffic to and from the city via its connection to the N25. The R448 dual carriageway is located to the north of the study area.

Waterford City is connected to major surrounding regions, towns and cities through bus and train services and there is a high concentration of commuting traffic to, from and through Waterford City.

Rail Infrastructure

The study area of the proposed development contains the Waterford Railway corridor serviced by Plunkett Station, Waterford railway station. Presently, Plunkett Station serves as a significant interchange point for Intercity services from Dublin Heuston and from Limerick Junction which provides onward connections to Cork, Limerick and

Galway. Before the Covid-19 pandemic, seven train services operated each way between Waterford and Dublin from Monday to Saturday inclusive, while only four services were provided each way on Sundays. Only two train services operated each way daily between Waterford and Limerick Junction on Mondays to Saturdays inclusive.

Until 18th September 2010, there was one daily service provided each way between Waterford and Rosslare to the east along the North Quays and via Belview, however due to low passenger numbers and competition with the road network, the rail corridor was suspended (NTA, 2010). The rail service was replaced by bus services to provide connection to Waterford City from Rosslare. This railway corridor east of Plunkett Station is currently out of service and maintained by Iarnród Éireann.

The operation of the rail infrastructure in Waterford City has been impacted by recurring flood events. Over the past 15 years, flooding at, and in the vicinity of Plunkett Station has been reported in news articles and observed by the Iarnród Éireann (IÉ) Inspection Staff – the latest being in October of 2020 (see Chapter 2 Need for Proposed Development of this EIAR). It has been found that large sections of the existing quay walls which separate the rail infrastructure from the River Suir are of inadequate height and are below the design flood level of 4mOD, rendering it ineffective at protecting IÉ lands and associated rail infrastructure against flooding. The flood waters frequently enter into Iarnród Éireann (IÉ) property and affect the railway infrastructure.

Marine based community infrastructure

The River Suir serves an amenity function as well as a transport corridor. It is also the location for a number of marine based community services including Waterford City River Rescue and Waterford Marine Search and Rescue (WMSAR) both of which operate east of the proposed development. Both organisations operate on a voluntary basis and are non-profit organisations and provide 24 hour a day, 365 days per year search and rescue services on the River Suir.

Waterford City River Suir Rescue base is at the Millennium Plaza (approximately 850m downstream of the proposed development) and is a member of the Community Rescue Boats of Ireland (CRBI) and affiliated to the Irish Coast Guard.

WMSAR is based further downstream (approximately 1.5km east from the proposed development) and is also a part of the CRBI and conducts suicide prevention night patrols along Waterford City's quaysides, participates in search and rescue, maintains and monitors ring-buoys among other activities. They are also an official Irish Sailing Association (ISA) training centre.

6.3.4 Economic Activity

The South East region generates 8% of the national Gross Domestic Product (GDP), estimated to be €19.9 billion[1]. There has been an overall decline in unemployment rates over the past number of years in the South East region which is a good indicator of economic activity. The following sections include a review of employment and key industries, unemployment rates and a review of commercial, retail and tourism activity in the area.

[1] Waterford Institute of Technology. 2017. *South East Economic Monitor*

6.3.4.1 Employment

The labour force consists of those who are able to work i.e., those aged 15 and over and out of full-time education. There was 91,631 persons at work in Waterford City and County in 2016 (census 2016), representing an increase of 2,416 persons recorded as working since the 2011 census. Table 6.12 provides a breakdown of the population employed in Waterford City and Suburbs at work by socio-economic group. The majority of the City's workforce (22%) are engaged in work under 'gainfully occupied and unknown', followed closely by 'non-manual' and then 'semi-skilled manual'.

Table 6.12 Persons in private households by socio-economic group Waterford City and Suburbs (census 2016)

Socio-economic group of reference person	Households	Persons
Z All others gainfully occupied and unknown	4,855	10,719
D Non-manual	4,174	10,629
F Semi-skilled	2,282	6,086
A Employers and managers	2,142	5,867
E Manual skilled	2,188	5,503
C Lower professional	2,041	5,197
B Higher professional	1,133	3,071
G Unskilled	1,247	2,908
H Own account workers	673	1,892
I Farmers	55	141
J Agricultural workers	23	56
Total	**20,813**	**52,069**

Persons at work by industry and sex in Waterford City and suburbs is presented in Table 6.13 from census 2016. These figures indicate that the majority of the workforce in the City and suburbs are engaged in professional services industry (5,476), the second largest industry is commerce and trade sector (4,510), with 'other' industry engaging 4,126 persons, followed by manufacturing industry (3,614) with a larger portion of this group involving males (2,592). Only 738 persons are employed in the building and construction industry which would be likely to increase with the proposed development and also the wider regeneration presented as a result of the NQ SDZ Planning Scheme.

Table 6.13 Persons at work by industry and sex Waterford City & suburbs (census 2016)

Industry	Male	Female	Total
Professional services	1,714	3,762	5,476
Commerce and trade	2,236	2,274	4,510
Other	2,046	2,080	4,126
Manufacturing industries	2,592	1,022	3,614
Transport and communications	946	300	1,246
Public administration	413	360	773

Industry	Male	Female	Total
Building and construction	688	50	738
Agriculture, forestry and fishing	105	26	131
Total	**10,740**	**9,874**	**20,614**

6.3.4.2 Unemployment

Census 2016 reports the average rate of unemployment in the State was 12.9%. Waterford City including its suburbs had the highest unemployment rate at 18.8% during this period.

6.3.4.3 Transport Infrastructure

There is extensive at-grade car parking extending from Merchants Quay east to Clyde Wharf that is operated by Q-Park. Other car parks in the city include: IPairc city square (on High street), Bolton Street car park, Ipairc Apple Market carpark, waterside car park, IPairc Railway Square car park and Thomas Hill car park.

Outside of the study area, significant economic and transport activity includes: Waterford Airport (approximately 8.5km south) and the Port of Waterford located at Belview Port and associated Industrial area that are sources of major economic activity, transport and trade. The road network is also important transport and economic infrastructure and includes many local, regional and national roads including, M9 to Dublin and N25 Cork to Rosslare Europort via Waterford and N24 national primary route serving Limerick to Waterford through Tipperary all located approximately 3km north west of the site.

6.3.4.4 Marine Based Economic Activities

There is significant marine based transport and economic activity on the River Suir. The marina to the east of the proposed development (Pontoon D) is owned and operated by Port of Waterford Company, currently leased to a private operator. The economic activities associated with the Port is located downstream at Belview Port.

Waterford City Marina is located on the south side of the River Suir and extends for approximately 650m east along the south quays. River Suir Cruises offer cruises of the River for tourism and amenity purposes and operate from Pontoon C (referred hereafter as the existing floating jetty). There are also occasional cruise ship and fishing vessels that berth in the area.

Fastnet Shipping Ltd. and South East Tugs, two commercial companies, operate on the south bank of the River Suir directly across the river from the proposed development and regularly use the River Suir channel.

The area is included in an International Ship and Port Facility Security Code (ISPS) which permits any ship to berth in this area. The International Maritime Organization (IMO) states that the ISPS code is a comprehensive set of measures to enhance the security of ships and port facilities, developed in response to the perceived threats to ships and port facilities in the wake of the 9/11.

6.3.4.5 Retail Activity

Waterford City has significant commercial and retail activity. There are several retail shopping locations, primarily in the south of the city and within the study area to include: Georges Shopping Centre and City Square Shopping Centre. The retail streets of Barronstrand Street, Broad Street and New Street are also important city centre retail and commercial areas along with Michael Street and Merchant's Quay.

Economic activity on the south quays include a number of hotels, restaurants, leisure facilities, retail, financial services including banking and accounting and other professional services.

The Economic Strategy for Waterford City and County stated that in 2013 "*Waterford has an estimated catchment of 250,000 people [and] estimates indicate that aggregate retail sales in the City currently amount to €287 million (convenience) and €393 million (comparison[2]) per annum*."[3] The current comparison retail offer is weak when compared with Waterford's main competitors. Both comparison scenarios considered in the Retail Strategy estimated the level of trade draw and retention of comparison expenditure within the city area will increase within the timeframe of the Strategy in line with improvements to the retail offer. It is likely that the proposed development will facilitate improved access to the NQ SDZ which is earmarked for significant retail development and as such will facilitate the growth in Waterford's retail offer and economic activity.

The Waterford City Retail Strategy Update (2018d) household survey found that "*approximately 92% of comparison goods expenditure in Waterford City is retained by the City Centre area and attracts a further 90% of comparison expenditure from the 0-30 minute drivetime isochrone and 52% from the 30-45 minute isochrone. The survey identifies an inflow of 8% of comparison expenditure from the 45-60-minute drivetime".*

6.3.4.6 Tourism Amenities

Tourism is a significant contributor to the region and local economy. In 2018, over 1,028,000 overseas visitors came to the South East region (Carlow, Kilkenny, Tipperary (South), Waterford, Wexford) generating €261 million in revenue[4]. Fáilte Ireland Key Tourism Facts 2018 report that the South East was the third most popular location for domestic trips in Ireland with over 1,683,000 domestic visitors travelling to the region generating €304 million revenue. Waterford City is located in 'Ireland's Ancient East' a marketing initiative developed by Fáilte Ireland which includes improved transport signage across Ireland to increase visitor numbers to Ireland's living culture and ancient heritage across Ireland.

A review of tourism related locations, community amenities and recreation facilities within the study area indicates that Waterford City has rich tourism and amenity offer including historical sites located in the heart of the city, nature walks and tours along the River Suir and surrounding area. The city has many support services including hotels, hostels, café, restaurants, tourist office, Theatre Royal, Edmund Rice centre, Garter Lane Theatre, etc. that would be considered to be significant and sensitive receptors. The Clock Tower is a significant and sensitive landmark feature along the historic south quays streetscape, located in the vicinity of the proposed south quays public plaza.

There is an amenity walkway along the existing flood defence wall on the south quays with a number of access points (gangways) to the various pontoons associated with Waterford City Marina.

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[2] Comparison goods include clothing/footwear, medial/ pharmaceutical, newsagents/ bookshops and bulky goods/ electronical equipment to include furniture, household appliances, tools/ equipment for household or gardens, small-scale hardware and, recreation and leisure products.

[3] Economic Strategy for Waterford City and County (2013) DKM Economic Consultants, Colliers Int. & Brady Shipman Martin

[4] Key Tourism Facts 2018, September 2019, Fáilte Ireland

The Waterford City to Dungarvan greenway has resulted in an increase in the number of visitors to Waterford City and the surrounding areas since its official opening in March 2017. Waterford City Council reported that in 2017 a total of 247,545 people used the greenway, of which 105,639 of this were on foot while 141,906 travelled by bike. The Waterford Greenway Bilberry car park is located on the south quays, approx. 1.4km west of Rice Bridge.

In the wider study area, on the south quays, other sites of interest include: The Waterford Viking Triangle which is part of the 'cultural quarter' in the City and includes Reginald's Tower (containing the Viking museum), Waterford Treasures Medieval Museum, King of the Vikings virtual reality experience and Bishop's Palace. Waterford Crystal is located on The Mall close to where guided tours are available. The Granary is also a site of interest on Merchant's Quay.

6.3.4.7 Marine related tourism activities

The River Suir is a significant tourism attraction, source of recreation and general amenity source for the city, mariners and its many tourists. Direct access to the River Suir from the city is via the Waterford Marina, which comprises six pontoons. All six pontoons have pedestrian gangways access points to the south quays. These accesses are located from east to west: Georges Quays and off Canada Street/ Canada Square, Adelphi Quay and Customs House Parade (beside William Vincent Wallace Plaza). Meagher's Quay (adjacent to the Clock Tower) and Merchants Quay. There is also some private mooring located off Adelphi Quay. Georges Quay is also the location of Waterford City Marina building.

The Waterford City Marina is fully serviced, open year-round with approximately 100 berths available. Mariners can avail of daily, weekly or seasonal rates. Access to the marina is by means of a mobile phone operated Global System for Mobile (GSM) communication system.

River Suir Cruises operate from this jetty and offer tours along the River Suir year-round.

Previous consultation with the marina operators undertaken for the River Suir Sustainable Transport Bridge EIAR which was completed in 2018, indicates that the marina is generally at capacity during peak summer months and on average 70% occupied at all other times of the year. The users of the marina comprise a significant proportion of local berth holders and visitors from Europe many of whom are from the United Kingdom including Milford Haven east of Waterford City in South Wales. Visiting boats generally stay up to 2 or 3 nights in the marina and have economic benefits to the wider City.

6.3.5 Health Profile

The majority of Waterford City reported that their health was either very good (56%) or good (29%) representing a total of 45,562 people (Census, 2016). 1.7% stated that their health was bad and 0.4% stated it was very bad (190 people). Census 2016 also reports that there were 8,333 people or 18% of the population with a disability in Waterford City. The number of carers was 2,114 persons. Types of disabilities can vary to include: physical disabilities, vision impairment. deaf or hard of hearing, mental health conditions and intellectual disability, etc.

The average lone parent ratio for the study area was 40.0 in 2016 (Pobal, 2016). The Lenus health profile for Waterford City published in 2015 (HSE, 2016) was also consulted and reports that Waterford City had the 3rd highest percentage of lone parent households of 13.5% in the State compared to the national rate of 10.9%.

Cancer incidence rates in Waterford City and County are average or below average for all cancers, except for male malignant melanomas and male lung cancer which has the highest rate nationally (City & County data 2015). Waterford City and County has average or below average death rates for all causes, except deaths due to cancers which are above the national average.

6.3.5.1 Levels of deprivation

The Haase and Pratschke (HP) deprivation index looks at geographical areas in order to measure the relative affluence or disadvantage of a particular geographical area. These are compiled from various census under 10 key indicators including: the proportion of skilled professionals, education levels, employment levels, and single-parent households found in an area. This data is particularly useful in assessing predicted health outcomes.

Overall the south east region is the second most disadvantaged region of Ireland and Waterford City is the second most disadvantaged area within the region. Analysis of census statistics together with Pobal data indicate that Waterford City South is the third most disadvantaged local electoral areas in the State with a deprivation score of -9.4 after Cork City West (-12) followed by Glenties (-10.6)[5].

The HP Pobal deprivation scores (Table 6.14) indicate that the majority of the study area is either 'marginally below average' affluence or 'disadvantaged'. Morisson's Road ED located within the south quays of the study area has a HP deprivation score of -20.32, 'very disadvantaged'. In contrast, the Park ED ranked the least deprived of all the areas in the study area but still scored 'marginally below average'. The combined HP Index deprivation score of the study area (500m) is -6.01.

Table 6.14 HP Pobal Deprivation Scores in the Study Area

ED's within 500m Study Area	Deprivation Score 2016	Deprivation Description
Aglish	-3.16	marginally below average
Ferrybank	-10.98	disadvantaged
Kilculliheen	-0.17	marginally below average
Custom House B	-5.20	marginally below average
Centre A	-2.49	marginally below average
The Glen	-4.61	marginally below average
Bilberry	-9.86	marginally below average
Military Road	-13.83	disadvantaged
Cleaboy	-3.73	marginally below average
Gracedieu	-3.26	marginally below average
EDs within 1km Study Area		
Dunkitt	-0.87	marginally below average
Shortcourse	-14.32	disadvantaged

[5]Trust Hasse & Jonathan Pratschke (2017) The 2016 Pobal HP Deprivation Index For Small Areas

ED's within 500m Study Area	Deprivation Score 2016	Deprivation Description
Ballybricken	-9.71	marginally below average
Custom House A	-4.98	marginally below average
Centre B	-10.28	disadvantaged
Mount Sion	-8.39	marginally below average
Morrison's Avenue East	-10.22	disadvantaged
Morrison's Avenue West	-18.08	disadvantaged
Morrison's Road	-20.32	very disadvantaged
Newport's Square	-18.57	disadvantaged
Park	0.33	marginally above average
Slievekeale	-12.23	disadvantaged
Waterford City	**-9.2**	marginally below average
Waterford County	**-4.6**	marginally below average
Source: Census 2016 and Pobal		

Historically, a number of the EDs within the study area have been targeted for investment and revitalisation through the Waterford RAPID programme which was recast in 2017 to become the Community Enhancement Programme (CEP). Other programmes such as the Social Inclusion and Community Activation Programme (SICAP) aims to reduce poverty and promote social inclusion and equality. SICAP in the study area is overseen and managed by the Local Community Development Companies operating in the area namely, Waterford Area Partnership and County Kilkenny Leader.

6.3.5.2 Collisions Statistics

The Road Safety Authority reports on collisions across Ireland. Plate 6.5 illustrates road collision from 2005 to 2016 across all modes of transport (pedestrian, bicycle, motorcycle, car, goods vehicles, bus and other). This information shows that there has been a high level of collisions occurring across the study area particularly along the south quays and on Rice Bridge.

Seven fatal collisions have occurred in the study area, see Chapter 5 Traffic Analysis for details.

Several other serious pedestrian collisions occurred along the south quays and dock road have occurred in addition to numerous minor collisions involving pedestrians, bicycle, goods vehicles, motorcycle, and cars occurring along the south quays and in a number of places across the study area. These collisions indicate there are safety issues along the roads in the vicinity of the study area.

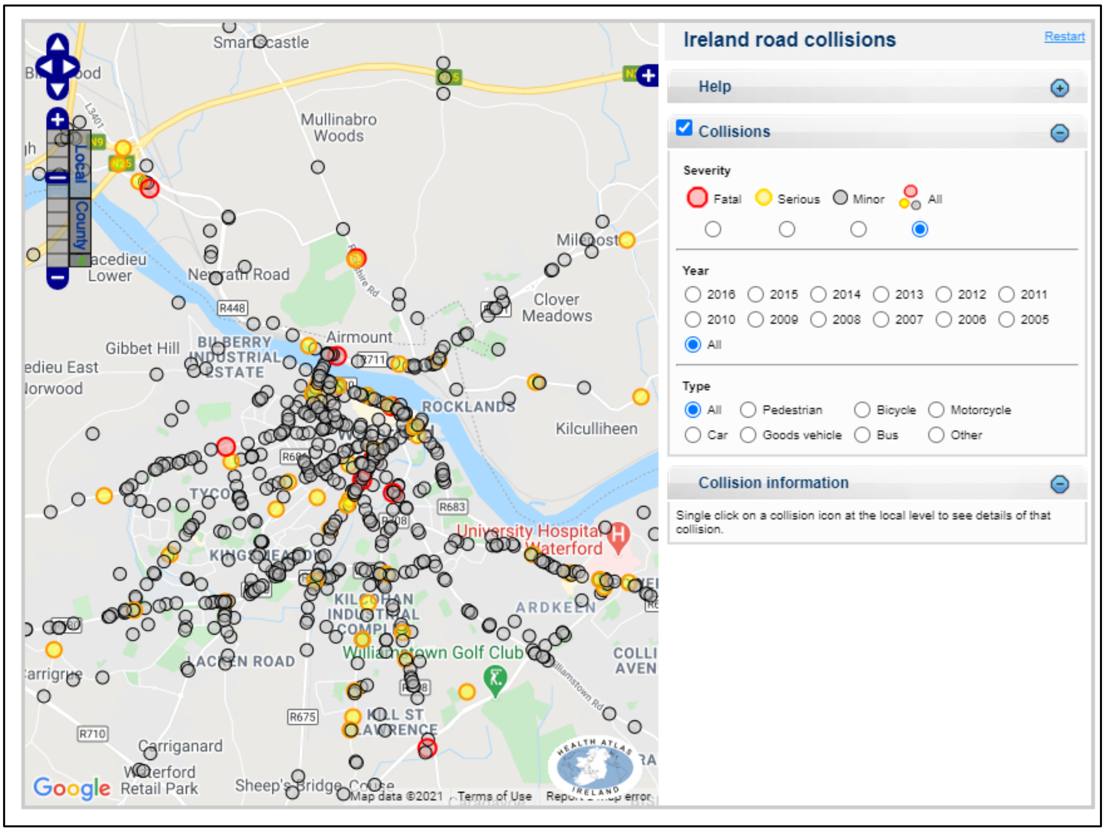

Plate 6.5 **Study Area Road Collisions Source: Road Safety Authority**

6.3.5.3 Major Accident / Seveso Sites

Human health and the environment are at risk of serious injury due to major industrial accidents which involve dangerous substances. All planning applications within 700m of Seveso sites require referral to the Health & Safety Authority (HSA) for technical advice in order to reduce the risk and limit the consequences of major industrial accidents. The Trans-Stock Warehousing and Cold Storage Limited is designated as an Upper Tier establishment under the Major Accident Seveso III (Directive 2012/18/EU). The site is located approximately 1.5km from the proposed development in Christendom, Ferrybank, see Chapter 18 Major Accidents and Disasters for more details.

6.3.5.4 Noise Environment

A baseline environmental noise survey was conducted in the vicinity of the proposed development in order to quantify the existing noise environment in the vicinity of the noise-sensitive locations that may be affected by the proposed development. The Noise and Vibration Chapter 12 details the results of this assessment. The potential for vibration at neighbouring sensitive locations during construction is typically limited to excavation works, piling activities, breaking operations and lorry movements on uneven road surfaces. The results of the noise survey from Chapter 12 indicate that the baseline noise levels at all locations assessed are dominated by existing traffic flows along the roads within Waterford City and train movements.

6.3.5.5 Air Quality Environment

Air quality in Ireland and in the area of the proposed development is considered to be good. Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality "Air Quality in Ireland 2019 (EPA 2020), details the range and scope of monitoring undertaken throughout Ireland. Long-term monitoring data has been used to determine background concentrations for the key pollutants in the region of the proposed development. The background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.) Chapter 13 details the results from this monitoring.

6.3.5.6 Radon

Radon is a naturally occurring radioactive gas that originates from the decay of uranium in rocks and soils. It is colourless, odourless and tasteless and can only be measured using special equipment. The proposed development is located in a high radon area. 'High Radon Area' is one in which more than 10% of homes are predicted to have radon levels in excess of the reference level of 200 Bq/m^3. Radon rises up through the ground to disperse in the air and only becomes a health hazard when it is trapped in buildings.

6.4 Predicted Impacts on Population and Human Health

In accordance with the EPA Guidelines and the above methodology, the following sections provide an overview of the predicted impacts on:

- Land use and social considerations, including effects on general amenity, journey characteristics, journey amenity and severance.
- Economic activity including tourism e.g. employment and population including associated land use.
- Human health, considered with reference to and interactions with other environmental receptors contained in corresponding chapters such as air, noise, traffic, as appropriate.

Likely or predicted significant impacts are split based on construction and operational phases under the headings above.

6.4.1 Construction Phase

6.4.1.1 Land Use and Social Considerations

Land use

Construction compounds will be located wholly within the IÉ landownership boundary. The lands are currently used as Irish Rail Yards with adjacent scrubland. General land use changes from Irish rail yards to construction sites/ compound is likely to have a *negative, imperceptible - slight*, *temporary* impact on landuse characteristics of the area throughout the construction period.

The construction of an impermeable trench within the car parking areas of Plunkett Station will temporarily restrict the number of parking spaces at the station, having a *negative, slight and temporary* impact on this land use.

Journey Characteristics, journey amenity and severance

Construction traffic will consist of vehicles transporting sheet piles, material required for construction and the movement of construction vehicles to and from the site, including cranes and other general construction traffic. Construction activities may impact on journey times during specific periods as part of construction works for both roads and navigational channel users. The main access route to the main construction compound is the R448 Regional Road which has a direct connection to the N25 National Road. A local road off the R448, near Newrath roundabout, goes directly to the proposed main construction compound location. An ancillary construction compound at Sally Park depot can be reached directly from the R448.

Chapter 5 Traffic Analysis determined that at the peak of the construction stage, the proposed development will result in an 0.1% increase in total traffic movements and an increase of 1.2% in HGV movements over the course of a working day on the R448 Terminus Street. Temporary traffic management arrangements are to be implemented to facilitate ongoing access for road users throughout the works. The potential impacts are likely to have *negative, temporary, not significant* impacts on the existing road network.

Construction of the overground flood defences at Rice Bridge roundabout will necessitate implementing traffic management to ensure the continuity of travel. Additionally, small sections of the pedestrian footpaths on the roundabout may be temporarily closed while the glass flood barriers are being installed, requiring minor diversions. The proposed works at Rice Bridge are estimated to be undertaken over 6 - 8 weeks. The potential impacts on users are likely to be *negative, imperceptible to slight* and *temporary* due to localised diversions of road traffic and pedestrian footpaths.

Access will be maintained to Plunkett Station and properties throughout the construction phase therefore no severance is predicted. Pedestrians will experience *imperceptible, neutral, temporary* severance.

The construction of an impermeable trench will require the closure of the western car park of Plunkett station for approx. 2 weeks, and for 10 weekends at the eastern car park reducing the number of car parking spaces at the station. However, the construction works will be carried out in a phased approach, whereby the eastern section of the car park will be open while the works to the western section are carried out and vice versa, ensuring that the car park remains open to the public throughout the construction phase. It is likely that there will be *negative, slight and temporary* impacts on journey characteristics.

The proposed development will not have any impacts on the rail commuter services as night-time works will be carried out when rail possessions are necessary.

Access will be maintained on the navigational channel throughout the construction phase. All boat users including search and rescue organisations vessels will continue to have access as required, therefore *no significant* impact on marine journey times is likely.

The riverside sheet-pile wall installation works will be carried out from a maximum of 2 barges positioned within the River Suir in the vicinity of the northern bank, and as such, the proposed riverside works are not likely to obstruct the navigational passage of commercial and recreational vessels during the construction phase. However, piling construction activities at the site may cause annoyance or nuisance to maritime recreational users of the River Suir over the duration of the construction phase. As such, the construction phase has the potential for *negative, slight to moderate, temporary* impacts on maritime recreational users.

Community Facilities

There is potential for community uses such as school traffic using the R448 & R680 Regional Roads to be impacted in the vicinity of the construction site however, these impacts are not likely to be significant or change the use of community facilities. The works contractor, when appointed, will be required to finalise the Construction Environmental Management Plan (CEMP) submitted with this application (see Appendix 4.1 A) and the traffic management procedures (as outlined in the CEMP) that maximises the safety of the workforce and the public, and minimises construction traffic generation and disruption, while maintaining access to properties at all times. The CEMP will be developed in consultation with Waterford City & County Council. The potential impacts are likely to be *negative, imperceptible to slight* and *temporary*.

6.4.1.2 Economic Activity

It is envisaged that that the proposed development is a sufficient distance away from the Waterford City Core economic area that impacts to amenity and journey characteristics will be limited during the construction phase. Impacts / disruptions resulting from temporary noise, and visual disruption may impact sensitive sites such as hotels and other commercial properties in the vicinity and are likely to have a *negative, slight to moderate temporary* impact on economic operators*.*

The construction stage will result in direct employment of construction workers for the 30 to 35 -week construction programme. Additional indirect employment and economic activity is likely due to provision of goods and services during construction stages. The proposed development during the construction phase is likely to have a positive, slight, and *temporary* impact on employment.

Marine based economic impacts

The River Suir will remain navigable to all marine based traffic throughout the construction stage. However, it is likely that there will be *negative, slight*, and *momentary* impacts to marine based operators during the construction stage primarily as a result of the presence of construction barges and transportation of materials on the River Suir. The contractor will be required to communicate the Traffic Management procedures (as outlined in the CEMP) to the Harbour Master and the Port of Waterford Company to minimise disruption to economic and social activities.

Marine Tourism Impacts

The majority of construction activities will be carried out within and in vicinity of the River Suir, and may be *indirect, negative, slight,* and *temporary* impacts on marine tourism. The proposed works may affect the attractiveness and amenity value of the River Suir and may impact on tourist numbers visiting both the south quays and boats berthing from overseas at Waterford City Marina.

6.4.1.3 Human Health

As already stated, environmental health standards are set to protect the vulnerable and not the robust, who are generally more resilient to changes in their environment. In accordance with the methodology outlined in Section 6.2.7, a summary of likely significant human health impacts/ hazards relating to the proposed development have been identified to include:

- Impacts of collisions/risks of accidents;
- Impacts of Emissions to Air;
- Impacts of Noise Emissions;
- Impact of Emissions to Hydrology and Hydrogeology;
- Psychosocial hazards; and
- Effects on physical activity.

Chemical and biological hazards will remain a possibility in certain limited circumstances during the construction and operation phases from potential traffic, spillages or accidents. Mitigation measures have been put in place throughout the various chapters of this document which aim to avoid, prevent and mitigate for any spillages / accidents during construction stage. These will be managed at detailed design and in accordance with best practice construction methods relating to good housekeeping and implementation of environmental, health and safety standards throughout the lifetime of the project as required by EU Directives, statutory legal requirements and national construction and employment law as appropriate and for this reason are not considered further as part of this environmental assessment.

Prior to any demolition, excavation or construction, the Construction Environmental Management Plan (CEMP) appended to this application (see Appendix 4.1A) will be finalised by the successful contractor. The CEMP will set out the Contractor's overall management and administration of the construction project. The CEMP will be finalised by the Contractor during the pre-construction phase to ensure commitments included in the statutory approvals are adhered to, and that it integrates the requirements of the outline CEMP, Environmental Operating Plan (EOP) and the Construction and Demolition Waste Management Plan (CDWMP).

6.4.1.4 Impacts of Collisions/ Risk of accidents

Construction activities may increase the risk of collisions due to an increase in the number of movements of HGVs entering and exiting the construction compounds on haulage routes, and during the construction of the overground flood defences at Rice bridge roundabout. Vulnerable persons in the population (the very young, elderly or disabled) are likely to be more at risk in this respect. The successful contractor will be required to prepare a CEMP and an Incident Operating Plan (IRP) in advance of the commencement of works, in order to ensure the safety of site personnel and members of the public and minimise construction phase-related traffic delays and disruptions. The proposed development is not likely to significantly increase the risk of accidents and collisions.

Construction workers will be exposed to a risk of potential accidents occurring while working at or near water. The Environmental Operating Plan (EOP) will be required to address these risks and detail measures to address health and safety risks as appropriate. Overall, *not significant, negative, temporary* impacts during the construction phase are predicted.

6.4.1.5 Impacts of Emissions to Air

The primary sources of air impacts that may affect air quality from the proposed development occur in the construction phase of the proposed development relating to dust generation and emissions from plant and vehicles. This can cause local impacts through air quality and dust nuisance at the nearest sensitive receptors. The assessment in Chapter 13 Air Quality and Climate relating to the sensitivity of the area to human health impact is low according to IAQM guidance (IAQM 2014). In the absence of mitigation there is the potential for *imperceptible, negative, short-term* impacts to human health as a result of the proposed development. Nonetheless, standard mitigation measures are to be incorporated as outlined in Chapter 13.

6.4.1.6 Impact of Noise and Vibration Emissions

The results of the noise survey completed as part of this EIAR as detailed in Chapter 12 Noise and Vibration indicate that the baseline noise levels at all locations assessed are dominated by existing traffic flows along the roads within Waterford City and train movements directly adjacent to the proposed development. The risk hazards include a variety of items of plant which will be in use for the purposes of site clearance, demolition and construction.

Noise levels for all other day time construction activities at all other receptors are predicted to be lower than the designated construction noise thresholds. All day-time activities have the potential to cause a *negative, slight* to *moderate* impact at all receptors.

The construction of an underground isolation structure and a c.50m section of the landside sheet pile wall will be undertaken over a four-week period during night-time possession works. It is expected that these works may cause a *negative, significant* and *temporary* impact at receptor R3 (residential properties), see Chapter 12 Noise and Vibration of this EIAR for further details.

Whilst the entire programme of works is expected to last approx. 7 months, individual activities such as piling will likely last for a smaller percentage of the entire programme (approximately 4 weeks of night-time piling is required) and as such, these exceedances will not be occurring continuously throughout the construction phase. The piling works are expected to take place at a range of distances from the sensitive receptors.

The Contractor undertaking the construction of the works will be required to take specific noise abatement measures and comply with the host of mitigation measures and noise monitoring programme set out in the Chapter 12.

Chapter 12 also assessed the vibratory piling works that will be carried out for the proposed flood defence wall. The closest receptors to the sheet piling works are the commercial properties at Sally Park yard, at approximately 20m distance from the works. It can be seen that vibration magnitudes at 20m distance are below those associated with cosmetic damage to buildings. These works will take place in a controlled manner and during daytime hours. The vibration assessment found that the works will not emit vibrations that may cause building damage and therefore are not likely to impact on human health. Given the distances between works and receptor locations it is expected that vibration impacts will be *negative, temporary and imperceptible to slight* impacts are likely.

6.4.1.7 Impact of Emissions to Hydrology and Hydrogeology

Water quality

There are no surface water abstraction points for potable water within the study area (or downstream on the River Suir) and therefore it is not considered to be a significant human health issue in this context. However, mitigation measures are proposed as part of this EIAR in Chapter 7 Biodiversity and Chapter 10 Hydrology in order to mitigate any likely contaminants entering the water table and the River Suir which may potentially affect human health during the construction phases. Therefore, no further mitigation is deemed to be required as part of this assessment.

Flood Risk

There is potential for flood events to occur during the construction phase. The construction works will increase the number of people near a known source of flooding, thus increasing the potential for flood risk related impacts on human health. However, with the inclusion of mitigation measures outlined in the CEMP and IRP during the construction phase, these is an expected *negative, temporary, imperceptible to slight* impact.

Hydrogeology

Sheet piles will be the primary method for achieving flood defences. Chapter 9 Hydrogeology of this EIAR found that there is likely to be an *imperceptible* impact on hydrogeology during construction phase.

6.4.1.8 Impacts of Emissions to Soil

Chapter 8 Soils and Geology of this EIAR was consulted regarding potential for contaminated land. The results indicate that there are no known existing contaminated soils and all borehole samples were classified as non-hazardous. During the construction stage, mitigations measures to reduce any adverse impacts to soils and surface water quality are described in Chapter 8 Soils and Geology and in Chapter 9 Hydrogeology.

6.4.1.9 Psychosocial Impacts on Human Health

Consideration of likely psychosocial hazards relating to the proposed development include nuisance, annoyance, and anti-social behaviour. During the construction phase, the proposed development has the potential to create nuisance particularly due to emissions from noise, air and dust that can impact on psychological health (described above). The construction activities are limited to specific locations and daytime periods for use of certain plant and machinery in order to reduce impacts to sensitive receptors. There is potential for an increase in noise levels during construction to cause nuisance and annoyance. Based on the results of Chapter 12 Noise and Vibration, during construction, daytime activities are expected to cause a *negative, slight to moderate temporary* effects and not significant impact at all receptors. During the night possession works for the underground isolation structure it is expected that a *negative, temporary, significant* impact will occur at R3 over the four-week period, Monday to Friday. Whist individual annoyance as a result of temporary increase in noise levels cannot be discounted, annoyance is not a heath effect. Therefore, impacts on Human Health are predicted to be *negative, temporary,* and *not significant*.

6.4.1.10 Other Physical Effects

The construction stage is not likely to result in changes / impact significantly to physical activity during the construction stage.

6.4.2 Operational Phase

6.4.2.1 Land use and Social Considerations

Land use

The proposed flood defences will encroach into the River Suir estuary ~1-2m for approximately 540m. Therefore, a minor amount of reclaimed land will be created in between the new defences and the existing wall. The reclaimed land will be managed by Irish Rail and the treatment and appearance of the area will be in keeping with railway and associated lands.

Development Plans for both Waterford and Kilkenny promote sustainable growth in the northern bank of Waterford City. The northern suburb of Ferrybank is within the administrative area of KCC and is also included in the Waterford Metropolitan Area Strategic Plan (MASP) area. The Kilkenny City and Count Development Plan 2021 - 2027 is supportive of the Waterford MASP as outlined in the Regional Spatial and Economic Strategy (RSES) for the Southern Region, which identifies policy objectives supporting sustainable mobility and improved regional connectivity to / and from Waterford, including rail connectivity.

The proposed Flood Defences West will form a continuation of the flood defences east which received planning approval as part of the SDZ Transportation Hub and will cumulatively protect the existing and future land use within the Waterford City North Quays area against existing and future flood risk. As such, the proposed development will assist the Kilkenny City and County Development Plan 2021 - 2027 to realise its sustainable development objectives by enabling sustainable growth of the areas on the northern side of the River Suir, such as Ferrybank. The proposed development is likely to have *positive, slight to moderate* impacts on land use within the north quays area of Waterford City.

Journey Characteristics, Amenity and Severance

The nature of the proposed development means that during the operational phase there will be a positive impact to road traffic. The overground flood defences at Rice Bridge roundabout will protect the road infrastructure and adjacent roads in extreme flood events. The predicted impact is *positive, moderate to significant and long-term*.

The introduction of the proposed development will increase resilience of the existing rail services. Previous flood events have resulted in disruptions to rail services to Plunkett Station. It is envisaged that, although rail services would be halted in extreme flood events, the defence against flooding for the railway corridor would lead to less maintenance and repair work post flood event, thus increasing service provision and reliability and can potentially result in increased uptake of rail as a mode of travel. The expected impact is *positive, significant,* and *long-term*.

During operation, the proposed flood defences will have no impact on marine navigation.

Community Facilities

Unobstructed access will be maintained to the navigable reach of the River Suir for search and rescue vessels (Waterford City River Suir Rescue and WMSAR) in order to patrol the river. The proposed development will not obstruct the navigation channel and therefore, will not impact on search and rescue services.

The proposed development will increase reliability of existing transport 'community' infrastructure such as the train services and subsequently increase access to education, religious, recreational and employment opportunities. The likely impact on community facilities is *positive, slight to moderate* and *long-term*.

6.4.2.2 Economic Impact

The proposed development will protect the strategic rail infrastructure connecting Waterford City to the rest of the country. Previous recurring flood events have resulted in significant monetary costs for the repair of sensitive rail network components. A minor increase in maintenance expenses is anticipated but this is negligible compared to long term savings afforded by the scheme. The predicted impact is *positive, significant,* and *long term.*

During operation, the proposed flood defences will have negligible impact on marine based economic activities. The navigational channel will remain navigable after construction, and no other economic impacts are predicted.

6.4.2.3 Human Health

Flooding can result in deaths, injuries and mental health illnesses during the flood event itself, during the recovery process, or from subsequent effects brought about by damage to major infrastructure such as health facilities, infrastructure, ecosystems, food and water supplies (WHO, 2017).

Although the lands proposed to be defended are mainly industrial, there is the potential risk to workers and users of the rail service. The proposed flood defences will reduce flood risk and thus benefit human health, resulting in a *positive, moderate to significant long-term* impact.

6.4.2.4 Impacts of Collisions/ Risk of accidents

It is not envisaged that there will be any impacts to Collisions/ Risk of accidents during the operational phase. The likely impact is *neutral, imperceptible,* and *permanent* to Collisions/ Risk of accidents.

6.4.2.5 Impacts of Emissions to Air Quality and Climate

Due to the nature of the proposed development, there will be no emissions to atmosphere during the operational phase. Therefore, there is no potential for impacts to air quality or climate as a result of the proposed development. The operational phase is considered *neutral* in terms of air quality and climate.

6.4.2.6 Impacts of Noise Emissions

As there are no predicted noise and vibration impacts during the operational stage, the likely impact is therefore *neutral.*

6.4.2.7 Impact of Emissions to Hydrology and Hydrogeology

Water quality

There are no surface water abstraction points for potable water within the study area (or downstream on the River Suir) and therefore it is not considered to be a significant human health issue in this context. The minor amendments to the existing drainage networks will likely have a *positive slight to moderate, long-term* impact as discussed in Chapter 10 Hydrology. Therefore, no further mitigation is deemed to be required as part of this assessment.

Flood Risk

The proposed development will defend lands, rail and road infrastructure on the north quays in extreme events from flooding. Through the design of the proposed development, the likely impact is seen as *positive, significant* and *long term*.

6.4.2.8 Psychosocial Impacts on Human Health

Consideration of the negative psychosocial hazards relating to the proposed development include potential for nuisance, anti-social behaviour. The proposed development is located on the periphery of Waterford City on lands that will not be open to the public. As a result of the isolated nature of the site which is in the private ownership of CIÉ (operated by IÉ) and the nature of the development during the operation phase, it is unlikely that the proposed development would result in negative psychosocial effects.

6.4.2.9 Other Physical Effects

Effects on physical activity

The proposed development site will not be open to the public and as such it is not likely to result in changes / impact significantly to physical activity during the operational stage.

6.5 Mitigation & Monitoring Measures

The design process, site visits and consultation undertaken to date has allowed for the inclusion of a number of mitigation measures for Population and Human Health as part of the design of the Flood Defences West development.

6.5.1 Construction Stage Mitigation Measures:

Develop and implement all mitigation measures detailed in Chapter 4 (Description of the Proposed Development); this is to include development of Construction Environmental Management Plan (CEMP) and associated traffic management proposals to address all modes of transport and will be required to be agreed with WCCC prior to construction stage.

- The CEMP will be required to maximise the safety of the workforce and the public and minimise traffic delays, disruption and maintain access to properties.
- The CEMP will also address temporary disruption to traffic signals, footpath access and the management of pedestrian crossing points.
- The contractor shall provide an appropriate information campaign for the duration of the construction works.
- The CEMP should minimise disruption to economic, marine users and residential amenities to be agreed by WCCC prior to construction and ensure access is maintained along the R448 & R680 for vehicles, pedestrians, cyclists, and economic operators at all times and ensure marine navigation is maintained.

Include appropriate measures relating to working near water as part of EOP.

The contractor will be required to develop and implement Stakeholder Management and Communication Plan and will be required to be agreed with WCCC prior to construction stage.

- All stakeholders will be required to be agreed with WCCC prior to construction commencing.
- Details of the general construction process/phasing will be communicated to the relevant stakeholders prior to implementation to ensure local residents and businesses are fully informed on the nature and duration of construction works.

Noise and Vibration mitigation will be provided for during construction of the development. Measures to mitigate noise and vibration impacts on sensitive receptors are detailed within Chapter 12 Noise and Vibration. The contractor will work within stringent construction limits and guidelines to protect residential and commercial amenities including the application of binding noise limits, hours of operation, along with implementation of appropriate noise and vibration control measures.

In order to minimise dust emissions during construction, a series of mitigation measures have been prepared as part of Chapter 13 Air Quality and Climate. Provided the dust minimisation measures are adhered to, the air quality impacts during the construction phase will not be significant. No further mitigation measures are required.

Emissions from the construction activities such as dust and risk of accidents were found to be potential short-term, negative impacts. It was found that noise emissions from construction activities, plant and machinery on site is likely to have a significant noise impact within the immediate area during distinct construction phases (i.e. piling activities) of the development.

Nightworks will also have a significant impact during the short duration they are required. All construction stage impacts will be temporary in nature and reduced and managed by CEMP and associated EOP and CDWMP and the range of mitigation measures of this EIAR.

All construction works will be temporary in nature and will be carried out in line with best practice thereby minimising the likely significant impacts to the community and human health impacts. The contractor will work within stringent construction limits and guidelines to protect surrounding populations and amenities.

6.5.2 Operational Stage Mitigation Measures

No operational mitigation measures are proposed as part of the proposed development.

6.6 Residual Impacts

The construction phase is likely to have *imperceptible to slight, negative* temporary residual impacts to the traffic, air and land uses including economic and tourism facilities in the immediate vicinity of the construction activities including those in the marine environment. The noise and vibration assessment determined that during night possession works for the construction of the underground isolation structure and c.50m of the landside sheet pile wall, it is expected that *a negative, temporary, significant* impact will occur at R3 over the four-week period, Monday to Friday.

The assessment has found that the construction phase is likely to have negligible impact on journey characteristics and general amenity. However, it is also likely to result in positive impacts on the local economy due to employment and local expenditure by construction workers, purchases of local materials and services.

During the operation phase, the proposed development will result in a *significant, positive, long-term* impacts due to the development defending lands north of the River Suir with benefits to the economy and human health.

The operation of the development will provide many significant positive impacts to the city which include the following;

- Protecting the existing rail and road infrastructure such as Plunkett Station and the Rice Bridge roundabout from existing and future flood risk.
- Upgrading the existing drainage network within the extents of the proposed development by increasing its capacity to account for extreme weather events induced by climate change.
- Eliminating costs associated with flood damage on built assets, particularly the rail infrastructure at, and to the west of Plunkett Station and the road infrastructure, specifically Rice Bridge roundabout.

The assessment found that the proposed development is likely to result in positive long-term change to human health by reducing flood risk. The development will also benefit the adoption of sustainable transport for the population's journey characteristics, journey amenity and general amenity due to the improvement in transportation infrastructure resilience.

6.7 References

Atkins (2004) *Waterford Planning, Land Use and Transportation Study (PLUTS) 2004-2020*

Central Statistics Office. 2017. Census 2016. [ONLINE] Available at: https://www.cso.ie/en/. [Accessed 18 July 2018].

CSO. (2017). *Ireland - Facts and Figures 2017*, Central Statistics Office, Ireland.

Department of the Environment, Community and Local Government. (2002) *National Spatial Strategy 2002-2020.*

CSO Suicides classified by county of residence of deceased, 2008-2014 [Online] Available at https://www.cso.ie/en/releasesandpublications/ep/p-vsar/vsar2014/deaths2014/ [Accessed 01/08/2018]

Department of Transport (2013) *The Design Manual for Urban Roads and Streets*.

Department of Transport Tourism and Sport & Department of Environment, Community and Local Government (2013) *Design Manual for Urban Roads and Streets*

Design Manual for Roads and Bridges (1993) Volume 11 Section 3, Part 8, Department of Transport, United Kingdom

DKM Economic Consultants, Colliers Int. & Brady Shipman Martin (2013) *Economic Strategy for Waterford City and County.*

Dublin and Mid East Regional Authorities. 2010. *Regional Planning Guidelines for The Greater Dublin Area 2010-2022.*

Environmental Protection Agency. 2002. *Guidelines on the Information to be contained in Environmental Impact Statements.*

Environmental Protection Agency. 2003. *Advice Notes on Current Practice (in the preparation of Environmental Impact Statements).*

Environmental Protection Agency. 2015. *Updated Advice Notes on Current Practice (in the preparation of Environmental Impact Statements (Draft) September 2015.*

Environmental Protection Agency. 2017 *Guidelines on the information to be contained in Environmental Impact Assessment Reports, Draft August*

Environmental Protection Agency (2016) State of the Environment Report 2016, Ireland's Environment 2016 - An Assessment, Environmental Protection Agency, [Accessed 16/02/2018] http://www.epa.ie/irelandsenvironment/stateoftheenvironmentreport/]

Fáilte Ireland guidelines on the treatment of Tourism in an Environmental Impact Assessment (2011).

Fáilte Ireland (2018) Tourism Facts 2017 Preliminary (2018) [ONLINE] Available at: http://www.failteireland.ie/FailteIreland/media/WebsiteStructure/Documents/3_Resea rch_Insights/5_International_Tourism_Trends/Failte-Ireland-s-Tourism-Facts-2017-preliminary.pdf?ext=.pdf [Accessed 01/08/2018]

Government of Ireland. (2018). *Project Ireland 2040 National Planning Framework*. [ONLINE] Available at: http://npf.ie/. [Accessed 20 July 2018].

Health Service Executive. (2015). *Health profile Lenus The Irish Health Repository*

Homes and Communities Agency. (2014) *Additionality Guide*

Institute of Public Health. (2005). *Health Impacts of Transport: A Review* Available at: https://www.publichealth.ie/files/file/IPH_Transport_text_44pp.pdf [Accessed 01/08/2018]

Institute of Public Health (2009). Health Impact Assessment Guidance [ONLINE] Available at https://www.publichealth.ie/sites/default/files/documents/files/IPH%20HIA_0.pdf [Accessed 01/08/2018]

Kilkenny County Council. (2021). *Kilkenny City and County Development Plan 2021 - 2027*

Pobal 2016 https://maps.pobal.ie/ [Accessed 18 July 2018]

RSA. (2018). *Provisional Review of Fatal Collisions January to December 31st, 2017*. [ONLINE] Available at: http://www.rsa.ie/Documents/Fatal%20Collision%20Stats/Provisional_Reviews_of_Fatal_Collisions/RSA%20Provisional%20Review%20of%20Fatalities%2031%20December%202017.pdf. [Accessed 20 July 2018].

Southern Regional Assembly. (2017) *Regional Spatial and Economic Strategy Issues Paper*

Transport Infrastructure Ireland/ National Roads Authority (2008) *Environmental Impact Assessment of national road schemes- A practical guide (Revision 1, November 2008)*

Toronto Public Health (2018) *Interventions to Prevent Suicide from Bridges: An evidence review and jurisdictional scan [Online] Available at: https://novascotia.cmha.ca/wp-content/uploads/2018/06/Interventions-to-Prevent-Suicides-from-Bridges.pdf [Accessed 06/03/2018]*

Trust Hasse & Jonathan Pratschke. (2017) *The 2016 Pobal HP Deprivation Index For Small Areas.*

United States Environmental Protection Agency. (2014). *Framework for Human Health Risk Assessment to inform Decision Making*. USEPA. [ONLINE] Available at: https://www.epa.gov/sites/production/files/2014-12/documents/hhra-framework-final-2014.pdf [Accessed 01/08/2018]

Waterford City Council and Loci, (2008). *Waterford North Quays - Urban Design Framework Plan 2008, Revision 2.*

Waterford City and County Council. (2012) *Waterford City Retail Strategy*

Waterford City Council (2013) *Waterford City Development Plan 2013 – 2019*

Waterford City and County Council. (2018a). *North Quays Planning Scheme*
Waterford City Council (2013a*). Waterford City and County Noise Action Plan 2013-2018*

Waterford City and County Council (2016) *One Waterford: Local Economic and Community Plan 2015-2020*

Waterford City and County Council (2018) *Waterford North Quays Planning Scheme*

Waterford City and County Council. (2018b). *North Quays Strategic Development Zone Traffic and Transportation Impact Assessment* (TTIA) prepared by Roughan and O'Donovan Consulting Engineers.

Waterford City and County Council. (2018c). *North Quays Strategic Development Strategic Environmental Assessment* prepared by Roughan and O'Donovan Consulting Engineers.

John Spain and Associates (2018d) *Waterford City Retail Strategy Update February 2018*

Waterford Institute of Technology. (2017) *South East Economic Monitor July 2017*

World Health Organisation (2017). *Flooding: Managing Health Risks In the WHO European Region.* [Online Accessed 07 April 2021]

Chapter 7
Biodiversity

Chapter 7 Biodiversity

7.1 Introduction

This chapter examines the ecology of the receiving environment within and surrounding the proposed Waterford City Public Infrastructure Project, Flood Defences West ("the proposed development") and assesses the potential impacts of the proposed development on Biodiversity. The methods employed to establish the ecological baseline within and around the proposed development are described, together with the process followed to determine the nature conservation importance of the ecological features present. The ways in which habitats, species and ecosystems are likely to be affected by the proposed development are explained and the magnitude of the likely effects predicted, taking into account the conservation condition of the habitats and species under consideration. Mitigation and enhancement measures are also proposed, and any residual effects are identified and assessed, taking into account the mitigation and enhancement measures proposed.

7.1.1 Conservation Legislation and Planning

The European Communities (Birds and Natural Habitats) Regulations, 2011 (as amended) ("the Habitats Regulations") transposed into Irish law Directive 2009/147/EC (the Birds Directive) and Council Directive 92/43/EEC (the Habitats Directive), which list priority habitats and species of international (European Union) conservation importance and that require protection. This protection is afforded in part through the designation of areas that represent significant populations of listed species within a European context, i.e. Natura 2000 sites. An area designated for bird species is classed as a Special Protection Area (SPA), and an area designated for other protected species and habitats is classed as a Special Area of Conservation (SAC). Wild bird species in SPAs and habitats and species listed on Annexes I and II, respectively, to the Habitats Directive in SACs in which they are designated features have full European protection. Species listed on Annex IV to the Habitats Directive are strictly protected wherever they occur, whether inside or outside the Natura 2000 network. This protection is afforded to animal and plant species by Sections 51 and 52, respectively, of the Habitats Regulations. Annex I habitats outside of SACs are still considered to be of national and international importance and, under Article 27(4)(b) of the Habitats Regulations, public authorities have a duty to strive to avoid the pollution or deterioration of Annex I habitats and habitats integral to the functioning of SPAs.

The Wildlife Act, 1976 (as amended) ("the Wildlife Acts") is the principle legislative mechanism for the protection of wildlife in Ireland. A network of nationally protected Nature Reserves, which public bodies have a duty to protect, was established under the Wildlife Acts. Sites of national importance for nature conservation are afforded protection under planning policy and the Wildlife Acts. Natural Heritage Areas (NHAs) are sites that are designated under the Wildlife Acts for the protection of flora, fauna, habitats and geological features of interest. Proposed Natural Heritage Areas (pNHAs) are published sites identified as of similar conservation interest to NHAs but have not been statutorily proposed or designated, but are nonetheless afforded some protection under planning policies and objectives. The Wildlife Acts also protect species of conservation interest from injury, disturbance and damage to them or to their breeding and resting places. All species listed in the Wildlife Acts must, therefore, be a material consideration in the planning process.

An additional important piece of national legislation for the protection of wild flora, i.e. vascular plants, mosses, liverworts, lichens and stoneworts, is the Flora (Protection) Order, 2015, which makes it illegal to cut, uproot or damage listed species in any way or to alter, damage or interfere in any way with their habitats.

Ireland's National Biodiversity Action Plan 2017-2021 (DAHG, 2017), in accordance with the Convention on Biological Diversity, is a framework for the conservation and protection of Ireland's biodiversity, with an overall objective to secure the conservation, including, where possible, the enhancement and sustainable use of biological diversity in Ireland and to contribute to collective efforts for conservation of biodiversity globally. Action 1.1.3 of the Plan states that "*all Public Authorities and private sector bodies move towards no net loss of biodiversity through strategies, planning, mitigation measures, appropriate offsetting and/or investment in Blue-Green infrastructure*". This is particularly relevant to proposed projects. The Plan is implemented through regional, county and local development plans, legislation and statutory instruments concerned with nature conservation.

The Waterford City Development Plan 2013-2019 (as extended) has as one of its Overall Goals "*To protect, restore and improve, where appropriate, areas of natural heritage value* [and to] *protect and promote the integrity of all Natura 2000 sites within the City* […]" (POL 1.1.4). The Plan has as one of its heritage policies to "*Protect, conserve and where relevant, restore and enhance the environmental quality, character and distinctiveness of* […] *flora and fauna, wildlife habitats* […] *and riverscapes of national, regional and local importance*" (POL 10.0.2). This policy is consistent with the Regional Spatial & Economic Strategy (RSES) for the Southern Region. One of the biodiversity policies of the Plan is "*To conserve, manage and where possible enhance the City's natural heritage*" (POL 10.4.1). This is supported by the Plan's objective "*To support the green infrastructure concept in development proposals where feasible*" (OBJ 10.4.11), which is also consistent with both the RSES for the Southern Region and the National Biodiversity Action Plan.

7.1.2 Approach and Objectives

A habitat is the environment in which an animal or plant lives and is generally defined in terms of vegetation and physical structures. Habitats and species of ecological significance occurring or likely to occur within the defined **Zone of Influence** and **study area** of the proposed development were classified as **Key Ecological Receptors**.

In accordance with National Roads Authority (NRA) *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (2009), an impact assessment has been undertaken of Key Ecological Receptors within the Zone of Influence of the proposed development. While these guidelines were specifically designed for national road schemes, their guidance on how to assess ecological impacts is comprehensive and applicable to a wide range of different types of projects. According to these guidelines, the Zone of Influence is the "effect area" over which change resulting from the proposed development is likely to occur. The Key Ecological Receptors are defined as features of sufficient value as to be material in the decision-making process for which potential impacts from the proposed development are likely.

In the context of the proposed development, a Key Ecological Receptor is defined as any feature valued as being of one of the following levels of importance:

- International Importance
- National Importance
- County Importance

- Local Importance (Higher Value)

Features of Local Importance (Lower Value) and features of no ecological value and are not considered to be Key Ecological Receptors. The assessment does not consider effects on aspects of the environment other than Biodiversity.

This chapter quantifies the potential impacts on identified Key Ecological Receptors and prescribes mitigation measures required to avoid and reduce any likely significant effects.

Determining the ecological issues to be addressed for the assessment was informed by early engagement with relevant stakeholders. During this scoping process, selected consultees were provided the opportunity to input into the proposed development through preliminary discussions on Key Ecological Receptors that could potentially be affected; strategies to avoid negative impacts; and, where possible, compensation or enhancement measures. Further details of the consultation process, including a list of the statutory and non-statutory consultees contacted, can be found in Section 7.2.5.

On completion of scoping, a desk study was undertaken to review all available published data describing the ecological conditions within the greater area of the proposed development. The desk study cross-referenced this published data with publicly available maps and aerial orthophotography from Ordnance Survey Ireland (OSi), National Parks & Wildlife Service (NPWS) and Environmental Protection Agency (EPA) to identify Key Ecological Receptors. During preparation of this assessment, the statutory conservation agency, the NPWS, provided data on nature conservation designations, habitats and species of conservation interest. The baseline information obtained from the desk study was the first stage in defining the Zone of Influence of the proposed development.

Determining baseline ecological conditions allows an accurate prediction of the likely impacts of the proposed development on Key Ecological Receptors and an assignment of ecological significance to them.

The results of the multidisciplinary walkover surveys and habitat mapping undertaken in November 2016, September 2018 and April 2021 are presented in Figure 7.2 in Volume 3 of this EIAR. The detailed results (including biotope mapping) of specialist surveys of hard and soft intertidal benthos and shoreline habitats are presented in Appendix 7.1.

Where negative impacts were identified, detailed and specific mitigation measures have been proposed in accordance with the hierarchy of options suggested in the research for the European Commission publication *Assessment of plans and projects significantly affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC* (EC, 2001). Preference was given to avoiding impacts at their source. Where this was not possible, the following approaches were adopted, in order of decreasing preference: reduce impacts at source, abate on site, and finally abate at receptor. These measures have been incorporated into the design of the proposed development.

The information provided in this chapter accurately and comprehensively describes the baseline ecological environment, provides an accurate prediction of the likely significant ecological impacts of the proposed development, prescribes specific mitigation as necessary and describes any residual ecological effects.

7.1.3 Terminology

The evaluation of Key Ecological Receptors and the terminology used to determine ecological value adheres to aforementioned guidance (NRA, 2009). The definitions of impacts follow the definitions in the EPA's *Draft Guidelines on the Information to be Contained in Environmental Impact Statements* (EPA, 2017).

7.2 Methodology

This section describes the methodologies that were followed in collecting information, in describing the baseline ecological conditions and in assessing the likely impacts of the proposed development.

7.2.1 Guidelines on Environmental Impact Assessment

The process of identifying, quantifying and evaluating the potential impacts of the proposed development on habitats, species and ecosystems followed best practice guidance on ecological surveys and assessment, as well as recognised guidance on EIA. This provided for an appropriately defined scope and evaluation process. The main sources of guidance are as follows:

- CIEEM (2018) *Guidelines for Ecological Impact Assessment in the UK and Ireland. Version 1.1 - Updated September 2019.* Chartered Institute of Ecology and Environmental Management.
- EPA (2003) *Advice notes on Current Practice (in the preparation of Environmental Impact Statements).* Environmental Protection Agency, Wexford.
- EPA (2017) *Draft Guidelines on the Information to be Contained in Environmental Impact Statements.* Environmental Protection Agency, Wexford.
- NRA (2006) *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes.* National Roads Authority, Dublin.
- NRA (2008a) *Environmental Impact Assessment of National Road Schemes – A Practical Guide. Revision 1.* National Roads Authority, Dublin.
- NRA (2008b) *Guidelines for Ecological Survey Techniques for Protected Flora and Fauna during the Planning of National Road Schemes.* National Roads Authority, Dublin.
- NRA (2008c) *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes.* National Roads Authority, Dublin.
- NRA (2008d) *Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes.* National Roads Authority, Dublin.
- NRA (2009) *Guidelines for Assessment of Ecological Impacts of National Road Schemes.* National Roads Authority, Dublin.
- TII (2020) *The Management of Invasive Alien Plant Species on National Roads – Technical Guidance.* Transport Infrastructure Ireland, Dublin.

7.2.2 Establishing the Zone of Influence

The key factors to be taken into account when establishing the Zone of Influence for a proposed development are:

- The nature, scale, and location of the proposed development;
- The sensitivities of the ecological receptors in the receiving environment; and,
- The potential for cumulative or in-combination impacts.

For example, in the case of a proposed development connected to a river, it may be necessary to extend the Zone of Influence a significant distance upstream and/or downstream to capture all potential impacts on water-dependent ecological receptors.

On the basis of the above key factors, the Zone of Influence for the proposed Flood Defences West has been defined as the entire area within 500m of the proposed development, as well as the entire extent of the transitional waters of the River Suir upstream and downstream of the proposed development. This is considered to be the maximum extent over which ecological impacts may occur directly, indirectly or in combination with other plans or projects. The Zone of Influence is presented in Figure 7.1 in Volume 3.

7.2.3 Establishing the Study Area

The extent of the study area is defined by the ecological features likely to occur within an effects distance from the proposed development. The desk study area covered the entire Zone of Influence, as described in the preceding section. For the field study, however, it was not practical to carry out surveys over such a large area. Therefore, the field study area was limited to the area subject to direct impacts or immediate effects, i.e. the proposed development boundary plus a 150m buffer. This area was considered to be adequate to identify all ecological features which could potentially be subject to direct impacts from the proposed development or act as pathways for indirect impacts or effects to other features in the wider Zone of Influence.

7.2.4 Desk Study

The desk study undertaken for this assessment included a thorough review of the available ecological baseline data within the study area. The following resources were used:

- National Parks & Wildlife Service (NPWS) Designations Viewer was reviewed to determine the location of nationally and internationally designated sites within the Zone of Influence of the proposed development
- National Parks & Wildlife Service (NPWS) provided data on rare and protected species and habitats
- National Biodiversity Data Centre (NBDC) database provided information on species records in the study area
- Irish Wetland Bird Survey (I-WeBS) data from BirdWatch Ireland provided monthly counts for survey sub-sites on the River Suir
- Environmental Protection Agency (EPA) Unified GIS Application provided data in relation to the Water Framework Directive Risk/Status of waterbodies in the Zone of Influence
- Bat Fauna Study (Kelleher, 2014)
- R & H Hall Flour Mill, Ferrybank, Waterford City - Bat survey report (Harrington, 2017)
- IFI fish sampling for the Water Framework Directive (2010-2018)
- Environmental Impact Assessment Report and Natura Impact Statement for the River Suir Sustainable Transport Bridge (ROD, 2018a,b)
- Environmental Impact Assessment Report and Natura Impact Statement for the Waterford North Quays Development (Fogarty, 2020a,b)
- Hydraulic Modelling of the Flood Defences West Scheme River Suir Flood Wall (Hydro Environmental, 2021)

- Waterford Flood Defence West – Intertidal Survey (Brophy, 2021)

As with all desk studies, the data considered were only as good as the data supplied by the recorders and recording schemes. The recording schemes provide disclaimers in relation to the quality and quantity of the data they provide, and these were considered when examining outputs of the desk study.

7.2.5 Consultation

The statutory and non-statutory consultees listed in Table 7.1 were contacted and invited to submit any observations in relation to the proposed development. Consultees were also provided with indicative drawings of the proposed development.

The purpose of the consultations was to:

- Identify any relevant information that consultees held, including the presence of data on protected species or species of conservation concern;
- Identify any concerns that consultees may have in relation to the proposed development; and,
- Identify any issues that the consultees would like to see addressed during the ecological impact assessment process.

Organisations or individuals consulted in relation to ecology and nature conservation, together with a summary of responses, are listed in Table 7.1. In each case, only the responses relevant to this chapter have been included. Following initial consultation, meetings were held with the statutory consultees, the NPWS and IFI. All issues raised by the consultees have been addressed as fully as possible in this Chapter.

Table 7.1 Details of Consultations

Consultee	Date	Summary
National Parks & Wildlife Service	2nd November 2020 (informal meeting)	NPWS noted the possibility that 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330) may be present within the project extents.
	14th December 2020	Following the meeting of 2nd November 2020, comments were received via the Development Applications Unit: The NPWS acknowledged the necessity for the proposed development and reiterated the expected impacts that the proposed development will have on Annex I habitats and Qualifying Interests within the Lower River Suir SAC.
	1st February 2021	Provided records of rare and protected species and habitats in the study area.
Inland Fisheries Ireland	5th November 2020 (informal meeting)	IFI expressed the view that, while the additional loss of mudflats is not ideal, on balance, the shorter construction programme facilitated by riverside piling may be preferable in terms of avoiding medium- or long-term impacts on recruitment/population structure of Twaite Shad and other species. IFI welcomes the proposed mitigation of an eco-wall or similar textured cladding to the outside of the sheet piles to facilitate faster colonisation of the

Consultee	Date	Summary
		new hard intertidal substrate by encrusting organisms.
	1st December 2020	IFI provided comments on the two feasible options for the proposed development and considered that Option B could be supported. This was selected as the preferred option. They highlighted that the proposed development will result in direct disturbance of migratory fish species, particularly Twaite Shad, and the loss of Annex I habitats within the Lower River Suir SAC. In addition to this, they advised that during construction, the barge craft should be positioned during high tide to minimise disturbance of benthic sediments and fauna. They also advised that piledriving should be carried out at low tide to minimise disturbance to fish species. It was also mentioned that noise and vibration effects are unavoidable but are likely to have minimal effects on fish species.
National Parks & Wildlife Service and Inland Fisheries Ireland	23rd March 2021 (informal meeting)	IFI stated that measures will be required to prevent entry of concrete or other construction materials to the River Suir during raising of the existing quay wall as part of remedial works where this intervention is proposed. NPWS expressed concerns relating to the permanent loss of an area (<100 m^2) of 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330), which is a qualifying interest of the Lower River Suir SAC, at Ch. 950, where the proposed sheet pile wall transitions back from riverside to landside. They also expressed concern about the permanent loss of *c.* 800m^2 of 'Mudflats and sandflats not covered by seawater at low tide' (1140) as a result of riverside piling. It was stated that the conservation status of this habitat is inadequate nationally and that the policy of No Net Loss should apply.

7.2.6 Ecological Survey Methodology

Field surveys were conducted adhering to the following guidelines:

- *Guidelines for Ecological Survey Techniques for Protected Flora and Fauna during the Planning of National Road Schemes* (NRA, 2008b)
- *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (NRA, 2009)
- Best *Practice Guidance for Habitat Survey and Mapping* (Smith et al., 2011)

The multidisciplinary walkover survey classified habitats according to *A Guide to Habitats in Ireland* (Fossitt, 2000) and aimed to identify any habitats corresponding to types listed on Annex I to the Habitats Directive using the *Interpretation Manual of European Union Habitats* (EC, 2013).

7.2.7 Multidisciplinary Walkover Survey

The multi-disciplinary walkover surveys included habitat mapping, and aimed to detect the presence, or likely presence, of a range of protected species. The presence (or signs) of protected fauna, including birds, mammals, amphibians and reptiles was noted during the visits. The multi-disciplinary walkover surveys provided baseline information regarding the existing ecology of the study area and informed the need for further specialist survey work. Multi-disciplinary walkover surveys were undertaken on 9th November 2016, 25th September 2018 and 8th April 2021. The surveys were undertaken by ROD ecologists Patrick O'Shea MCIEEM, Owen O'Keefe MCIEEM, Kate Moore GradCIEEM and Kalvin Townsend-Smyth QualCIEEM. Patrick is an ecologist with over 7 years' experience and holds a BA (Mod) Hons in Botany from Trinity College Dublin and an MSc in Ecological Management & Conservation Biology from Queen's University Belfast. Owen is an ecologist with over 5 years' experience and holds a BSc (Hons) in Ecology from University College Cork. Kate is an ecologist with over 5 years' experience and holds a BSc (Hons) in Environmental Biology from University College Dublin. Kalvin is an ecologist with 2 years' experience and holds a BSc (Hons) in Wildlife Biology from the Institute of Technology, Tralee.

The desk study and walkover surveys identified Key Ecological Receptors in the study area. The following sections outline the methodologies followed during the ecological surveys.

7.2.8 Habitat Survey

Habitat surveys were conducted as part of the multidisciplinary walkover surveys and in accordance with best practice guidance (Smith et al., 2011). The whole site and an appropriate buffer were systematically and thoroughly walked, and all habitats present were assessed, classified and sketched onto field maps. Habitats were identified in accordance with Fossitt (2000).

7.2.9 Survey of Watercourses

The proposed development runs along the northern bank of the River Suir. An aquatic ecological assessment was undertaken for the proposed development during the multidisciplinary walkover surveys. A review of literature and IFI fish sampling data in relation to the aquatic environment of the River Suir catchment was undertaken. The survey targeted specifically the presence or suitability of the River Suir in the vicinity of the proposed development as habitat for fish and other aquatic species. The survey also aimed to confirm the presence or likely presence of qualifying interests of the Lower River Suir SAC such as Atlantic Salmon, Twaite Shad, Sea Lamprey, River Lamprey and Otter, as well as estuarine Annex I habitats.

7.2.10 Fisheries and Aquatic Fauna

The River Suir was assessed with regard to its potential to support fish, including but not limited to salmonids, lamprey and shads. A review of the literature relating to these species, including local studies, was conducted. This included a review of records from IFI's fish sampling, conducted under the Water Framework Directive (WFD) and as part of reporting requirements under Article 17 of the Habitats Directive. A review of the EPA Q-value status and WFD surface water quality and risk status for the River Suir was also undertaken. Given that the proposed development is located in and adjacent to the Suir Estuary, species which are limited to freshwater habitats, including Freshwater Pearl Mussel (*Margaritifera margaritifera*) and White-clawed Crayfish (*Austropotamobius pallipes*), were not deemed to be at risk and, therefore, focussed surveys for these species were not deemed appropriate.

7.2.11 Otter

The function of the Otter survey was to identify any sensitive features within the study area potentially of use for breeding, resting, foraging or commuting Otter and to identify any presence or likely presence of Otter. The Otter survey was conducted adhering to best practice guidance (NRA, 2008c) and involved a systematic search of the riverbanks for physical evidence of Otter e.g. spraints, prints, slides, trails, couches and holts. The survey methodology was also cognisant of the recommendations in the *Otter Threat Response Plan 2009-2011* (NPWS, 2009) which recognises the importance of the riparian buffer (10 m on both banks) for Otter.

7.2.12 Bats

Following a desk study of bat records and previous survey data from the vicinity of the proposed development, a bat suitability assessment was undertaken as part of the multidisciplinary walkover surveys to identify built or natural features in the study area with potential to support roosting bats. The bat suitability assessment was conducted adhering to best practice guidance (NRA, 2008b,c; Collins (ed.), 2016) and involved a visual assessment of suitable features on buildings capable of supporting roosting bats. There were no suitable trees within the vicinity of the proposed development. Built structures were assessed using the criteria in Collins (ed.) (2016). The locations of buildings that could provide low to high roosting potential were recorded with high-definition GPS. Linear landscape features with potential to provide important foraging and commuting habitat for bats were also recorded and geospatially referenced.

7.2.13 Badger

The badger survey was conducted as part of the multidisciplinary walkover surveys and aimed to identify the presence or likely presence of Badger (*Meles meles*) in the study area. The badger survey was conducted following best practice guidance (NRA, 2008b) and involved a systematic search for physical evidence of badgers, e.g. setts, latrines, and badger paths. The optimal period for badger surveys is during the seasonal peaks in territorial activity and when vegetation cover which may obscure signs is at a minimum (January to April and less pronounced peak in October).

7.2.14 Other Mammals, Reptiles and Amphibians

During the walkover survey the potential for the study area to support other protected mammals, reptiles and amphibians was assessed. Given that the study area is highly urbanised and subject to high levels of continuous disturbance, and that no evidence of such species was recorded, it was concluded that further species-specific surveys were not required.

7.2.15 Birds

Following the desk study, the multidisciplinary walkover surveys included identification of habitats and features likely to be of importance for birds and recording of all incidental observations of birds (by sight and song) during the surveys. As the final survey was undertaken in April, it was the most likely to identify any areas being used by breeding birds. Based on the results of the desk study and multidisciplinary walkover survey, it was determined that further surveys specifically for birds were not necessary in this case.

7.2.16 Invasive Alien Plant Species

During the walkover surveys, the presence of invasive species was recorded. The focus was on identifying species subject to restrictions under Section 49 of the Habitats Regulations. Target notes were taken on any invasive species identified. Information recorded included the area of infestation, plant condition, height and location. Site features that could affect control measures such as adjacent land use, structures and services were also recorded.

7.2.17 Ecological Evaluation and Impact Assessment Methodology

The ecological evaluation and impact assessment within this chapter follows the methodology that is set out in the CIEEM, EPA and TII/NRA guidance documents listed in Section 7.2.1 above.

7.2.18 Evaluation of Ecological Resources

The criteria used for the ecological evaluation follows those set out in Section 3.3 of NRA (2009). These guidelines provide a methodology for evaluating the importance of ecological receptors on a geographic scale, as follows:

- International Importance
- National Importance
- County Importance
- Local Importance (Higher Value)
- Local Importance (Lower Value)

The guidelines set out the criteria by which each level of importance can be assigned. For example, Locally Important (Lower Value) receptors contain habitats and species that are widespread and of low ecological significance and only of importance in the local area. Conversely, receptors of International Importance are either designated for conservation as part of the Natura 2000 network (SAC or SPA) or provide the best examples of habitats or internationally important populations of protected fauna.

All habitats and species within the Zone of Influence and study area were assigned a level of importance on the above basis and, in line with the guidelines, receptors of Local Importance (Higher Value) or above were selected as Key Ecological Receptors.

7.2.19 Impact Assessment Methodology

The EPA (2017) guidelines were used to characterise and evaluate the likely impacts of the proposed development on the receiving environment. The parameters used to characterise impacts are:

- Magnitude - relates to the quantum of impact, for example the number of individuals affected by an activity;
- Extent - relates to the area over which the impact occurs;
- Duration - intended to refer to the length of time for which the impact is predicted to continue, until recovery or re-instatement;
- Reversibility - whether an impact is ecologically reversible, either spontaneously or through specific action; and,
- Timing/frequency of impacts in relation to important seasonal and/or life-cycle constraints should be evaluated. Similarly, the frequency with which activities (and associated impacts) would take place can be an important determinant of the impact on receptors.

It is necessary to ensure that any assessment of impact takes account of construction and operational phases; direct, indirect and cumulative impacts; and, those that are temporary, reversible and irreversible. The most relevant criteria for assessment of effect include quality and significance and these are defined in Tables 7.2 and 7.3. The following terms are defined when quantifying duration (EPA, 2017):

- Momentary – seconds to minutes
- Brief – less than 1 day
- Temporary – up to 1 year
- Short-term – 1 to 7 years
- Medium-term – 7 to 15 years
- Long-term – 15 to 60 years
- Permanent – more than 60 years

Table 7.2 Criteria for Assessing Impact Significance (EPA, 2017).

Significance	Definition
No change	No discernible change in the ecology of the affected feature
Imperceptible	An impact capable of measurement but without noticeable consequences
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences
Slight	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate	An impact that alters the character of the environment that is consistent with existing and emerging trends
Significant	An impact which, by its character, its magnitude, duration or intensity alters a sensitive aspect of the environment
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Profound	An impact which obliterates sensitive characteristics

Table 7.3 Criteria for Assessing Impact Quality (EPA, 2017).

Impact Type	Criteria
Positive	A change which improves the quality of the environment e.g. increasing species diversity, improving reproductive capacity of an ecosystem or removing nuisances
Neutral	A change which does not affect the quality of the environment
Negative	A change which reduces the quality of the environment e.g. lessening species diversity or reducing the reproductive capacity of an ecosystem

Once the potential impacts are characterised, the significance of any such impacts on the identified Key Ecological Receptors is evaluated.

7.2.20 Process of Assessing Significance

The significance of impacts was evaluated following guidance set out in NRA (2009), whereby impacts are assigned a level of significance based on their characterisation, irrespective of the importance of the receptor, i.e. significance is determined by the effect on conservation status or ecological integrity, regardless of geographical level at which these would be relevant.

7.2.21 Mitigation

Through the options selection and iterative design process, the proposed development has been designed to avoid or reduce the likely impacts on Key Ecological Receptors. Where potential impacts on Key Ecological Receptors are predicted which cannot be avoided by design, mitigation has been prescribed to ameliorate such impacts.

The proposed best practice design and mitigation measures relating to biodiversity are set out in this chapter. These measures are both effective and realistic in terms of cost and practicality. Provided that these measures are implemented as prescribed herein, they have a high probability of success in terms of mitigating the likely impacts on Key Ecological Receptors.

The potential impacts of the proposed development were considered and assessed to ensure that all impacts on Key Ecological Receptors are adequately addressed and no significant residual impacts remain following mitigation.

7.2.22 Survey Limitations

Standard and widely accepted survey methods were followed. However, any biases or limitations associated with these methods could potentially affect the results collected. Whilst every effort was made to provide a comprehensive description of the study area and full assessment of the likely impacts on the receiving environment, fluctuations in habitat areas or species populations may not be fully reflected due to the instantaneous nature of the field surveys. Notwithstanding that, the combination of field survey data with the background knowledge provided by the desk study is considered to provide an accurate representation of the baseline for the habitats and species within the Zone of Influence.

Smith et al. (2011) states that the optimal time of year for habitat surveys is April to September, inclusive, as this is the growing season for most plants. Two of the multi-disciplinary walkover surveys were undertaken in April and September, i.e. at either end of the optimal season for habitats. The April 2021 survey was also undertaken during the optimal season for breeding birds. A third walkover survey was undertaken in November 2016, towards the beginning of the optimal survey period for wintering waterbirds. The November survey also covered the optimal survey period for terrestrial mammals and physical habitat features, as features are less likely to be obscured by vegetation. Therefore, the three surveys dates are considered to cover key seasonal periods for the aspects of biodiversity of concern in relation to the proposed development.

7.3 Desk Study Results

7.3.1 General Description and Context

The site of the proposed development begins c. 100m east of Plunkett Station and extends west for c. 1.5km along the northern bank and within the foreshore of the River Suir in Waterford City. The principal habitat types that exist along the footprint of the proposed development include mudflats, buildings and artificial surfaces, and a tidal river. The River Suir is designated as the Lower River Suir SAC and is hydrologically connected to the River Barrow and River Nore SAC, which is located c. 9km downstream of the proposed development.

'Estuaries' (1130) and 'Mudflats and sandflats not covered by sea water at low tide' (1140) are protected habitats listed on Annex I to the Habitats Directive and are present within the footprint of the proposed development, but are not Qualifying Interests of the

Lower River Suir SAC. These habitats support a range of benthic invertebrates and macroalgae, as well as other species which feed on them. In addition to this, the tidal river also hosts a number of rare and protected species, most of which are listed as Qualifying Interests of the Lower River Suir SAC, including lamprey species, Atlantic salmon, Twaite Shad and Otter. 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)' (1330) are also present between the bottom of the existing quay wall and the high-water mark at one location.

7.3.2 Aquatic Environment

Water Quality

The WFD requires that each EU Member State protects and improves water quality in all waters so that good ecological status is achieved. Additionally, proposed actions (within discrete River Basin Management Plans) are also required, to secure national natural water resources for the future. The EPA is the competent authority responsible for monitoring, protecting and improving the water environment in the Republic of Ireland. In accordance with WFD guidelines, water quality 'Status' is assigned using a variety of available data on aquatic flora and fauna (including fish), the availability of nutrients, and aspects like salinity, temperature and pollution by chemical pollutants. Morphological features, such as quantity, water flow, water depths and structures of the riverbeds, are also taken into account.

The EPA water quality classification system (Quality Rating System (Q-values)) is also used to assess water quality in Irish rivers, taking into account aquatic macrophytes, phytobenthos and hydromorphology. The Q-value system has been shown to be a robust and sensitive measure of riverine water quality and has been linked with both chemical status and land-use pressures in catchments. Individual macroinvertebrate taxa are ranked for their sensitivity to organic pollution and the Q-value of the watercourse is based primarily on the relative abundance of these taxa within a biological sample. A review of both the Q-value status and WFD status for the watercourses was undertaken.

The online EPA Unified GIS Application provides access to information at individual waterbody level and at Water Management Unit level for all the River Basin Districts in Ireland. Waterbodies can relate to surface waters (these include rivers, lakes, estuaries [transitional waters], and coastal waters) or to groundwater. Table 7.4 shows the information recorded regarding water quality status at the location of the proposed development.

Table 7.4 EPA Water Quality Results

Transitional Waterbody	WFD Status (2013-2018)	WFD Status (2010-2012)	WFD Risk (2020)
Middle Suir Estuary	Poor	Poor	At Risk
Lower Suir Estuary (Little Island - Cheekpoint)	Good	Moderate	At Risk
Barrow Suir Nore Estuary	Moderate	Good	At risk

The River Suir at Waterford City (Middle Suir Estuary Transitional Waterbody) had a WFD Status of 'Eutrophic' in the 2010-2012 reporting period and 'Poor' in 2013-2018. The 'Poor' Status is indicated to be as a result of poor Phytoplankton Status as per the EPA Catchments website. Additionally, there appears to have been a deterioration across some parameters from the 2010-2015 to the 2013-2018 monitoring periods, these include Nutrient and Hydromorphological conditions. Further details on water quality are in Chapter 10: Hydrology of this EIAR.

Hydrodynamic Modelling

Hydrodynamic modelling was carried out by Hydro Environmental Ltd. (2021) in order to predict any hydraulic changes that the proposed flood defences would create within the River Suir. The hydrodynamic modelling report can be found in Appendix 10.1 to this EIAR and it concluded the following:

"*Computed velocity increases from the proposed vertical sheet piled wall are relatively small and of insufficient magnitude to produce sufficient shear stress […] that would result in any potential significant erosion of the permanent consolidated sediments on the channel bed and banks in the vicinity of the affected area. Fresher unconsolidated silts will be mobile under tidal ebb and flood conditions both for the proposed and existing cases and slight reduction in silt deposition adjacent to the sheet piled wall is anticipated.*"

Considering this, the proposed flood defences do not pose a significant risk of creating hydraulic changes that will threaten intertidal mudflats or any other habitats located along the banks of the River Suir, as seen in plates 7.1 and 7.2 below.

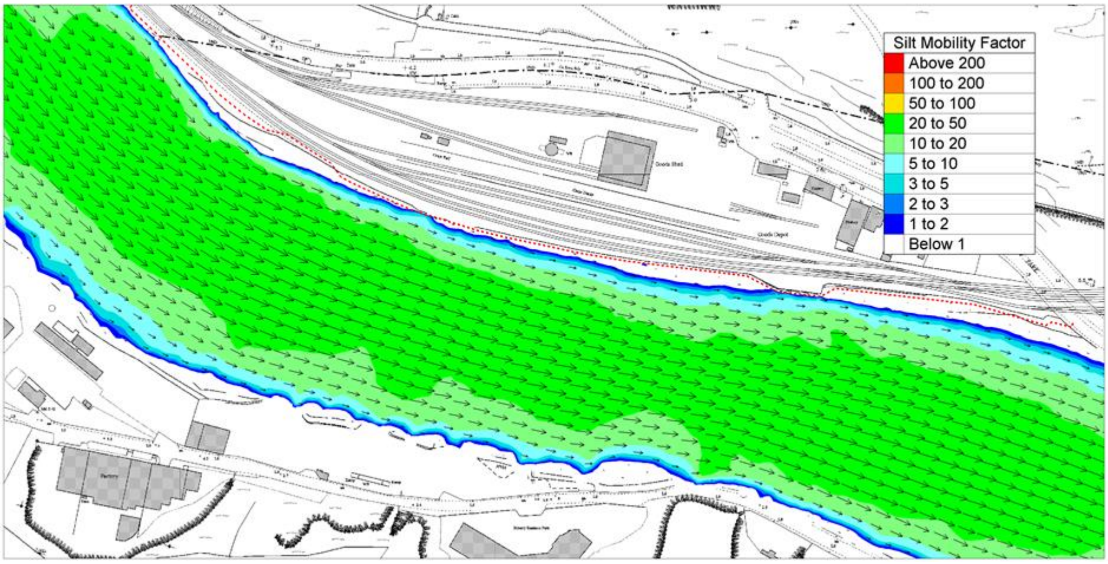

Plate 7.1 **Fine silt mobility factor at mid-ebb spring tide – existing case (Hydro Environmental Ltd., 2021).**

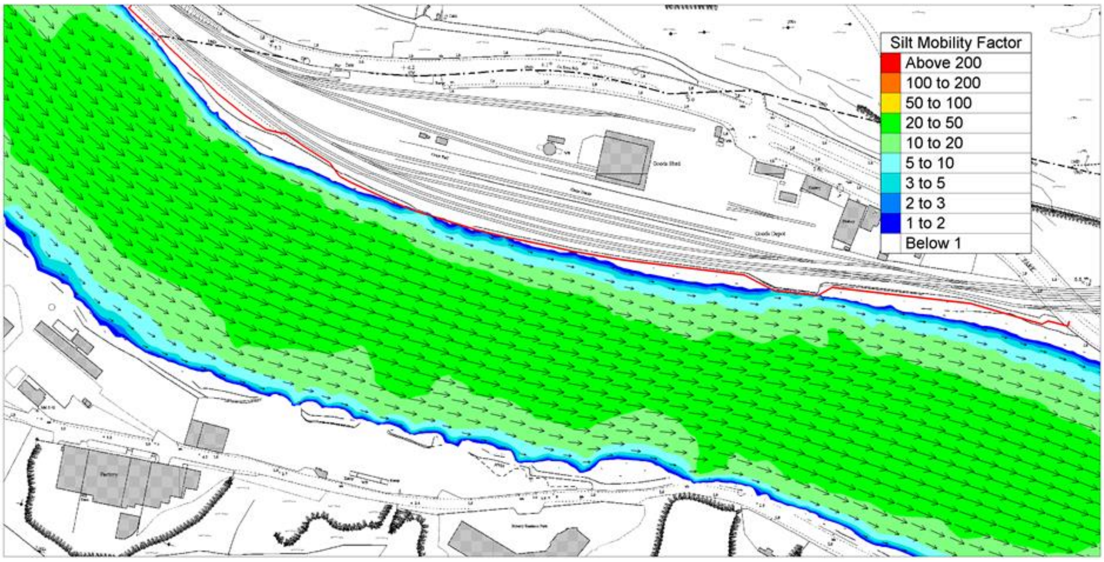

Plate 7.2 **Fine silt mobility factor at mid-ebb spring tide – proposed case (Hydro Environmental Ltd., 2021).**

Environmental Testing

Ground investigations specific to the proposed development were commissioned by ROD and carried out by IGSL Ltd in Q2 and Q3 of 2019. Waste Classification and Waste Acceptance Criteria (WAC) analysis were carried out in 2019 by ChemTest Laboratories, accredited Laboratory facility on 36 samples from across the proposed development area. The samples are tested for an array of geochemical determinants and the results compared to established limits, typically classifying samples as inert, exceeding inert and hazardous.

All samples were classified as non-hazardous. Traces of asbestos were detected in a single sample, but the sample is classified as non-hazardous as the level detected was <0.001%. This sample was taken at one of the historical landing stages at Ch. 570. Further details on the contamination assessment are in Chapter 8 Soils and Geology of this EIAR.

Benthic Habitats

An inshore benthic survey of Waterford Harbour was carried out for the NPWS by Atlantic RMS Ltd in July 2008 (Kennedy, 2008). Sample station 1, immediately downstream of the R680 Rice Bridge was the closest station to the proposed development. At this point the sediment was approximately 75% sand and 25% mud with gravel, cobbles and dredge spoil also being observed. The benthic habitat at the proposed development location was classified as level 5 biotope infralittoral fluid mobile mud in variable salinity. Records in the field described this habitat as laminated mud or sand layers deposited on the mud.

The benthic fauna was low in diversity and numbers, most likely due to the stress of the variable salinity, shallow water depth and associated resuspension of sediments by wind and tidal disturbance. This is typical for shallow infralittoral sediments that are exposed to wind driven and tidal disturbance. Six species were identified in the samples including a species of bivalve, a species of small crustacean and four species of worms and bristle worms.

Ground investigations were undertaken to characterise the riverbed in 2018 to inform the EIAR for the River Suir Sustainable Transport Bridge (ROD, 2018a). The riverbed is characterised by soft sediment, sands and gravel varying in thickness from 1.2m to

20.7m. The thickness of the alluvial material increases from north to south. Additionally, ground investigations specific to the proposed Flood Defences West were carried out in 2019 and are described in full in Chapter 8 Soils and Geology of this EIAR. At the eastern end of the proposed development, to the south of the Plunkett Station and below ancillary car parks, the quaternary sediments typically consist of dense granular made ground (gravels and cobbles) on top of shallow siltstone/shale bedrock. From the R448 Terminus Street bridge to the western end of the proposed development, the ground model is relatively homogenous, consisting of three major layers including made ground, alluvium and glacial overburden. In front of (to the south of) the quay wall, in the mudflats and the riverbed, the ground layer descriptions are similar except that no made ground is present. The thickness of alluvium varies within the mudflats and the riverbed, while the rockhead level continues to fall as you approach the centreline of the river.

Focussed surveys, sampling and analysis of the intertidal mudflats, existing quay wall and shoreline habitats along the extent of the proposed development were undertaken in March 2021 by Botanical, Environmental & Conservation (BEC) Consultants Ltd on behalf of WCCC. The results of these surveys are presented in Section 7.4 and the full report (Brophy, 2021) is presented in Appendix 7.1.

7.3.3 Habitats, Flora and Fauna

The desk study also identified which important habitats and species which historically occurred and, therefore, potentially occur within the Zone of Influence and study area. The following sections give an overview of the results of the desk study.

National Parks & Wildlife Service Data

Table 7.5 below lists the rare and protected species records obtained from the NPWS in February 2021.

Table 7.5 Records for rare and protected species. Source: NPWS (2021).

Common Name	Scientific Name	Status*
Mammals		
Badger	*Meles meles*	WA
Grey Seal	*Halichoerus grypus*	Annex II HD, WA
Hedgehog	*Erinaceus europaeus*	WA
Irish Hare	*Lepus timidus hibernicus*	Annex V HD, WA
Irish Stoat	*Mustela erminea hibernica*	WA
Otter	*Lutra lutra*	Annexes II, IV HD, WA
Pine Marten	*Martes Martes*	Annex V HD, WA
Red Squirrel	*Sciurus vulgaris*	WA
Amphibians & Reptiles		
Common Frog	*Rana temporaria*	Annex V HD, WA
Common Lizard	*Zootoca vivipara*	WA
Fish		
River Lamprey	*Lampetra fluviatilis*	Annexes II, IV HD, WA
Twaite Shad	*Alosa fallax*	Annexes II, IV HD, WA

Common Name	Scientific Name	Status*
Invertebrates		
Freshwater Pearl Mussel	*Margaritifera margaritifera*	Annexes II, IV, WA
Plants		
Basil Thyme	*Clinopodium acinos*	FPO
Betony	*Stachys officinalis*	FPO
Borrer's Saltmarsh-grass	*Puccinellia fasciculata*	FPO
Clustered Clover	*Trifolium glomeratum*	FPO
Cottonweed	*Achillea maritima*	FPO
Divided Sedge	*Carex divisa*	FPO
Green-winged Orchid	*Anacamptis morio*	FPO
Lesser Centaury	*Centaurium pulchellum*	FPO
Meadow Barley	*Hordeum secalinum*	FPO
Narrow-leaved Helleborine	*Cephalanthera longifolia*	FPO
Opposite-leaved Pondweed	*Groenlandia densa*	FPO
Perennial Glasswort	*Sarcocornia perennis*	FPO
Lichens		
Reindeer Moss	*Cladonia portentosa*	Annex V HD

**Status (listing conferring protection or describing conservation status) abbreviations: Annex II/IV/V (non-avian species) = Habitats Directive (HD); WA = Wildlife Act, 1976 (as amended); FPO = Flora (Protection) Order, 2015.*

National Biodiversity Data Centre Database

Table 7.6 lists the rare and protected species records submitted to the NBDC for the hectads (10km × 10km grid squares) intersecting the study area. To avoid repetition, records of species already listed in Table 7.5 above have been removed from Table 7.6. Table 7.7 lists the invasive alien species recorded within these hectads.

Table 7.6 Records from within the Zone of Influence. Source: NBDC (2021).

Common name	Scientific name	Status*
Mammals		
Brown Long-eared Bat	*Plecotus auritus*	Annex IV HD, WA
Common Dolphin	*Delphinus delphis*	Annex IV, WA
Common Pipistrelle	*Pipistrellus pipistrellus*	Annex IV HD, WA
Daubenton's Bat	*Myotis daubentonii*	Annex IV HD, WA
Harbour Porpoise	*Phocoena phocoena*	Annexes II, IV HD, WA
Leisler's Bat	*Nyctalus leisleri*	Annex IV HD, WA
Long-finned Pilot Whale	*Globicephala melas*	Annex IV, WA
Minke Whale	*Balaenoptera acutorostrata*	Annex IV, WA
Natterer's Bat	*Myotis nattereri*	Annex IV HD, WA
Pygmy Shrew	*Sorex minutus*	WA

Common name	Scientific name	Status*
Soprano Pipistrelle	*Pipistrellus pygmaeus*	Annex IV HD, WA
Amphibians and Reptiles		
Smooth Newt	*Lissotriton vulgaris*	WA
Leatherback Turtle	*Dermochelys coriacea*	Annex IV HD, WA
Fish		
European Eel	*Anguilla anguilla*	EC Regulation (Council Regulation 1100/2007)
Invertebrates		
Marsh Fritillary	*Euphydryas aurinia*	Annex II HD
Plants		
Chives	*Allium schoenoprasum*	FPO
Lesser Snapdragon	*Misopates orontium*	FPO
Birds		
Barn Swallow	*Hirundo rustica*	Amber
Bar-tailed Godwit	*Limosa lapponica*	Annex I BD, Red
Black-headed Gull	*Larus ridibundus*	Amber
Black-tailed Godwit	*Limosa limosa*	Amber
Brent Goose	*Branta bernicla*	Amber
Common Gull	*Larus canus*	Amber
Cormorant	*Phalacrocorax carbo*	Amber
Curlew	*Numenius arquata*	Red
Dunlin	*Calidris alpina*	Annex I BD, Red
Fulmar	*Fulmarus glacialis*	Amber
Goldcrest	*Regulus regulus*	Amber
Golden Plover	*Pluvialis apricaria*	Annex I BD, Red
Goldeneye	*Bucephala clangula*	Red
Great Crested Grebe	*Podiceps cristatus*	Amber
Great Northern Diver	*Gavia immer*	Annex I BD, Amber
Greenfinch	*Carduelis chloris*	Amber
Grey Plover	*Pluvialis squatarola*	Red
Grey Wagtail	*Motacilla cinerea*	Red
Herring Gull	*Larus argentatus*	Amber
House Martin	*Delichon urbicum*	Amber
House Sparrow	*Passer domesticus*	Amber
Kestrel	*Falco tinnunculus*	Red
Kingfisher	*Alcedo atthis*	Annex I BD, Amber
Lapwing	*Vanellus vanellus*	Red

Common name	Scientific name	Status*
Lesser Black-backed Gull	*Larus fuscus*	Amber
Linnet	*Carduelis cannabina*	Amber
Little Egret	*Egretta garzetta*	Annex I BD
Little Gull	*Larus minutus*	Annex I BD, Amber
Mallard	*Anas platyrhynchos*	Amber
Meadow Pipit	*Anthus pratensis*	Red
Mute Swan	*Cygnus olor*	Amber
Oystercatcher	*Haematopus ostralegus*	Red
Peregrine Falcon	*Falco peregrinus*	Annex I BD
Pintail	*Anas acuta*	Amber
Purple Sandpiper	*Calidris maritima*	Red
Red-breasted Merganser	*Mergus serrator*	Amber
Red Kite	*Milvus milvus*	Annex I BD, Red
Red Knot	*Calidris canutus*	Red
Redshank	*Tringa totanus*	Red
Redwing	*Turdus iliacus*	Red
Ringed Plover	*Charadrius hiaticula*	Amber
Sandpiper	*Actitis hypoleucos*	Amber
Shag	*Phalacrocorax aristotelis*	Amber
Shelduck	*Tadorna tadorna*	Amber
Short-eared Owl	*Asio flammeus*	Annex I BD, Amber
Sky Lark	*Alauda arvensis*	Amber
Snipe	*Gallinago gallinago*	Red
Spotted Flycatcher	*Muscicapa striata*	Amber
Starling	*Sturnus vulgaris*	Amber
Swift	*Apus apus*	Red
Teal	*Anas crecca*	Amber
Turnstone	*Arenaria interpres*	Amber
Wheatear	*Oenanthe oenanthe*	Amber
Wigeon	*Anas penelope*	Amber
Willow Warbler	*Phylloscopus trochilus*	Amber

**Status (listing conferring protection or describing conservation status) abbreviations: Annex II/IV/V (non-avian species) = Habitats Directive (HD); Annex I, II, III = Birds Directive (BD); WA = Wildlife Acts and Red/Amber = Birds of Conservation Concern in Ireland 2020-2026 (Gilbert et al., 2021).*

Table 7.7 Invasive alien species recorded within the Zone of Influence. Source: NBDC (2021).

Common name	Scientific name
American Mink	*Neovison vison*
Brown Rat	*Rattus norvegicus*
Common Cord-grass	*Spartina anglica*
Dace	*Leuciscus leuciscus*
Grey Squirrel	*Sciurus carolinensis*
Giant Hogweed	*Heracleum mantegazzianum*
Giant Knotweed	*Fallopia sachalinensis*
Giant-rhubarb	*Gunnera tinctoria*
Himalayan Balsam	*Impatiens glandulifera*
Himalayan Knotweed	*Persicaria wallichii*
Japanese Knotweed	*Fallopia japonica*
New Zealand Pigmyweed	*Crassula helmsii*
Rhododendron	*Rhododendron ponticum*
Sea-buckthorn	*Hippophae rhamnoides*
Sika Deer	*Cervus nippon*
Spanish Bluebell	*Hyacinthoides hispanica*
Three-cornered Garlic	*Allium triquetrum*
Water Fern	*Azolla filiculoides*

Fisheries and Aquatic Fauna

The River Suir catchment is internationally important for the presence of fish species including Twaite Shad (*Alosa fallax*), Atlantic Salmon (*Salmo salar*), Lamprey species, European Eel (*Anguilla anguilla*) and European Smelt (*Osmerus eperlanus*). The status and occurrence of these species within the study area is described below.

<u>*Twaite Shad*</u>

Twaite Shad is a Qualifying Interest for the Lower River Suir SAC and the River Barrow and River Nore SAC. The River Suir at the location of the proposed development is used by juvenile Twaite Shad. Adult shad move from the sea into estuaries in spring and spawn just above the top of tidal waters in May and June. During the breeding season, large numbers of adult shad move up and down the estuary with the tide. Most adults return to the lower estuary within days of spawning and to sea by the end of the summer. Juvenile shad spend one or two years in the estuary, moving up and down with the tides and feeding on planktonic crustaceans and other invertebrates. Twaite Shad is classed as vulnerable to extinction in Ireland and anecdotal reports indicate a substantial decline in the River Suir (King et al., 2011).

As part of its national monitoring programme for Habitats Directive: Annex II and Red Data Book fish species, IFI has been studying the ecology and behaviour of Twaite Shad in the estuaries of the larger rivers in the South-East of Ireland since 2010. The following reports describe the methods used to survey for shads and their respective degrees of success (a detailed review is presented in the Natura Impact Statement prepared for the proposed development):

- King, J.J. and Linnane, S.M. (2004) The status and distribution of lamprey and shad in the Slaney and Munster Blackwater SACs. *Irish Wildlife Manuals* 14. National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.
- Kelly, F., Harrison, A., Connor, L., Matson, R., Morrissey, E., Feeney, R., Wogerbauer, C., O'Callaghan, R. and Rocks, K. (2011) *Sampling Fish for the Water Framework Directive – Summary Report 2010*. Inland Fisheries Ireland, Dublin.
- IFI (2011) *Sampling Fish for the Water Framework Directive – Transitional Waters 2010: Barrow, Nore and Suir Estuaries.* Inland Fisheries Ireland, Dublin.
- IFI (2012) *National Programme: Habitats Directive and Red Data Book Fish species. Executive Report 2011. IFI Report Number: IFI/2012/1-4103.* Inland Fisheries Ireland, Dublin.
- Rooney, S.M., O'Gorman, N.M., King, J.J. (2013) *National Programme: Habitats Directive and Red Data Book Species Executive Report 2012.* Inland Fisheries Ireland, Dublin.
- Rooney, S.M., O'Gorman, N.M., Cierpial, D. and King, J.J. (2014) *National Programme: Habitats Directive and Red Data Book Species Executive Report 2013.* Inland Fisheries Ireland, Dublin.
- O'Gorman, N.M., Rooney, S.M., Cierpial, D. and King, J.J. (2015) *National Programme: Habitats Directive and Red Data Book Species Executive Report 2014.* Inland Fisheries Ireland, Dublin.
- Rooney, S. and King, J.J. (2015) *A poster on acoustic tracking of twaite shad by the Habitats Directive and Red Data Book Species team presented at the 3rd International Conference on Fish Telemetry (ICFT) in Halifax, Nova Scotia in 2015.* Inland Fisheries Ireland, Dublin.
- Gallagher, T., O'Gorman, N.M., Rooney, S.M., Coughlan, B., and King, J.J. (2016) *National Programme: Habitats Directive and Red Data Book Species Executive Report 2015.* Inland Fisheries Ireland, Dublin.
- Gallagher, T., O'Gorman, N.M., Rooney, S.M., Coghlan, B., and King, J.J. (2017) *National Programme: Habitats Directive and Red Data Book Species Summary Report 2016.* Inland Fisheries Ireland, Dublin.
- Gallagher, T., O'Gorman, N.M., Rooney, S.M., Coghlan, B., and King, J.J. (2019) *National Programme: Habitats Directive and Red Data Book Species Summary Report 2017.* Inland Fisheries Ireland, Dublin.
- Gallagher, T., O'Gorman, N.M., Rooney, S.M., and King, J.J. (2020) *National Programme: Habitats Directive and Red Data Book Species Summary Report 2018.* Inland Fisheries Ireland, Dublin.
- IFI (2021a) *Twaite Shad* <https://www.fisheriesireland.ie/fish-species/twaite-shad .html> [Accessed 01/03/2021]. Inland Fisheries Ireland, Dublin.
- IFI (2021b) *Juvenile Shad Monitoring* <https://www.fisheriesireland.ie/Habitats-and-Red-Data-Book/juvenile-shad-monitoring.html> [Accessed 01/03/2021]. Inland Fisheries Ireland, Dublin.
- IFI (2021c) *Adult Shad Monitoring* <https://www.fisheriesireland.ie/Habitats-and-Red-Data-Book/adult-shad-monitoring.html> [Accessed 01/03/2021]. Inland Fisheries Ireland, Dublin.

Notwithstanding the significant ongoing survey effort in IFI's monitoring programme over the last 8 years, gaps remain in the understanding of the ecology and behaviour of Twaite and Allis Shad, particularly in relation to juveniles during their residency in estuaries, and anecdotal records from anglers and commercial netsmen remain the most significant source of information. However, having thoroughly reviewed existing literature relating to this species, it was considered that sufficient information was available to inform the assessment of the proposed development in terms of the likely impacts on this species. Furthermore, having examined the survey methods used by IFI and others, it was considered that any additional surveys carried out to inform this assessment would not contribute any significant additional information regarding the distribution, densities and movement patterns of post-larval and juvenile Twaite Shad in the Lower Suir Estuary.

Salmonids

Atlantic Salmon is a Qualifying Interest of the Lower River Suir SAC and the River Barrow and River Nore SAC. While the River Suir at the location of the proposed development does not provide suitable spawning habitat for salmonids, e.g. Atlantic Salmon (*Salmo salar*) and Brown Trout (*S. trutta*), it is an important link between the estuarine, coastal and oceanic feeding grounds for these species and their spawning beds further upstream. Salmonid species may be present at the location of the proposed development at any time of the year but occur in most significant numbers during their upstream spawning migration (predominantly in autumn and winter) and out-migration of smolts (almost entirely in spring). In addition, sea or slob trout (Brown Trout with a marine or estuarine adult phase) may be present at any time of the year.

Lamprey

Sea Lamprey (*Petromyzon marinus*), River Lamprey (*Lampetra fluviatilis*) and Brook Lamprey (*Lampetra planeri*) are all listed as Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC. Sea Lamprey and River Lamprey are both likely to be present at the location of the proposed development in significant numbers during their upstream spawning migrations and downstream migrations following metamorphosis. The major upstream movements of Sea Lamprey occur in April, May and, to a lesser extent, June, while those of River Lamprey occur earlier, beginning in August and continuing over the winter and spring. The downstream migration of Sea Lamprey occurs in September and October, while that of River Lamprey occurs over an extended period from late winter to early summer. Salinity levels measured during the site investigations for the River Suir Sustainable Transport Bridge varied from 3.1 ppt to 18 ppt across 5 samples, which is not considered suitable for Brook Lamprey or juvenile lampreys of any species (ROD, 2018a).

European Eel

Unlike salmonids and lampreys, European Eel has a catadromous life history, i.e. spawning occurs at sea and juveniles migrate into fresh waters to feed and mature. The major influx of juvenile eels ("elvers") occurs in early spring. Large numbers of elvers are expected to be present at the proposed development location during this time.

European Smelt

Another species known to use the River Suir at this location is European Smelt. This estuarine species is most likely to be present in significant numbers at the proposed development location during March and April.

Otter

There are frequent and widespread records of Otter throughout the study area according to data supplied by the NBDC (2021) and the NPWS (2021). Additionally, evidence of Otter in the form of spraints and prints was recorded during surveys carried out c. 500m downstream of the proposed development to inform the EIAR for the River Suir Sustainable Transport Bridge (ROD, 2018a). However, no holts or couches were observed. Nevertheless, records and data reviewed as part of the desk study strongly indicate that Otter are present at the location of the proposed development.

Bats

The brownfield site on the northern bank of the River Suir east of Plunkett Station was designated as a Strategic Development Zone (SDZ) by the Government of Ireland and WCCC is the planning agency for this site, known as the North Quays (Waterford) SDZ. In order to inform the Planning Scheme for the SDZ and related planning application, a number of ecological studies have been undertaken on the site, including bat studies.

A study of the bat fauna on the North Quays SDZ (Kelleher, 2014) included a desk study, details of which are outlined below. The existing bat records within 10km of the North Quays (sourced from BCI's National Bat Records Database) reveals that seven of the ten known Irish species have been observed locally. These include Common Pipistrelle (*Pipistrellus pipistrellus*) and Soprano Pipistrelle (*Pipistrellus pygmaeus*), Leisler's Bat (*Nyctalus leisleri*), Brown Long-eared Bat (*Plecotus auritus)*, Daubenton's Bat (*Myotis daubentonii)*, Natterer's (*Myotis nattereri*) and Whiskered Bat (*Myotis mystacinus*) as shown in Table 7.8. Roosts of some of these species are also known within this radius but none are in the vicinity of the proposed development.

Table 7.8 Status of Bat Species within 10 km of the North Quays. Source: *Aardwolf Wildlife Surveys Bat Fauna Survey* (Kelleher, 2014).

Common name	Scientific name	Presence	Roosts	Source
Common Pipistrelle	*Pipistrellus pipistrellus*	Present	3 known	BCI
Soprano Pipistrelle	*Pipistrellus pygmaeus*	Present	1 known	BCI
Nathusius' Pipistrelle	*Pipistrellus nathusii*	Potential/rare	0 known	BCI
Leisler's Bat	*Nyctalus leisleri*	Present	4 known	BCI
Brown Long-eared Bat	*Plecotus auritus*	Present	3 known	BCI
Lesser Horseshoe Bat	*Rhinolophus hipposideros*	Absent	N/A	BCI
Daubenton's Bat	*Myotis daubentonii*	Present	0 known	BCI
Natterer's Bat	*Myotis nattereri*	Present	1 known	BCI
Whiskered Bat	*Myotis mystacinus*	Present	2 known	BCI
Brandt's Bat	*Myotis brandtii*	Potential/rare	0 known	BCI

Furthermore, a bat study was undertaken by Andrew Harrington on behalf of WCCC prior to the demolition of buildings on the North Quays in June and July 2017 (Harrington, 2017). During the surveys on 1st July (dusk) and 2nd July (dawn), only one bat was recorded on the North Quays.

A bat activity survey, to supplement the previous studies (Kelleher, 2014; Harrington, 2017) was undertaken to inform the EIAR for the River Suir Sustainable Transport Bridge (ROD, 2018a). The survey was carried out on 24th July 2018 in suitable weather conditions. Bat activity during the survey was low. Two species of Bat, namely Common Pipistrelle (*Pipistrellus pipistrellus*) and Leisler's Bat (*Nyctalus leisleri*), were recorded during the survey.

In addition to this, pre-demolition emergence/re-entry surveys were carried out by ROD at six buildings located adjacent to the North Quays site in September and October 2020. This involved a total of 9 dawn re-entry surveys and 6 dusk emergence surveys. Species recorded during these surveys included Leisler's Bat, Common Pipistrelle, Soprano Pipistrelle and Nathusius' Pipistrelle. The general level of bat activity in the area was low to moderate and the more commonly observed species were Leisler's Bat and Common Pipistrelle.

Other Terrestrial Mammals

There have been a number of records for most native Irish mammals within the study area, including Badger, Irish Hare, Red Squirrel, Hedgehog and Irish Stoat. However, none of these records fall within or immediately adjacent to the proposed development. The location of the proposed development does not support suitable habitats for these species as they are highly modified lands which are subject to frequent disturbance from passing trains and boats.

Marine Mammals

A Marine Mammal Risk Assessment (MMRA) was undertaken by IWDG Consulting to inform the EIAR for the River Suir Sustainable Transport Bridge in 2018 (IWDG Consulting, 2018). The report states that most sightings of cetaceans (whale, dolphin and porpoises) were recorded in the estuary downriver of Waterford City. In reference to pinnipeds (seals), the MMRA reports that there were no Harbour Seal (*Phoca vitulina*) haul-out or breeding sites recorded near Waterford City, while pupping and haul out site for Grey Seal occur 40 km from the proposed development at Great Saltee Island.

The MMRA concluded that "*a number of marine mammals have been recorded in the River Suir, in and adjacent to Waterford city but their occurrence is so sporadic that it is extremely unlikely that any would be exposed to potential impacts from this development. No mitigation required*".

The MMRA for the Sustainable Transport Bridge is applicable to the proposed Flood Defences West as the two developments are located within 100m of each other and would give rise to the same type of impact on marine mammals (hydroacoustic impacts from pile driving). However, as explained in more detail further on in this chapter, such impacts from the Flood Defences West would be of a much lower magnitude.

Birds

The data retrieved from the NBDC database (Table 7.6 above) contains records of a considerable number of bird species within the Zone of Influence, all of which are Red-listed or Amber-listed in *Birds of Conservation Concern in Ireland 2020-2026 (*Gilbert, G. et al., 2021) and some of which are listed on Annex I to the Birds Directive. Many of these birds are wetland species which spend the winter in the Suir-Barrow-Nore Estuary, while others are riparian species more likely to occur along the freshwater stretches of the River Suir, e.g. Kingfisher. Raptors such as Peregrine Falcon are also included, and have been recorded in Waterford City in the past.

BirdWatch Ireland provided Irish Wetland Bird Survey (I-WeBS) data for the three subsites close to the proposed development. The subsites and the years for which data was received are present in Table 7.9 below.

Table 7.9 I-WeBS sub-sites reviewed.

Subsite name	Code	Years of surveys	Distance from the proposed development
Fiddown Bridge (only)	OM303	2012/13	1 km upstream
Derrigal-Portnascully	OM361	2012/13; 2013/14; 2014/15; 2015/16; 2016/17; 2017/18; 2018/19	15 km upstream
Barrow Bridge-Passage East	OM496	2013/14	8 km downstream

Subsite OM361 is situated along the River Suir, at least 15km upstream of Waterford City. This site consists of fields which provide habitat for wetland water birds. Nationally important numbers of Greylag Goose have been recorded here. No species have been recorded occurring in nationally or internationally important numbers at subsite OM303 or OM496, which are located 19km upstream and 8km downstream of the proposed development, respectively. There was no data available from subsite OM390 (Belview-Little Island-Faithlegg, c. 2.5km downstream) or OM498 (Barrow Bridge-Creadan Strand, c. 10 km downstream).

The I-WeBS data shows that subsite OM361 is used by large numbers of wintering birds. However, the location of the proposed development has been highly modified and is subjected to frequent disturbance from the passage of trains and boats, and does not provide suitable habitat for species that are present within the wider environment in significant numbers.

Invasive Species

During the invasive species survey carried out to inform the EIAR for the River Suir Sustainable Transport Bridge (ROD, 2018a), two species restricted under Section 49 of the Habitats Regulations, namely Common Cord-grass (*Spartina anglica*) and Japanese Knotweed (*Fallopia japonica*), were recorded on the bank of the River Suir c. 500m downstream of the proposed Flood Defences West. A number of examples of other invasive but not legally restricted species, including Butterfly Bush (*Buddleja davidii*) and Traveller's Joy (*Clematis vitalba*), were also recorded.

Chinese Mitten Crab (*Eriocheir sinensis*) was recorded in the Waterford Estuary in 2009 (Invasive Species Ireland, 2021) and is presumed to still be present there. This is the only record of this species in Ireland. However, it is much more widespread in Great Britain (NIEA, 2020) and remains a threat.

7.3.4 Designated Sites

The NPWS *Designations Viewer* was reviewed for the location of designated sites within the Zone of Influence. The proposed development traverses the Lower River Suir SAC and is hydrologically connected to the River Barrow and River Nore SAC, as well as 8 No. pNHAs which are listed in Table 7.10 below. The detailed Site Synopses, Natura 2000 data forms and Conservation Objectives for the Lower River Suir SAC and the River Barrow and River Nore SAC were reviewed as part of the assessment. Designated sites within the Zone of Influence are summarised in Table 7.10. The locations of the designated sites are displayed in Figure 7.1 in Volume 3.

Table 7.10 Designated sites within the Zone of Influence.

Designated site (site code)	Distance from the proposed development	Description
European sites		
Lower River Suir SAC (002137)	Immediate proximity	This site consists of the freshwater stretches of the River Suir immediately south of Thurles, the tidal stretches as far as the confluence with the Barrow/Nore immediately east of Cheekpoint in Co. Waterford. The Suir and its tributaries flow through the counties of Tipperary, Kilkenny and Waterford. The Lower River Suir contains excellent examples of a number of Annex I habitats, including the priority habitats alluvial forest and Yew woodland. The site also supports populations of several important animal species; some listed on Annex II of the Habitats Directive or listed in the Irish Red Data Book. The presence of two legally protected plants (Flora (Protection) Order, 2015) and the ornithological importance of the site adds further to the ecological interest and importance.
River Barrow and River Nore SAC (002162)	9 km downstream	This site comprises the River Barrow and River Nore catchments from the source in the Slieve Bloom Mountains to Creadan Head in Waterford. Urban centres along the site include Portarlington, Athy, Carlow, Kilkenny and New Ross. Overall, it is of considerable conservation significance for the occurrence of good examples of habitats and of populations of plant and animal species that are listed on Annexes I and II of the Habitats Directive. Furthermore, it is of high conservation value for its populations of a number of bird species listed on Annex I of the Birds Directive. The occurrence of several Red Data Book plant species and the endemic population of the hard-water form of the Freshwater Pearl Mussel (limited to a 10 km stretch of the Nore) add further value to this site.
Nationally designated sites		
Ballyhack pNHA (000695)	14.5 km downstream	No site synopsis available for this pNHA. See River Barrow and River Nore SAC.
Barrow River Estuary pNHA (000698)	9 km downstream	No site synopsis available for this pNHA. See River Barrow and River Nore SAC.
Duncannon Sandhills pNHA (001738)	18.6 km downstream	No site synopsis available for this pNHA. See River Barrow and River Nore SAC.
Fiddown Island pNHA (000402)	19.3 km upstream	No site synopsis available for this pNHA. See Lower River Suir SAC.
King's Channel pNHA (001702)	3.6 km downstream	An offshoot of the Suir Estuary below Waterford surrounding Little Island, where the southern shore is lined in places by a flat saltmarsh. The saltmarsh is best developed in Grantstown with a sequence of plant communities. The middle zone has a few clumps of protected (Flora Protection Order, 2015) Meadow Barley (*Hordeum secalinum*).
Lower River Suir (Coolfinn, Portlaw) pNHA (000399]	12.6 km upstream	No site synopsis available for this pNHA. See Lower River Suir SAC.

Designated site (site code)	Distance from the proposed development	Description
River Suir Below Carrick-on-Suir pNHA (000655)	25.1 km upstream	No site synopsis available for this pNHA. See Lower River Suir SAC.
Tibberaghny Marshes pNHA (000411)	21.8 km upstream	No site synopsis available for this pNHA. See Lower River Suir SAC.
Waterford Harbour pNHA (000787)	15.5 km downstream	No site synopsis available for this pNHA. See River Barrow and River Nore SAC.

With regard to European sites, an Appropriate Assessment (AA) Screening was carried out by Waterford City and County Council, as the competent authority, for the proposed development in compliance with Article 6(3) of the Habitats Directive. As part of this assessment, the potential for the proposed development to have an effect on any European sites in the Zone of Influence was considered. The AA Screening concluded as follows:

> "*This AA Screening Report has examined the details of the project and the relevant European sites and has concluded, on the basis of objective information, that the proposed development, either individually or in combination with other plans or projects, is likely to give rise to impacts which would constitute significant effects in view of the Conservation Objectives of the Lower River Suir SAC and the River Barrow and River Nore SAC.*"

Following the AA Screening determination, a Natura Impact Statement (NIS) has been prepared in respect of the proposed development, detailing the impacts predicted on the Lower River Suir SAC and River Barrow and River Nore SAC and prescribing appropriate measures to mitigate those impacts.

There are a number of pNHAs that are located within the Zone of Influence and are hydrologically connected to the proposed development as set out in Table 7.10 above. This hydrological connection between the proposed development and these nationally designated sites provides a pathway for water quality impacts to be carried to these sites. These pNHAs collectively support a range of rare and protected species and habitats, some of which are listed on Annex I to the Habitats Directive. Many of these species and habitats are also listed as qualifying interests of the Lower River Suir SAC and the River Barrow and River Nore SAC and are sensitive to water quality impact and changes in hydraulic regime and other hydromorphological processes.

7.4 Field Survey Results

7.4.1 Habitats

This section describes the habitats recorded during the field survey within the study area (the proposed development footprint and a 150m buffer). A total of 16 different Fossitt (2000) habitats and habitat mosaics were identified in the study area. These habitats are listed below and mapping of these habitats is presented in Figure 7.2 in Volume 3 of this EIAR:

- (Mixed) broadleaved woodland (WD1)
- Exposed siliceous rock (ER1)
- Scrub/Exposed siliceous rock (WS1/ER1)
- Siliceous scree and loose rock (ER3)

- Dry meadows and grassy verges/Scrub (GS2/WS1)
- Buildings and artificial surfaces (BL3)
- Scrub (WS1)
- Recolonising bare ground (ED3)
- Dry meadows and grassy verges (GS2)
- Wet grassland (GS4)
- Tidal rivers (CW2)
    - Sea walls, piers and jetties (CC1)
    - Lower salt marsh (CM1)
    - Upper salt marsh (CM2)
    - Mud shores (LS4)
    - Estuaries (MW4)
- Wet grassland/Scrub (GS4/WS1)

(Mixed) broadleaved woodland (WD1)

Some examples of '(Mixed) broadleaved woodland' are present at the top of the rock face north of the railway line in the vicinity of Plunkett Station. Other than the River Suir and adjacent saltmarshes, these small areas of woodland are the habitats of highest biodiversity value in the field study area. However, they are outside the proposed development boundary and will not be affected.

Exposed siliceous rock (ER1)

The exposed cliff face north of the railway line in the vicinity of Plunkett Station is an outcrop of the Ballylane geological formation and corresponds to the Fossitt (2000) habitat 'Exposed siliceous rock'. This feature provides suitable habitat for roosting bats and nesting birds, particularly Peregrine. Works to stabilise this cliff face have received planning permission (WCCC Part VIII) and are not part of the proposed development.

Scrub/Exposed siliceous rock (WS1/ER1)

Part of the cliff face described above is interspersed with Gorse (*Ulex europaeus*) and other shrubs, forming a mosaic of 'Scrub/Exposed siliceous rock'. This provides suitable habitat for nesting birds and other fauna. As noted above, works in this location have planning permission as part of the cliff stabilisation works and are not part of the proposed development.

Siliceous scree and loose rock (ER3)

Exposed rock on the cliff face north of Plunkett Station is subject to weathering which results in occasional rockfalls. The build-up of scree and loose rock at the bottom of the cliff corresponds to the Fossitt (2000) habitat 'Siliceous scree and loose rock'.

Dry meadows and grassy verges/Scrub (GS2/WS1)

The wide sloping road verge north of the R448 comprises dry grassland habitat with a mosaic of Gorse-dominated scrub. This habitat is of low-moderate biodiversity value and will not be affected by the proposed development as it is outside the site boundary and will not experience any disturbance as a result of the construction works.

Buildings and artificial surfaces (BL3)

Much of the land surrounding the proposed development, particularly on the northern side, is built land consisting of roads, railways, buildings and bridges. Further away from the river, the majority of the surrounding area comprises built areas including the urban centre of Waterford. Generally, built habitats are not considered to be of high ecological significance.

Plate 7.3 Buildings, railway tracks, roads, bridges, walls and other artificial surfaces make up a significant portion of the study area.

Scrub (WS1)

The main area of scrub in the field study area is immediately north of the railway and south of the R488 road (on the sloped embankment). This area comprises a narrow, elongated strip of low-growing trees and shrubs, including many non-native Sycamore and Butterfly Bush. This area extends northwest to the commercial estate near the Newrath level crossing. While this habitat is of some biodiversity value in terms of providing habitat for birds, bats and invertebrates, this is limited by its position almost entirely enclosed by buildings and artificial surfaces. Furthermore, no works or disturbance to this area is proposed as part of the proposed development.

Smaller areas of scrub are also present between the railway line and the River Suir. One very small area, comprising an immature Sycamore and some Hawthorn is found adjacent to the signal cabin at Ch.1155. A larger area is found adjacent to the proposed construction site compound at the north-western end of the site. This area is heavily infested with invasive alien species, most notably Japanese Knotweed, but also Butterfly Bush, Montbretia and Cotoneaster.

Recolonising bare ground (ED3)

Areas of railway ballast which are >5m from the track contain many species which are typical of ruderal vegetation, e.g. Nettle, Dandelion and other asters, willowherbs, and ragworts. Ivy, Ivy-leaved Toadflax and Wild Strawberry are also common, as well as Creeping Cinquefoil, Bramble and other opportunistic species. This habitat forms part of the transition from railway ballast to dry grassy verges to wet grassland to the quay wall. This habitat will be lost during construction but will recover during the operation of the proposed development.

Plate 7.4 'Recolonising bare ground' with horsetail (*Equisetum* sp.) at Ch. 950.

Dry meadows and grassy verges (GS2)

A number of small strips of grassy vegetation are found in the vicinity of the proposed development, generally at the sides of roads and also between the railway line and quay wall. Very small areas of this habitat will be lost during construction of the proposed development but will eventually recover.

Wet grassland (GS4)

This habitat is present between the railway line and the River Suir, mostly between Ch. 780 and Ch. 1.100. It is most notable where the existing quay wall has fallen onto the mud (the influence of the river at this point is not sufficient to promote the development of this habitat into saltmarsh). In the study area, there are only poor examples of this habitat, dominated by Common Couch with occasional Red Fescue and shrubs (including the invasive Butterfly Bush). Therefore, these habitats are of low biodiversity value.

Plate 7.5 'Wet grassland' at Ch. 850, with Butterfly Bush and Gorse visible.

Wet grassland /Scrub (GS4/WS1)

On the southern side of the River Suir, directly opposite the proposed development, the riverbank upstream of the boatyards comprises 'Wet grassland' interspersed with areas of Gorse, forming a grassland-scrub mosaic. This area will not be affected at all be the proposed development.

Tidal rivers (CW2)

The proposed development runs along the northern bank of the River Suir. The river within the extents of the proposed development is subject to the influence of the tides and is designated as part of the Lower River Suir SAC. This habitat class contains other habitat types within it, namely 'Sea walls, piers and jetties' (CC1), 'Lower salt marsh' (CM1), 'Upper salt marsh' (CM2), 'Mud shores' (LS4), and 'Estuaries' (MW4), which are discussed in the following paragraphs. Specialist surveys of these habitats were undertaken by BEC Consultants Ltd on 15th March 2021 (Brophy, 2021) and the results are included as relevant.

Plate 7.6 The River Suir at Ch. 960, comprising 'Tidal rivers', including 'Sea walls, piers and jetties, 'Lower salt marsh', 'Mud shores' and 'Estuaries'. More detailed photos of these habitats are presented in the Intertidal Survey Report (Brophy, 2021) in Appendix 7.1 to this EIAR.

Sea walls, piers and jetties (CC1)

This category is used for all coastal constructions that are partially or totally inundated by sea water at high tide. This habitat was recorded along footprint of the proposed development as a masonry and concrete sea walls. The banks of the river on the southern side of the River Suir opposite the location of the proposed development consists of a series of floating jetties where many vessels are moored.

Brophy (2021) surveys the hard intertidal surfaces within the extents of the new riverside flood defence wall in March 2021. Brophy's description of these habitats is reproduced below and the full data are presented in Appendix 7.1.

> "*The hard substrata biotopes of the study area were limited to artificial surfaces in the form of the historical retaining wall separating the estuary from the rail line. The biotopes here were typical of the sheltered location in a reduced salinity environment on an artificial substratum. The eastern end of the study area showed the most developed zonation of intertidal hard substratum biotopes. From bottom to top, this area included a band of '*Ascophyllum nodosum *and* Fucus vesiculosus *on variable salinity mid eulittoral rock' (LR.LLR.FVS.AscVS) up to 1.5 m wide* […]*, '*Fucus ceranoides *on reduced salinity eulittoral rock' (LR.LLR.FVS.Fcer) approximately 30 cm wide* […]*, sparse and intermittent '*Enteromorpha *spp. on freshwater-influenced and/or unstable upper eulittoral rock' (LR.FLR.Eph.Ent)* […] *and 'Yellow and grey lichens on supralittoral rock' (LR.FLR.Lic.YG)* […]*, which is similarly sparse and intermittent. Heading west, the LR.LLR.FVS.AscVS zone rapidly disappears, as the upper mud shore covers its potential substratum along the base of the retaining wall, leaving only the upper three biotopes. There is often*

> *a strip of bare stone between the LR.LLR.FVS.Fcer and the LR.FLR.Eph.Ent above it.*
>
> *The barnacle* Austrominius modestus *was recorded on some of the wooden posts found emerging from the mudflat […] and occasionally on rocks on the mud.*"

The remaining supports of former landing stages along the proposed development extent and supports for the R448 flyover also fall into this habitat class. However, these areas are too small to be mapped at the scale required.

These habitats are considered to be of moderate biodiversity value as, while they are not species-rich or of a very natural or locally distinct character, they are one of the principal ecosystem features which define this part of the River Suir and support the integrity of habitats and species of conservation interest in the Lower River Suir SAC.

Plate 7.7 Existing quay wall surface with Fucus spp. community.

Lower salt marsh (CM1) and Upper salt marsh (CM2)

An area of 106m^2 of saltmarsh, comprising mostly 'Lower salt marsh' (CM1) with a smaller band of 'Upper salt marsh' (CM2) higher up the shore, was identified between the existing quay wall and the mudflats from Ch. 925 to Ch. 975. The species present in the lower zone included Common Saltmarsh-grass (*Puccinellia maritima*) and Sea Plantain (*Plantago maritima*), while the upper zone contained Creeping Bent (*Agrostis stolonifera*). Sea Aster (*Tripolium pannonicum*) was present in both zones. The invasive Common Cordgrass was not present at the time of survey. This habitat corresponds to the Annex I habitat 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330), which is listed as a Qualifying Interest of the Lower River Suir SAC. Brophy (2021) noted that this saltmarsh has formed in the shelter provided by an outward projection of the existing quay wall.

A similar area was also observed further up the River Suir (northwest), adjacent to the proposed construction compound. However, this area is not within the works extent and will not be affected in any way.

Borrer's Saltmarsh-grass (*Puccinellia fasciculata*), which is listed as Near Threatened in *Ireland Red List No. 10: Vascular Plants* (Wyse Jackson et al., 2016) and protected under the Flora (Protection) Order, 2015, was not observed during any of the surveys.

While these are not "best examples" of saltmarsh habitats, they are considered to be of very high biodiversity value as they conform to a type listed on Annex I to the Habitats Directive and are Qualifying Interests of the Lower River Suir SAC.

Plate 7.8 Saltmarsh habitats at Ch. 925 to Ch. 975.

Mud shores (LS4)

Mud shores are formed primarily of very fine sediment and usually occur along the most sheltered sections of coastline. The silt/clay fraction of the sediment is typically found in the upper reaches of estuaries. They are subject to variable, reduced or low salinity conditions. Mud shores are often characterised by elevated mudflats that are dissected by networks of shallow channels associated with flooding and drainage. This habitat is present in the intertidal areas of the River Suir, including within the footprint of the proposed development.

This habitat corresponds to the Annex I habitat 'Mudflats and sandflats not covered by seawater at low tide' (1140). However, this habitat is not listed as a Qualifying Interest of the Lower River Suir SAC.

Brophy (2021) surveyed the mudflats within the extents of the new riverside flood defence wall in March 2021. Brophy's description of the mudflats is reproduced below and the full data are presented in Appendix 7.1.

> "*The intertidal mud of the study area is all classified as '*Tubificoides benedii *and other oligochaetes in littoral mud' (LS.LMu.UEst.Tben) under the JNCC Marine Biotope Classification* […]. *This biotope is species-poor and found in upper estuarine locations where the salinity is reduced, with wave exposure ranging from sheltered to extremely sheltered (Connor et al., 2004). The substratum is one of fine sandy mud, and extends from the lower shore to the upper shore (Connor et al., 2004). Within the study area, the nature of the mudflat in the upper shore differed from lower down. The upper shore along much of the length comprised firm, anoxic mud, with rubble and debris dumped onto it from the land side, with quite a steep profile* […]. *Burrows were visible in this upper shore mud surface and Horned Wrack (*Fucus ceranoides*) was growing on rocks scattered along the shore. The lower shore was one of soft mud, with the anoxic layer often deeper than the 25 cm reached by the core and a flatter profile* […].
>
> *In the current survey, only four species were recorded across the five sampling locations* […]. *The oligochaete worm* Baltidrilus costatus *was recorded at the uppermost sample station S1, which was located on the upper shore. The true fly (Diptera) larva of the Family Dolichopodidae was found at sample station S2, forming burrows in the upper shore. A single mayfly* Baetis rhodani *was recorded at sample station S3; this must have washed down from upstream as there is no suitable habitat present in the estuary for this species. Similarly, a larva of the water beetle* Esolus parallelepipedus *recorded at S5 must also have been washed down, as, again, no suitable habitat for this species is present within the estuary. No fauna were recorded from sample station S4.* […]
>
> *The granulometric analysis classified all stations as 'Sandy Mud', with the mud content ranging from 59.6% (S3) to 79.3% (S1)* […]. *Total Organic Carbon ranged from 7.37% (S2) to 8.20% (S5)* […]."

While the mudflat habitats at this location are very species-poor and do not represent best examples of this habitat type, they are the principal feature which defines this part of the River Suir and support the integrity of habitats and species of conservation interest in the Lower River Suir SAC, though they are not a Qualifying Interest in their own right. Therefore, they are considered to be of high biodiversity value.

Plate 7.9 **'Mud shores' at the western end of the proposed extent of the new riverside flood defence wall.**

Estuaries (MW4)

For the purposes of this assessment, the River Suir below the low-water mark has been classed as the Fossitt (2000) habitat type 'Estuaries' (MW4). In addition, the River Suir at this location corresponds to the Annex I habitat 'Estuaries' (1130) which is not listed as a Qualifying Interest of the Lower River Suir SAC. EC (2013) describes this habitat as the downstream part of a river valley, subject to the tide and extending from the limit of brackish waters. Therefore, the Annex I type applies to the intertidal areas also, corresponding to the Fossitt (2000) habitat type 'Tidal rivers' (CW2).

Character of Habitats

The site of the proposed development has been highly modified from its natural state over centuries of urbanisation, navigation, dredging and reclamation. Its character is typical of urbanised or industrialised estuarine environments.

Significance of Habitats

The habitats present on the site were assessed in accordance with NRA (2009). The River Suir itself, although highly modified, is the habitat with the highest biodiversity value within the site as it supports a number of habitats and species of conservation importance, some of which are Qualifying Interests of the Lower River Suir SAC and other connected sites. Therefore, these habitats are considered to be of moderate-high biodiversity value. Other habitats are of considerably lower significance.

7.4.2 Fauna

Terrestrial Mammals

Otter

During the three walkover surveys, signs of Otter activity were recorded within the study area. Evidence of Otter activity included prints along the mudflats outside the existing quay wall. No spraints or any potential holts or couches were recorded within 150 m of the proposed development.

Plate 7.10 Otter prints on the mudflats at Ch. 980.

Bats

The bat suitability assessment undertaken during the walkover surveys assessed the area within the proposed development boundary as being of Low-Moderate suitability for bats. This was based on an appraisal of the potential of specific features on the site to support roosting bats, as well as the general site conditions in terms commuting and foraging habitat for bats. Table 7.11 below described the appraisal of these features with regard to their suitability for bats.

Table 7.11 Appraisal of the proposed development site for roosting, commuting and foraging bats (see Figures 4.1 to 4.6 in Volume 3 for chainage reference points).

Feature*=	Description	Suitability
R448 elevated roadway (Ch. 345 to Ch. 385)	The underside of this concrete structures contains a large number of gaps at expansion joints and along transverse grooves in the soffit structure (see Plate 7.11 below). While these do not provide ideal roosting habitat, particularly for maternity or hibernation, bats have been known to use such features in the past, even for hibernation. Features present on this structure could be used by bats due to their size, protection, height above the ground and dryness. However, these features are in an otherwise exposed (estuarine) environment, are unlikely to have a stable temperature during the winter and are subject to significant disturbance. Furthermore, there is poor connectivity to suitable foraging habitats in the vicinity. Therefore, this structure is very unlikely to support a roost of conservation importance.	Low-Moderate
Buildings (signal cabin at Ch. 1.155, small disused buildings at Ch. 1.470 and beyond)	These buildings are small, single-storey buildings, generally of wooden or other lightweight construction and uninhabited (see Plates 7.12 to 7.14 below). These buildings are in reasonably good condition, with little opportunity for bats to access the interior or voids in the roofs. While they may provide space for roosting by significant numbers of bats and are subject to much less disturbance due to their location away from the more urbanised parts of the site, their lightweight construction means that they are unlikely to maintain a stable temperature. They are also poorly connected to nearby foraging habitat. Therefore, they are unlikely to support a roost of conservation importance.	Moderate
Other buildings (Plunkett Station, Sally Park Depot)	These buildings are much larger and in constant use. They are in good repair with almost no opportunity for bats to gain entry to the interior spaces or voids in the roofs. As they are in constant use, they are likely to be too warm for hibernation and are also subject to human disturbance. While they are better connected to foraging habitat to the north of the proposed development, they are still in a relatively exposed environment adjacent to the River Suir. Therefore, based on the lack of roost features on these structures and the prevailing levels of disturbance, they are very unlikely to support a roost of conservation importance.	Low
Scrub, other vegetation and River Suir	Terrestrial habitat connectivity within the proposed development site is generally very poor, with most of the site being buildings and artificial surfaces and no continuous hedgerows or treelines running the length of the site. A narrow strip of scrub is present between	Low

Feature*=	Description	Suitability
	the railway line and the R448 road from Ch. 1150 onwards, but this is a "dead end" and is subject to significant disturbance from the road, as well as light spill. Areas of grassland and scrub on the riverbank are isolated, being linked only by ruderal vegetation which is of little benefit to bats. The only continuous natural feature and the only feature which is well connected to the wider landscape is the River Suir. While rivers usually act as important commuting corridors for bats (and foraging habitats in the case of Daubenton's Bat), the value of the River Suir at this location to commuting and foraging bats is limited by its significant exposure, which reduces its suitability for most Irish species, with the possible exception of Leisler's Bat (Ireland's largest bat and one of the more common species). There is no woodland or other habitat which is of high value for foraging bats and there are no known roosts in the immediate vicinity. Therefore, the proposed development site is of low suitability for commuting and foraging bats.	

Plate 7.11 Gaps in soffit of the R448 elevated roadway which could potentially be used by roosting bats.

Plate 7.12 **Signal cabin (left) at Ch. 1155 with connection to the River Suir.**

Plate 7.13 **Disused building at the proposed location of the main construction compound.**

Plate 7.14 Further disused buildings in the vicinity of the proposed location of the main construction compound.

Based on the results of the desk study and the bat suitability assessment above, and taking into account the nature and scale of the proposed development, further surveys focussing on bats, potential roost features, or suitable commuting or foraging habitats were deemed unnecessary.

Other Terrestrial Mammals (including Badger)

No evidence of badgers was recorded in the study area during the multidisciplinary walkover surveys, and there is very limited suitable habitat or connectivity to the same. Development projects will generally not involve significant impacts on populations of other highly mobile terrestrial mammals, nor are there particularly relevant/effective mitigation measures specific to any of these species. Thus, in most cases, further surveys of e.g. Badger or Hedgehog, over and above the field evidence collected during the multidisciplinary walkover survey would not be appropriate. This was the case with regard to the proposed development. Therefore, targeted surveys for such species were not carried out.

Marine Mammals

No sightings or evidence of any marine mammals (cetaceans or pinnipeds) were recorded during the surveys undertaken to inform this assessment.

Birds

The habitat assessment undertaken as part of the multidisciplinary walkover survey did not identify habitats that support important assemblages or significant populations of breeding or wintering birds. There is no Kingfisher nesting habitat in the study area and Kingfisher movement will not be restricted. Table 7.12 lists the birds that were recorded during the multidisciplinary walkover surveys.

Table 7.12 Bird species recorded during the surveys.

Common name	Scientific name
Grey Heron	*Ardea cinerea*
Buzzard	*Buteo buteo*
Goldfinch	*Carduelis carduelis*
Black-headed Gull	*Chroicocephalus ridibundus*
Hooded Crow	*Corvus cornix*
Rook	*Corvus frugilegus*
Herring Gull	*Larus argentatus*
House Sparrow	*Passer domesticus*

Reptiles and Amphibians

The multidisciplinary walkover surveys did not record any evidence of Common Frog (*Rana temporaria*), Smooth Newt (*Lissotriton vulgaris*) or Common Lizard (*Zootoca vivipara*) within the study area. Further survey/assessment was not deemed necessary due to the lack of suitable habitat or previous records of these species in the area.

7.4.3 Flora

No species protected under the Flora (Protection) Order, 2015 were recorded within the study area. Table 7.13 below provides a list of plant species recorded during the multidisciplinary walkover surveys.

Table 7.13 Plant species recorded during the surveys.

Common name	Scientific name
Sycamore	*Acer pseudoplatanus*
Creeping Bent	*Agrostis stolonifera*
Lords-and-Ladies	*Arum maculatum*
Daisy	*Bellis perennis*
Sea Beet	*Beta vulgaris* subsp. *maritima*
Rape	*Brassica napus*
Butterfly Bush	*Buddleja davidii*
Pot Marigold	*Calendula officinalis*
Hairy Bittercress	*Cardamine hirsuta*
Red Valerian	*Centranthus ruber*
Spear-thistle	*Cirsium vulgare*
Traveller's Joy	*Clematis vitalba*
Scurvygrass	*Cochlearia* sp.
Cotoneaster	*Cotoneaster* sp.
Hawthorn	*Crataegus monogyna*
Montbretia	*Crocosmia* × *crocosmiiflora*
Ivy-leaved Toadflax	*Cymbalaria muralis*

Common name	Scientific name
Wild Teasel	*Dipsacus fullonum*
Common Couch	*Elytrigia repens*
Willowherbs	*Epilobium* spp.
Horsetails	*Equisetum* spp.
Japanese Knotweed	*Fallopia japonica*
Wild Strawberry	*Fragaria vesca*
Cleavers	*Galium aparine*
Herb-Robert	*Geranium robertianum*
Crane's-bills	*Geranium* spp.
Ivy	*Hedera helix*
St John's Wort	*Hypericum* sp.
Holly	*Ilex aquifolium*
Red Dead-nettle	*Lamium purpureum*
Himalayan Honeysuckle	*Leycesteria formosa*
Common Mallow	*Malva sylvestris*
Winter Heliotrope	*Petasites fragrans*
Common Reed	*Phragmites australis*
Ribwort Plantain	*Plantago lanceolata*
Sea Plantain	*Plantago maritima*
Polypody	*Polypodium* sp.
Creeping Cinquefoil	*Potentilla reptans*
Primrose	*Primula vulgaris*
Cherry Laurel	*Prunus laurocerasus*
Common Saltmarsh-grass	*Puccinellia maritima*
Bramble	*Rubus fruticosus* agg.
Willow	*Salix* sp.
Groundsel	*Senecio vulgaris*
Smooth Sowthistle	*Sonchus oleraceus*
Rowan	*Sorbus aucuparia*
Dandelion	*Taraxacum vulgaria*
Wood Sage	*Teucrium scorodonia*
Sea Arrowgrass	*Triglochin maritima*
Sea Mayweed	*Tripleurospermum maritimum*
Sea Aster	*Tripolium pannonicum*
Bulrush	*Typha latifolia*
Gorse	*Ulex europaeus*
Common Nettle	*Urtica dioica*
Laurustinus	*Viburnum tinus*
Vetches	*Vicia* spp.

7.4.4 Invasive Alien Species

One species restricted under Section 49 of the Habitats Regulations, namely Japanese Knotweed (*Fallopia japonica*), was recorded during the multidisciplinary surveys. One stand of this species was recorded between the IÉ property boundary and the river in the vicinity of the proposed main construction compound at the north-western end of the proposed development boundary (ITM Grid Reference: 659127, 613604). This stand covered an area of c. 40m^2 and was mostly between the fence and the river, though one plant was in at least its second year of growth in the railway ballast inside the fence at the southern corner of the abandoned iron bridge span.

This stand of Japanese Knotweed will require treatment prior to works commencing. Further stands are known from further up the railway line (beyond the level crossing which is proposed to be used as a haul route) but these are outside the proposed development boundary and not on haul routes.

Plate 7.15 Japanese Knotweed at the proposed location of the main construction compound.

A number of examples of other invasive but not legally restricted species, including Himalayan Honeysuckle, Butterfly Bush, Traveller's Joy, Cherry Laurel, Cotoneaster, Montbretia, and Winter Heliotrope were recorded within the study area.

7.4.5 Ecological Corridors

Article 10 of the Habitats Directive recognises the importance of ecological networks as corridors and steppingstones for wildlife, including for migration, dispersal and genetic exchange of species of flora and fauna. The Directive requires that ecological connectivity and areas of ecological value outside the Natura 2000 network are maintained and it recognises the need for the management of these areas through land use planning and development policies.

Ecological corridors are important in connecting areas of local biodiversity with each other and with nearby designated sites to prevent islands of habitat from becoming isolated. Ecological corridors include linear features such as treelines, hedgerows, disused railway lines, rivers, streams, canals and ditches. They are particularly important for mammals, especially bats, and small birds. The River Suir provides a number of important ecological corridors including an aquatic corridor and some associated shoreline terrestrial habitat corridors such as mudflats and saltmarsh. The River Suir provides a range of habitats and facilitate networks or linkages to the surrounding countryside for biodiversity, flora and fauna.

While ecological corridors are essential for the movement and conservation of native biodiversity, they can also act as conduits for the spread of invasive alien species. This is particularly the case for rivers and other aquatic corridors. Therefore, biosecurity is of paramount importance for development projects along ecological corridors, especially rivers.

7.5 Evaluation of Key Ecological Receptors

Table 7.14 below details the evaluation of the ecological receptors that were identified during the desk study and the subsequent field surveys and the evaluation of the importance of each receptor on a geographical scale. Receptors of Local Importance (Higher Value) or above were selected as Key Ecological Receptors.

The assessment of the likely impacts of the proposed development and subsequent proposal of mitigation measures and assessment of residual impacts focus on those receptors which were selected as Key Ecological Receptors in Table 7.14 below.

Table 7.14 Evaluation of Ecological Receptors for the Proposed Development

KER	Description	Evaluation of importance, following NRA (2009)
River Suir, including Annex I 'Estuaries'	The proposed development runs along the northern bank of the River Suir. The river forms an integral part of the Lower River Suir SAC. The Qualifying Interests of this SAC include habitats and species likely to be impacted upon by the proposed development, such as Twaite Shad and Otter. The River Suir at the location of the proposed development corresponds to the Annex I habitat 'Estuaries'. The River Suir has also been identified as an important ecological feature and as an ecological corridor. The river channel will be permanently altered by the proposed development and there is a risk of pollution during the construction phase of the proposed development.	**International Importance** on the basis that this watercourse forms an integral part of the Lower River Suir SAC and hosts habitats and populations of species listed on Annexes I and II, respectively, to the Habitats Directive. Therefore, the River Suir, including Annex I 'Estuaries', has been selected as a Key Ecological Receptor (KER 1).
Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide'	Intertidal habitats in the vicinity of the proposed development include both hard and soft substrates, i.e. the existing quay wall and the mudflats, respectively. The mudflats represent examples of the Annex I habitat 'Mudflats and sandflats not covered by sea water at low tide' (1140). These habitats support a range of biological communities, comprising benthic macroalgae and invertebrates, as well as species which feed on them. Species supported by these intertidal habitats include rare and protected species, including species listed as Qualifying Interests of the Lower River Suir SAC, such as lamprey species, Atlantic salmon, Twaite Shad and Otter.	**National Importance** on the basis that intertidal habitats in the vicinity of the proposed development include an Annex I habitat (though not a "best example" of this habitat, which is not a Qualifying Interest of the Lower River Suir SAC) and provide support for populations of Annex II and IV species, which are Qualifying Interests of the Lower River Suir SAC. Therefore, intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide', have been included as a Key Ecological Receptor (KER 2).
Shoreline Habitats, including Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)'	Shoreline habitats in the vicinity of the proposed development include Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330). This habitat covers a relatively small area (106 m^2) within the boundary of the proposed development and is listed as a Qualifying Interest of the Lower River Suir SAC.	**International Importance** on the basis that shoreline habitats in the vicinity of the proposed development include an Annex I habitat listed as a Qualifying Interest of the Lower River Suir SAC. Therefore, shoreline habitats, including Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', have been included as a Key Ecological Receptor (KER 3).
Fish Species, including Annex II migratory species	Sea Lamprey, River Lamprey, Twaite Shad and Atlantic Salmon are all Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC. These species, as well as European Eel and Smelt, are likely to be present in the vicinity of the proposed development, at different times of the year and during critical periods during their life histories, e.g. migrations.	**International Importance** on the basis that these species are listed on Annexes II and IV to the Habitats Directive and are Qualifying Interests of the Lower River Suir SAC (and the River Barrow and River Nore SAC). Therefore, fish species, including Annex II migratory species, have been included as a Key Ecological Receptor (KER 4).
Otter	Otter is listed on Annexes II and IV to the Habitats Directive and is a Qualifying Interest of both the Lower River Suir SAC and the River Barrow and River Nore SAC. This species is known to occur in the vicinity of the proposed development.	**International Importance** on the basis that this species is listed on Annex II and IV to the Habitats Directive and is a Qualifying Interest of the Lower River Suir SAC (and the River Barrow and River Nore SAC). Otter has, therefore, been selected as a Key Ecological Receptor (KER 5).

KER	Description	Evaluation of importance, following NRA (2009)
Bat Species	All nine resident breeding bat species in Ireland are legally protected and roost sites (whether in use or not) are also protected under both European and Irish legislation. All bat species occurring in Ireland are protected under the Wildlife Acts and are listed in Annex IV to the Habitats Directive. A number of bat species are known to roost within 10 km of the proposed development and more common species, e.g. Leisler's Bat and Common Pipistrelle, are known to feed in low numbers in the vicinity of the proposed development. Linear features such as rivers are known to be of particular importance for bat feeding and commuting.	**Local Importance (Higher Value)** on the basis that the habitats in the vicinity of the proposed development support low numbers of common bat species, which are listed on Annex IV to the Habitats Directive and are protected under the Wildlife Act, but are very unlikely to support roosting bats. Therefore, bat species have been selected as a Key Ecological Receptor (KER 6).
Other Terrestrial Mammals	All native Irish mammals are protected under the Wildlife Act. However, no such species other than Otter (covered above) are listed as Qualifying Interests of the Lower River Suir SAC or are known to regularly occur in the vicinity of the proposed development. It is unlikely that terrestrial mammals are present at the site location due to the lack of suitable habitat.	**Local Importance (Lower Value)** on the basis that the site and surrounding area provide small areas of semi-natural habitat that could be of benefit to individual mammals, but not resident or regularly occurring populations. Therefore, other terrestrial mammals have not been selected as a Key Ecological Receptor.
Marine Mammals	All native marine mammals and those that migrate frequently through Irish waters are protected under the Wildlife Act and species such as Bottlenose Dolphin and Harbour Porpoise are listed on Annex II to the Habitats Directive. All cetaceans are listed on Annex IV to the Habitats Directive. Grey Seal and Harbour Seal are also listed on Annex II to the Habitats Directive. No marine mammals are Qualifying Interests of the Lower River Suir SAC and their presence at the location of the proposed development is infrequent and sporadic.	**Local Importance (Lower Value)** on the basis that the site and surrounding area provides limited suitable habitat for marine mammals and there are no resident or regularly occurring populations. Therefore, marine mammals have not been selected as a Key Ecological Receptor.
Birds	All bird species are protected under the Wildlife Act, and a number of species that have been recorded in the study area are listed on Annex I to the Birds Directive, e.g. Bar-tailed Godwit and Golden Plover. Additionally, some of these species are Red-listed in *Birds of Conservation Concern in Ireland 2020-2026* (Gilbert, G. et al.,2021), e.g. Curlew. The habitats in the vicinity of the proposed development include mudflats, which provide foraging habitat and a food source for wading birds in particular in the form of marine invertebrates. However, due to the narrow, constrain and urbanised setting of these habitats in Waterford City, and the frequent disturbance from passing road traffic, trains and boats, the value of these habitats to birds is very limited and few observations have been made at these locations. The multidisciplinary walkover surveys found no nesting habitat for species such as Kingfisher or Sand Martin, or any areas of woodland or scrub that could provide habitat for other breeding birds.	**Local Importance (Lower Value)** on the basis that habitats in the vicinity of the proposed development provide very limited suitable foraging habitat for birds and there are no resident or regularly occurring populations of conservation importance. Therefore, birds have not been selected as a Key Ecological Receptor.

KER	Description	Evaluation of importance, following NRA (2009)
Invasive Alien Species	Invasive alien species which are restricted under Section 49 of the Habitats Regulations, e.g. Japanese Knotweed and Common Cordgrass, as well as other invasive but not legally restricted species, e.g. Butterfly Bush, are known to occur in the vicinity of the proposed development. High-impact aquatic invasives, such as Chinese Mitten Crab, have also been recorded in the vicinity in the past. Such species pose a threat to native biodiversity, including rare and protected habitats and species, and designated sites, if they are caused to spread. The introduction of new invasive alien species or export of these species to other sites is a significant threat to Biodiversity.	As invasive alien species are an aspect of Biodiversity which represents a threat to other aspects which are considered to be of conservation importance, they are not assigned a value on a geographical scale. However, it is important that the risks associated with invasive alien species, which can include significant impacts on receptors of International Importance, it is critical that they are considered in all parts of this assessment. Therefore, invasive alien species have been selected as a Key Ecological Receptor (KER 7).
Nationally Designated Sites	There are a number of pNHAs that intersect the Zone of Influence and are hydrologically connected to the proposed development. These sites include the King's Channel pNHA, Barrow River Estuary pNHA, Waterford Harbour pNHA, Ballyhack pNHA, Duncannon Sandhills pNHA, River Suir Below Carrick-On-Suir pNHA, Tibberaghny Marshes pNHA, Fiddown Island pNHA and Lower River Suir (Coolfinn, Portlaw) pNHA.	**National Importance** on the basis that these are nationally designated sites and likely support examples of Annex I habitats and populations of Annex II and other protected species. Given that all of these sites are remote from the proposed development and connected to it by the same pathway for impacts, i.e. the River Suir, they are assessed collectively. Therefore, pNHAs have been selected as a Key Ecological Receptor (KER 8).

7.6 Description of Likely Impacts (Unmitigated)

7.6.1 Impacts on Designated Sites

The proposed Flood Defences West runs along the edge of and intersects with one European site, namely the Lower River Suir SAC and is hydrologically connected to the River Barrow and River Nore SAC. The NIS for the proposed development presents all the predicted impacts on these sites and their Qualifying Interests. The NIS also provides a detailed analysis and evaluation of these impacts in the context of the Conservation Objectives. The NIS prescribes mitigation to prevent adverse effects on the integrity of the SACs. The impacts on nationally designated sites (KER 8) are assessed below as a single Key Ecological Receptor.

7.6.2 General Impacts on Key Ecological Receptors

Construction Stage

Habitat Loss

During construction, there will be temporary loss of habitats as a result of areas of the River Suir being occupied by the cofferdams for the construction of the three drainage outfalls and the sandbags or aqua-dam beneath remedial works to the existing wall (as mitigation to prevent pollutants entering the river during these works). As only one cofferdam will be in place at any one time, the total temporary habitat loss at any time will be c. 35m^2 and there will be full recovery of these habitats almost immediately following removal of these temporary measures. Therefore, the temporary habitat loss during construction will not give rise to significant impacts on any receptors.

Habitat Connectivity

Given the very small extent of the sandbags or aqua-dam beneath remedial works to the existing quay wall, it will not give rise to any additional barrier to connectivity for fish species, otters or other receptors. With regard to the temporary cofferdams, these will extent c. 9m beyond the new sheet pile flood defence wall, cutting off the intertidal corridor. However, as these will be only c. 5m wide and are temporary (4 weeks each, 12 weeks in total), they will not present a significant barrier to connectivity for fish species, otters or other receptors.

Disturbance

The use of barges or vessels and sheet piling poses a risk of hydroacoustic impacts on fauna in the River Suir, most notably Twaite Shad, which is particularly sensitive to hydroacoustic impacts given that it is a hearing-specialist species and that juveniles are likely to be present in the estuary at all times of the year. The NIS contains a detailed analysis of the likely hydroacoustic impacts arising from sheet piling, which is the loudest of the proposed construction activities. This assessment considered the implications of using either one or two piling rigs, using mostly vibratory piling but also allowing for a number of strikes (maximum 200 strikes) from an impact hammer to achieve the required depth for some piles.

Artificial lighting poses a risk of negative impacts on biodiversity, particularly Otter, bats and fish, by fragmentation of commuting/foraging corridors, disruption of circadian rhythms and increased risk of predation. Over a prolonged period, such impacts can lead to reduced reproductive success/recruitment. The requirement for nightworks for parts of the construction of the proposed development poses a risk of such impacts. However, the risk is limited due to the short duration of these works. No structures, trees or other features with potential to support roosting bats will be removed or altered as part of the proposed development.

Owing to the scale of the proposed development, neither its construction nor its operation has the potential to give rise to significant shading impacts on the River Suir or the species it supports.

Water Quality

Due to the use of barges and other construction machinery on and in close proximity to the River Suir, there is a risk of pollution to the river during construction. This could be in the form of spilled fuel, oil, concrete or grout or disturbance of contaminated ground. The aspects of the construction of the proposed development which pose the greatest risk of such impacts include:

- Delivery of piles by barge and driving of piles;
- Remedial works to the existing quay wall where these are proposed;
- Demolition of the existing quay wall at the tie-in points between the landside and riverside sections of the new wall and to 800mm below ground level from Ch. 360 to Ch. 900; and,
- Works to accommodate one new drainage outfall, as well as existing outfalls to the River Suir where these cross the proposed flood wall.

Given the naturally high sediment load in the River Suir at this location, sedimentation is not considered to pose a significant risk. However, the synergistic effects of the naturally occurring sediment with any pollutants must be considered. Any pollution incident could have significant negative impacts on aquatic and shoreline life depending on the severity of the pollution. Pollution can also have indirect negative impacts on water-dependent terrestrial habitats and species that are hydrologically connected to the source of the pollution.

Invasive Alien Species

Construction activities pose a risk of the spread of invasive non-native species to, from or within the vicinity of the works. A species of particular concern in this case is Chinese Mitten Crab, which could be spread within the Suir-Barrow-Nore Estuary by barges and other vessels associated with the construction of the proposed development. There is also a risk that poor siting of the construction compound or other construction-related activities could facilitate the spread of Japanese Knotweed, particularly along the railway line, where this species has been recorded.

Dust Deposition

Construction activities will result in the mobilisation of dust into the air. The main sources of dust include:

- Demolition of sections of the existing quay wall;
- Excavations for the proposed impermeable trench through the Plunkett Station car park;
- Excavations as part of drainage works;
- Earthworks (i.e. fill behind the riverside section of the new flood defence wall);
- Sheet piling on land; and,
- Movement of construction vehicles.

This dust will be deposited on the surrounding land, including habitats that are listed as Qualifying Interests of the Lower River Suir SAC. Dust deposition can have negative effects on the vegetation it covers as it reduces the ability of plants to photosynthesise. However, due to the very small quantities of demolition and earthworks, the nature of the fill material (i.e. clean), the fact that construction routes will be on railway ballast rather than dust roads, and short duration of works, as well as the likely washing away of any dust deposited in the estuarine environment during spring tides (every fortnight), this impact will be imperceptible and temporary. Therefore, it does not warrant further consideration in terms of its effect on biodiversity.

Design and Operational Stage

Habitat Loss

The proposed development will result in the loss of c. 800m^2 of intertidal mudflats on the northern bank of the River Suir west of Rice Bridge. This habitat is of a type listed on Annex I to the Habitats Directive, namely 'Mudflats and sandflats not covered by seawater at low tide' (1140), and the area that would be lost is within the Lower River Suir SAC. While not listed as a Qualifying Interest of the SAC, intertidal mudflats are important for the achievement of the conservation objectives for Twaite Shad and other Qualifying Interests of the SAC.

A small area (106m^2) of the Annex I saltmarsh habitat 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330) is present at the bottom of the existing quay wall from Ch. 925 to Ch. 975. The riverside sheet pile flood defence wall was originally proposed to tie into the landside sheet pile wall at Ch. 950. However, in order to avoid any loss of this habitat, which is a Qualifying Interest of the Lower River Suir SAC, the design has been amended so that the new wall will now revert back behind the existing wall c. 50m earlier, at Ch. 900. This will avoid any direct loss of Annex I saltmarsh habitat.

A small area of hard intertidal substrate (i.e. the existing quay wall) and its associated biological communities will be permanently lost as a result of the proposed development. However, this habitat will be replaced by another hard intertidal surface (either steel sheet pile or highly structured or bio-active pre-cast concrete cladding) and there is potential for enhancement to result in a net increase in the total area and diversity of hard intertidal biodiversity at this location.

Habitat Connectivity

The proposed development also provides for reduced habitat connectivity along the intertidal mudflat corridor due to constriction of the habitat by c. 1.0m over a length of c. 540m and associated reduction in the portion of the tidal cycle when there is exposed mudflat. The loss and fragmentation of intertidal mudflat habitat associated with the proposed development are likely to be permanent. This presents a potential negative impact on species which move up and down this corridor, e.g. Otter.

Zonation and Habitat Heterogeneity

The loss of upper intertidal mudflat and c. 540m length of hard upper intertidal and splash zone habitat constitutes a potential reduction in habitat heterogeneity/zonation and, consequently, species diversity. However, there is scope for enhancement of the design to ensure that there is No Net Loss of biodiversity in terms of zonation and habitat heterogeneity.

Hydraulic Impacts

Hydrodynamic modelling (Hydro Environmental Ltd., 2021) indicated that there would be a slight increase in flow velocity immediately adjacent to the sheet piled wall, however the increased rate of flow is of insufficient magnitude to provide enough shear stress that would result in any significant erosion of consolidated sediments within or along the banks of the River Suir. Therefore, the proposed flood defences do not pose a significant risk of creating hydraulic changes that will threaten intertidal mudflats or any other habitats located along the banks of the River Suir including the Annex I habitat 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)'. Nevertheless, a slight reduction in silt deposition adjacent to the flood will is anticipated.

Disturbance

There is no new artificial lighting or any other source of ongoing disturbance impacts proposed for the operational phase of the proposed development. Therefore, there will be no ongoing disturbance impacts.

7.6.3 Impacts on Key Ecological Receptors

Table 7.15 below describes the likely impacts from the proposed development on each of the Key Ecological Receptors.

Table 7.15 Characterisation and evaluation of likely impacts on Key Ecological Receptors, following EPA (2017) and NRA (2009).

Key Ecological Receptor	Construction phase impacts	Operational phase impacts	Ecological significance if unmitigated
KER 1 River Suir, including Annex I 'Estuaries'	Construction activities, particularly piling activities, which will involve the use of spud-can or jack-up barges, will disturb habitats and species in the River Suir, through noise, light and physical disturbance. Noise and light will impact on species including fish, otters and bats, and these impacts are discussed under KERs 4, 5 and 6 below. Physical disturbance to habitats will occur during the anchoring or jacking up of the barge. This will result in disturbance of subtidal sediments and benthic fauna in the immediate area around the anchors or jack feet and will be recovered within 24 hours of completion of these activities. Water quality impacts arising from any accidental pollution incident associated with the construction of the proposed development would likely affect the overall structure and function of the estuarine ecosystem. The characteristics of this impact would depend on the nature and quantities of pollutants and the timing and duration of their input into the River Suir. The impacts of pollution incidents on individual components of this Key Ecological Receptor, e.g. intertidal habitats, fish species etc., are discussed under KERs 2 to 5 below. The impacts of the importation or spread of invasive alien species associated with the construction of the proposed development are assessed under KER 7 below.	The presence of the proposed development will result in the permanent direct loss of c. 800 m^2 of habitats in the River Suir, including Annex I 'Estuaries'. At the National level, the most recent Article 17 report (NPWS, 2019) states that the total area of Annex I 'Estuaries' in Ireland is 761 km^2, 479 km^2 of which is within SACs. The overall conservation status of this habitat is Inadequate, on the basis that while its range and area are Favourable, its specific structure and functions are Inadequate, and its overall trend is deteriorating. The main pressures and threats are marine pollution and invasive alien species. The loss of 800 m^2 represents a 0.00011% reduction in the national habitat area (0.00016% of the area in SACs). Given the extremely small proportion of this habitat to be lost and the fact that reclamation is not one of the main pressures or threats to this habitat, the conservation status will not be significantly affected. Habitat connectivity, zonation and heterogeneity would also be reduced over the extents of the riverside sheet pile wall due to the constriction of the intertidal mudflat corridor and the replacement of the existing masonry quay wall with steel sheet piles, which support less diverse biological communities than other, more highly structured/textured materials.	The disturbance to the River Suir, including Annex I 'Estuaries', associated with the construction of the proposed development is considered to constitute a **Temporary Slight-Imperceptible Negative Impact** as it involves fully reversible impacts over a very small area and short duration. Water quality impacts which could arise in the event of accidental pollution from the proposed development could constitute **Short-term Significant Negative Impacts**, if they were to occur, as they would have the potential to significantly impact on sensitive receptors over a very wide area, but would likely recover in the short term. The permanent direct loss of estuarine habitats, including Annex I 'Estuaries' is considered to constitute a **Permanent Significant Negative Impact** on the River Suir. However, the impact of this loss at the National level will be **Imperceptible** for the reasons outlined in the preceding column. The reduction in habitat connectivity, zonation and heterogeneity would constitute a **Long-term Slight-Moderate Negative Impact** as habitat connectivity is only partially reduced (in the upper intertidal/during the higher portion on the tidal cycle) and zonation and heterogeneity would partially recover as the sheet pile wall is colonised by macroalgae and invertebrates.
KER 2	Construction activities will disturb intertidal habitats within the proposed development extents through noise, light and physical	The presence of the proposed development will result in the permanent direct loss of intertidal habitats, including c. 800 m^2 of Annex I	The disturbance to intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide', associated with the

Key Ecological Receptor	Construction phase impacts	Operational phase impacts	Ecological significance if unmitigated
Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide'	disturbance. Noise/vibration and lighting will cause disturbance to invertebrate fauna on the hard and soft intertidal substrates while works are ongoing, but will recover almost immediately. Physical disturbance to such fauna from piling and other construction activities (including demolition of sections of the existing quay wall) may result in mortality of small numbers of individuals of these species. However, there will be no impacts at the population scale and these biological communities will recover fully within 1 year of the disturbance. Water quality impacts arising from any accidental pollution incident associated with the construction of the proposed development would likely affect the overall structure and function of the intertidal habitat. The characteristics of this impact would depend on the nature and quantities of pollutants and the timing and duration of their input into the River Suir, but could involve impacts such as pH stress in the event of spillage of cementitious material or contamination of soft sediments with hydrocarbons in the event of a petrol spill. The impacts of the importation or spread of invasive alien species associated with the construction of the proposed development are assessed under KER 7 below.	'Mudflats and sandflats not covered by seawater at low tide' and a c. 540 m length of upper intertidal quay wall. At the National level, the most recent Article 17 report (NPWS, 2019) states that the total area of Annex I 'Mudflats and sandflats not covered by seawater at low tide' in Ireland is 646 km^2, 313 km^2 of which is within SACs. The overall conservation status of this habitat is Inadequate, on the basis that while its range and area are Favourable, its specific structure and functions are Inadequate, and its overall trend is deteriorating. The main pressure and threat is marine pollution. The loss of 800 m^2 represents a 0.00012% reduction in the national habitat area (0.00026% of the area in SACs). Given the extremely small proportion of this habitat to be lost and the fact that reclamation is not one of the main pressures or threats to this habitat, the conservation status will not be significantly affected. Habitat connectivity, zonation and heterogeneity would also be reduced over the extents of the riverside sheet pile wall due to the constriction of the intertidal mudflat corridor by c. 1.5 m over a length of c. 540 m and the replacement of the existing masonry quay wall with steel sheet piles, which support less diverse biological communities than other, more highly structured/textured materials.	construction of the proposed development is considered to constitute a **Short-term Slight-Moderate Negative Impact** as it involves fully reversible impacts over a small area and short duration. Water quality impacts which could arise in the event of accidental pollution from the proposed development could constitute **Short-term Significant Negative Impacts**, if they were to occur, as they would have the potential to significantly impact on sensitive receptors over a very wide area, but would likely recover in the short term. The permanent direct loss of intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide' is considered to constitute a **Permanent Significant Negative Impact** in the River Suir. However, the impact of this loss at the National level will be **Imperceptible** for the reasons outlined in the preceding column. The reduction in habitat connectivity, zonation and heterogeneity would constitute a **Long-term Slight-Moderate Negative Impact** as habitat connectivity is only partially reduced (in the upper intertidal/during the higher portion on the tidal cycle) and zonation and heterogeneity would partially recover as the sheet pile wall is colonised by macroalgae and invertebrates.
KER 3 Shoreline Habitats, including Annex I 'Atlantic salt meadows (*Glauco-*	Water quality impacts arising from any accidental pollution incident associated with the construction of the proposed development would likely affect the overall structure and function of shoreline habitats. The characteristics of this impact would depend on	There will be a very small quantity of direct and permanent loss of extremely narrow strips of vegetation (not representing examples of any Annex I habitat) at the bottom of the existing quay wall within the extents of the proposed	Water quality impacts which could arise in the event of accidental pollution from the proposed development could constitute **Short-term Significant Negative Impacts**, if they were to occur, as they would have the potential to significantly impact on sensitive receptors over

Key Ecological Receptor	Construction phase impacts	Operational phase impacts	Ecological significance if unmitigated
Puccinellietalia maritimae)'	the nature and quantities of pollutants and the timing and duration of their input into the River Suir. Specifically, high water levels would be required to directly convey any such impacts to shoreline habitats. Contamination of groundwater or soft substrates may also represent a pathway for such impacts to shoreline habitats. Overall, these habitats are at a reduced risk of exposure to pollution compared with aquatic habitats. The impacts of the importation or spread of invasive alien species associated with the construction of the proposed development are assessed under KER 7 below.	riverside sheet pile wall. There will be no direct loss of any Annex I habitats.	a very wide area, but would likely recover in the short term. The permanent direct loss of shoreline habitats is considered to constitute a **Permanent Slight-Imperceptible Negative Impact** on the basis that the habitats which would be affected are not of conservation importance and the areas which would be lost are extremely small.
KER 4 Fish Species, including Annex II migratory species	The construction of the proposed development would cause hydroacoustic disturbance to fish species. The loudest element of the works is considered to be riverside piling and the most sensitive species by far is Twaite Shad. Based on the analysis in the NIS, startle or stress response by Twaite Shad would occur only within a 100 m radius of 20 minutes of continuous vibratory piling from one rig or 185 m from the same period of simultaneous piling by two rigs. Temporary injury thresholds for Twaite Shad would not be exceeded at more than 71 m from 20 minutes of continuous vibratory piling from one rig or 113 m from the same period of simultaneous piling by two rigs. Temporary injury thresholds for Twaite Shad would not be exceeded at more than 216 m from 200 strikes of an impact hammer. Given the extremely precautionary approach to the calculation of these effect distances, the fact that fish are not stationary, the 140 m width of the River Suir at its narrowest point within the extent of the proposed development, and the short duration of the works, the only risk to	The presence of the proposed development will result in the permanent direct loss of intertidal habitats, including c. 800 m^2 of habitats which support fish species. These comprise intertidal habitats of hard and soft substrate, hosting biological communities upon which fish species depend for food, e.g. planktonic larvae of encrusting invertebrates. These habitats also provide shelter for fish species, particularly small fish such as juvenile shad, as will as for migratory fish resting at the channel edge during the day between nightly movements upstream. The loss of these habitats represents a reduction in food availability and shelter for these species. Habitat connectivity, zonation and heterogeneity would also be reduced over the extents of the riverside sheet pile wall due to the replacement of the existing masonry quay wall with steel sheet piles, which support less diverse biological communities than other, more highly structured/textured materials. This	In the event of prolonged periods of continuous piling or where breaks between pile drives are not sufficiently long, the hydroacoustic impacts on Twaite Shad and other fish species would constitute a **Short-term Moderate-Significant Negative Impact** on the basis that injury may occur to fish species of conservation importance, including Qualifying Interests of the Lower River Suir (and River Barrow and River Nore SAC), potentially in numbers that could result in population-scale impacts. Given the short duration of the construction works and very short duration of nightworks, artificial lighting is considered to constitute a **Temporary Slight Negative Impact** on fish species, including Annex II migratory species. Water quality impacts which could arise in the event of accidental pollution from the proposed development could constitute **Short-term Significant Negative Impacts**, if they were to occur, as they would have the potential to

Key Ecological Receptor	Construction phase impacts	Operational phase impacts	Ecological significance if unmitigated
	aquatic fauna would be where there are prolonged periods of continuous piling or where breaks between pile drives are not sufficiently long. Artificial lighting during construction, particularly during nightworks, will negatively impact on fish species by disruption of circadian rhythms and increased risk of predation. Over a prolonged period, such impacts can lead to negative effects at the population scale. Fish species are particularly sensitive to water quality impacts, which might arise from accidental pollution incident associated with the construction of the proposed development. The characteristics of this impact would depend on the nature and quantities of pollutants and the timing and duration of their input into the River Suir, but could involve significant physiological stress which could affect local populations. The impacts of the importation or spread of invasive alien species associated with the construction of the proposed development are assessed under KER 7 below.	would result in reduced connectivity for fish species by loss of slow-flow areas at the channel edge and reduced food availability due to the impoverished biological communities on the sheet pile wall.	significantly impact on sensitive receptors over a very wide area, but would likely recover in the short term. The loss of habitat and reduced habitat connectivity, zonation and heterogeneity are considered to constitute a **Permanent Significant Negative Impact** on the basis that there would be a permanently reduced food supply and lack of channel edge shelter for fish species, including Qualifying Interests of the Lower River Suir (and River Barrow and River Nore SAC).
KER 5 Otter	Noise and lighting associated with the construction of the proposed development will potentially cause disturbance to otters in the vicinity of the construction site. However, the effect on any otters disturbed will be limited due to the large area within the River Suir for otters to pass the construction site at a distance, as well as the ability of otters to habituate to human presence, as evidenced by their presence in many urban centres.	The direct and permanent loss of upper intertidal mudflat along a 540 m length represents a loss of commuting habitat for otters, as otters may walk along the mudflats to avoid high flow velocities during mid-ebb and mid-flood. However, the analysis in the NIS demonstrates that otters will be capable of swimming against these flows, so there is no significant barrier to commuting. The loss of access to terrestrial habitat behind the new quay wall will not be significant as the area is small and the habitat is sub-optimal for holting.	Disturbance of otters during the construction of the proposed development would constitute a **Short-term Slight-Moderate Negative Impact** on the basis that it is limited to the short duration of the works and due to the opportunity for otters to avoid these impacts within the River Suir, as well as otters' known tolerance for human presence in the urban environment.

Key Ecological Receptor	Construction phase impacts	Operational phase impacts	Ecological significance if unmitigated
	Water quality impacts arising from any accidental pollution incident associated with the construction of the proposed development may impact otters indirectly, through reduced prey availability if populations of fish and other aquatic fauna, e.g. crustaceans and molluscs, are significantly impacted. The only foreseeable impact on otters from invasive alien species is competition with American Mink for prey. However, this species is extremely unlikely to be introduced or spread as a result of the proposed development.	The reduction in habitat quality for fish and other aquatic fauna poses a risk of indirect impacts on otters through reduced food availability.	Water quality impacts, if they were to occur, would constitute a **Medium-term Slight Negative Impact** on otters as they would result in reduced populations of prey species, but would be fully reversible in time. The loss of habitats on the northern edge of the River Suir would constitute a **Permanent Slight Negative Impact** on otters for the reasons outlined in the preceding column. The reduction in aquatic habitat quality would constitute a **Permanent Slight-Imperceptible Negative Impact** on otters through reduced food availability if populations of prey species were impacted, which would likely be of a very small magnitude. Otters are known to be able to switch prey items quickly in response to availability (Bailey & Rochford, 2006).
KER 6 Bat Species	The construction of the proposed development will involve noise and lighting impacts on the banks of the River Suir where bats are likely to commute and forage. This risk of disturbance to bats from noise and lighting is particularly high if nightworks are carried out during the warmer half of the year (April-October) when bats are more likely to be active. Based on the results of the desk study and bat suitability assessment, disturbance to any bat roosts is very unlikely. Bats are very unlikely to be subject to any water quality or invasive alien species impacts as a result of the proposed development.	The operation of the proposed development will not involve any habitat loss or ongoing impacts on bats through lighting or any other form of disturbance.	The impact of disturbance to bats during the construction of the proposed development is considered to constitute a **Temporary Slight Negative Impact** on foraging and commuting bats on the basis that the number of bats likely to be affected is very low and that, based on the assessment above, those bats are very unlikely to be rare species, e.g. Lesser Horseshoe. Furthermore, the disturbance will end once the construction programme is complete and bats will be able to use this area as before.
KER 7 Invasive Alien Species	Construction activities, particularly the haulage and export of equipment, plant and materials to and from the construction site, present a risk of	The operation of the proposed development does not itself provide for the instruction or spread of invasive alien species. However, the	The impacts of invasive alien species, if there were to be significant spread, could constitute **Permanent Profound Negative Impacts** on

Key Ecological Receptor	Construction phase impacts	Operational phase impacts	Ecological significance if unmitigated
	the introduction or spread of invasive alien species in the vicinity of the proposed development. The impacts that these species can have on native biodiversity include competition for food and other resources, increased predation pressure, disease, and reduced habitat integrity (specific structure and function). These impacts can occur over large areas and over long durations (including permanently) and can include the local elimination of some habitats and species.	impoverished biological communities likely to develop on the steel sheet pile wall are more susceptible to invasion by such species (due to lower competition generally associated with the low diversity of these communities). Therefore, the nature of the steel sheet pile wall creates a weak point in the resilience of the habitats in the estuary against invasive alien species, increasing the ongoing risk of establishment and spread should an invasive species be introduced at some point in the future.	the basis that sensitive receptors of International Importance could be profoundly impacted, e.g. if Salmon Fluke (*Gyrodactylus salaris*) were to be introduced it could cause the local extinction of Atlantic Salmon from the Lower River Suir SAC.
KER 8 Nationally Designated Sites	Due to the distance between the proposed development and these nationally designated sites, there is no risk of disturbance impacts. The only sources and pathways from the construction of the proposed development to the sites in question relate to the water quality and invasive alien species impacts discussed above, which pose a risk of reductions in overall habitat quality and species populations in these sites.	There will be no direct or indirect habitat loss or reduction in habitat connectivity, zonation and heterogeneity in any of these sites as a result of the operation of the proposed development. However, there is a very small risk of indirect affects through ecological connections via species populations which might be affected by the operation of the proposed development.	All of the impacts on nationally designated sites relate to either water quality impacts, invasive alien species or ecological connections to impacts on the other receptors, which have already been assessed above. The significance of these impacts is up to **Long-term Very Significant Negative Impacts** (invasive alien species).

7.7 Mitigation

This section describes the measures proposed to mitigate any harmful or negative impacts associated with the proposed development on the Key Ecological Receptors, as described in the preceding sections. General mitigation measures included within the design of the proposed development are described first, with more specific measures to prevent or minimise impacts on the individual Key Ecological Receptors provided subsequently.

7.7.1 General Mitigation

Mitigation by Avoidance

The proposed development minimises land-take from ecologically sensitive areas and has been constraints-led from the initial phase, through an iterative design process, and into the final proposed development. The design of the flood defences has followed the basic principles outlined below to eliminate the potential for impacts on Key Ecological Receptors where possible, and to minimise such impacts where total elimination is not possible. The proposed development has been designed to minimise direct or indirect impacts on any habitats or species or other ecological features that were classified as being of Local Importance (Higher Value) or above. The alignment of the proposed flood defence wall has been designed to avoid, as far as possible, direct, indirect or secondary adverse effects on European sites and other designated sites for nature conservation. The final design of the flood defences has been developed with consideration of the following:

- Annex I habitat 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' was located under the original footprint of the proposed flood defences and has now been avoided through the iterative design process.
- Significant impacts on migratory fish species, particularly Twaite Shad, were reduced by selecting an option for the flood defences that required the least amount of night-works, which would result in a much longer construction programme and present significantly greater risks of medium- to long-term population-scale impacts.

Mitigation by Design

The proposed development has been designed having regard to European and national legislation and all relevant guidelines and engineering best practice for the planning and construction of developments. These guidelines and best practice provide practical measures that can be incorporated into the design to minimise the impact and protect the receiving environment.

7.7.2 Specific Mitigation Measures

KER 1 River Suir, including Annex I 'Estuaries'

This subsection described the mitigation proposed for general impacts on biodiversity in and immediately adjacent to the River Suir. Mitigation specific to other individual Key Ecological Receptors is described separately in relation to each of the Key Ecological Receptors.

Habitat Loss, Fragmentation and Degradation

As discussed in the assessment of impacts above, the principal impact of the proposed development on the River Suir relates to the direct and indirect loss, fragmentation and degradation of intertidal and shoreline habitats. The direct loss of c. 800m^2 of intertidal habitat cannot be avoided through design. However, indirect loss can be avoided and fragmentation and degradation mitigated through the ecological enhancement of the riverside sections of the new sheet pile flood defence wall.

This enhancement will be provided by the attachment of highly structured or bio-active pre-cast concrete cladding ("eco-cladding") to the intertidal river face of the riverside sheet pile section of the new flood defence wall (see photomontages in Figures 11.1 and 11.2 in Volume 3 of this EIAR). The physical structure of this cladding will mitigate these impacts as follows:

- Any indirect loss of intertidal mudflats which might result from erosion associated with increased flow velocities immediately adjacent to the riverside sheet pile wall will be mitigated by the "rough" surface of the cladding, which will reduce flow velocities immediately adjacent to the wall. This will safeguard the remaining mudflats and shoreline habitats from the effects of erosion.
- The highly structured surface of the cladding will maximise the opportunity for biological communities of hard intertidal substrates to colonise the new wall. The structure and composition of these communities will depend on the structure of the wall and the communities already present in the River Suir, which will act as a source to "seed" the cladding with encrusting organisms, including macroalgae ("seaweeds") and bivalve molluscs. The physical structure will also provide shelter/habitat for mobile species such as crabs and small fish.
- As the biological communities develop, particularly the seaweed, e.g. *Fucus* spp., the flow velocity moderation provided by the cladding will be enhanced, providing further protection against erosion for mudflats and shoreline habitats. Depending on the magnitude of this effect, over time, this may lead to an indirect recovery of a small portion of the mudflat habitat lost and, consequently, a slight increase in the area of saltmarsh (though this is unlikely to be significant).
- Once fully developed, the biological communities on the cladding would act as a source of food for a wide range of aquatic fauna in the River Suir and also as a reservoir of larvae or "seed" for the colonisation of other hard intertidal substrates elsewhere in the Suir Estuary.
- The flow velocity moderation provided by the cladding would also benefit fish and other mobile species, as discussed under *KER 4 Fish Species, including Annex II migratory species*. This addresses the habitat fragmentation impact.

The quantum of each benefit will depend on the final specification, e.g. the roughness of the surface and whether or not the cladding incorporates ledges or "shelves" to encourage shoreline vegetation at the top and/or accumulation of narrow strips of intertidal mudflats in the upper and mid-littoral zones. Incorporation of such features would further enhance the biodiversity value of the new flood defence wall through the provision of greater habitat zonation, heterogeneity and connectivity.

Assuming the specification of an appropriate cladding for the new riverside sheet pile wall, the replacement of intertidal mudflats (of high biodiversity value) and existing quay wall (of moderate biodiversity value) with a new sheet pile wall (of very low biodiversity value) would be mitigated as the cladding would increase the biodiversity of the new riverside flood defence wall to moderate-high (the as the overall value of the habitats being lost). While the loss of mudflat habitat is permanent and unmitigable, there would be No Net Loss of Biodiversity within the River Suir. Similarly, there would be no adverse effect on the conservation status of Annex I 'Estuaries'.

This mitigation would also contribute to the achievement of the policies and objectives set out in the National Biodiversity Action Plan, the RSES for the Southern Region and the Waterford City Development Plan with regard to the protection and enhancement of the biodiversity value of ecological features and the provision of green infrastructure (and blue infrastructure), particularly in urbanised environments.

Artificial Lighting

As discussed in the assessment of impacts above, artificial lighting associated with the construction of the proposed development poses a risk of potential negative impacts on habitats and species in and adjacent to the River Suir. Therefore, the following limits on construction lighting is proposed:

- Subject to any Health & Safety and/or navigational requirements, construction lighting over the river channel shall be turned off outside of working hours.
- Construction lighting shall be limited to the minimum area required to be lit and minimise light spill to areas not required for construction.
- In order to further limit any light spill, solid hoarding shall be erected around areas which will be subject to night-time construction activities.

Given the implementation of the above measures and the short duration of night-time construction activities (6-8 weeks), these works are unlikely to give rise to significant impacts beyond the duration of the works and, therefore, no additional mitigation is proposed in relation to these works.

As there will be no new artificial lighting associated with the operation of the proposed development, no mitigation is proposed in relation to lighting for the operational phase.

Water Quality

As is normal practice with infrastructure projects, an Environmental Operating Plan (EOP) and Construction Environmental Management Plan (CEMP) have been prepared for the Flood Defences West and are included in Appendix 4.1 and Appendix 1.4A in this EIAR, respectively. These will be updated and finalised by the selected contractor to suit the detailed construction methodology and allocate responsibilities to individuals in the construction team. In doing so, the measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the Plans is sufficient to allow an assessment of the anticipated impacts including residual impacts.

The following will be implemented as part of this plan:

- An Incident Response Plan (see Appendix 4.1 C) detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, non-compliance with any permit or license, or other such risks that could lead to a pollution incident, including flood risks.
- All necessary permits and licenses for in stream construction work for provision of the flood defences will be obtained prior to the commencement of construction.
- Inform and consult with Inland Fisheries Ireland.

During construction, cognisance will have to be taken of the following guidance documents for construction work on, over or near water.

- *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016)
- *C532 Control of water pollution from construction sites: guidance for consultants and contractors* (CIRIA, 2001)
- *CIRIA C648 C648 Control of water pollution from linear construction projects: technical guidance* (CIRIA, 2006)

- *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes* (NRA, 2006)

Based on the above guidance documents, the following principal mitigation measures will be adhered to for the construction phase:

General Mitigation Measures

- Site works will be limited to the minimum required to construct the necessary elements of the proposed development.
- Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels or cut-off ditches.
- Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and bunding.
- Protection of waterbodies from silt load will be carried out through the use of gully silt/sediment filters and shallow berms in hardstanding areas to provide adequate treatment of run-off to watercourses.
- Settlement tanks, silt traps/bags and bunds will be used. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap.
- The anticipated site compounds/storage facility will be fenced off at a minimum distance of 5m from the top of the edge of the quay wall/river edge. Any works within the 10m buffer zone will require measures to be implemented to ensure that silt-laden or contaminated surface water run-off from the compound does not discharge directly to the watercourse. See the EOP and Construction Environmental Management Plan in Appendix 4.1 and 4.1 A of this EIAR for further detail.
- Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with NRA (2008d). All chemical and fuel filling locations will be contained within bunded areas and set back a minimum of 20m from watercourses.
- Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner, off site, to prevent pollution.
- The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses.

Specific Mitigation Measures - Concrete Works

Remedial works to the existing masonry quay wall and increasing its height will require the use of in-situ concrete. The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. As the use of concrete cannot be avoided, the following control measures will be employed:

- Sandbags or an aqua-dam will be in place for the duration of remedial works to the existing quay wall to effectively isolate the area beneath these works from the River Suir and thereby control the risk of pollutants entering the river. This mitigation shall be removed once the remedial works are complete.
- Hydrophilic grout and quick-setting mixes or rapid hardener additives shall be used to promote the early set of concrete surfaces exposed to water.

- When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used.
- Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters.
- Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW).
- The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if wet weather is forecast such that precipitation may make it difficult to maintain a dry working area.
- There will be no spills of concrete, cement, grout or similar materials hosed into surface water drains. Such spills shall be contained immediately and any run-off shall be prevented from entering the watercourse.
- Concrete waste and wash-down water shall be contained and managed on site to prevent pollution of all surface watercourses.
- On-site concrete batching and mixing activities shall only be permitted within the identified construction compounds.
- Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the manufacturer).
- Chute washout shall be carried out at designated locations only. These locations will be signposted. The concrete plant and all delivery drivers will be informed of their location with the order information and on arrival to site.
- Chute washout locations will be provided with an appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste in accordance with the Contractor's Construction and Demolition Waste Management Plan.

Operational Phase

The only potential water quality impacts associated with the operational phase relate to accidental spillage of paint which will be used in the periodic (approximately every 10 years) repainting of the exposed sections of the new sheet pile flood defence wall. In order to control this risk, the paint specified for this purpose shall not contain lead or tributyltin (TBT) or shall be otherwise approved for use near water.

Invasive Alien Species

Mitigation relating to biosecurity and the management of the risks associated with the spread of invasive alien species described under *KER 7 Invasive Alien Species*. Given the full and proper implementation of that mitigation, the proposed development does not pose a significant risk to Biodiversity in the River Suir in terms of the introduction or spread of invasive alien species.

KER 2 Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide'

Habitat Loss, Fragmentation and Degradation

As discussed under *KER 1 River Suir, including Annex I 'Estuaries'*, the direct loss of c. 800m^2 of intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide', cannot be avoided through design. However, indirect loss can be avoided and fragmentation and degradation mitigated through the provision of a highly structured or bio-active pre-cast concrete cladding, such as that described in relation to KER 1, to the outside of the riverside sheet pile wall. While the loss of mudflat habitat is permanent and unmitigable, there would be No Net Loss of Biodiversity with regard to the intertidal habitats at this location and the effect on the conservation status of Annex I 'Mudflats and sandflats not covered by seawater at low tide' would be imperceptible at the National level.

Water Quality

The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the protection of water quality during the construction of the proposed development will ensure that the impact on intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide', arising from accidental pollution associated with the proposed development would not give rise to significant effects on those habitats.

Invasive Alien Species

Mitigation relating to biosecurity and the management of the risks associated with the spread of invasive alien species described under *KER 7 Invasive Alien Species*. Given the full and proper implementation of that mitigation, the proposed development does not pose a significant risk to intertidal habitats in terms of the introduction or spread of invasive alien species.

KER 3 Shoreline Habitats, including Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)'

Habitat Loss

A number of small areas of rough grassland habitats between the railway line and the River Suir will be lost as a result of the proposed development. Given the isolation of these habitats from the River Suir by the new flood defence wall and other habitats to the north by the railway line, it was not deemed appropriate to reinstate or improve these habitats as there is a risk to fauna, e.g. Otter, crossing the railway line to access them. Thus, the loss of these habitats is permanent, but is of low magnitude given the low biodiversity value of these habitats and their small extents.

Any direct losses of saltmarshes and other shoreline habitats of high biodiversity value, including Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', have been largely avoided through the iterative design process. In particular, direct loss of the area of c. 106m^2 of Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' has been avoided entirely through moving the western tie-in point of the new flood defence wall, which was originally to transition back behind the existing quay wall at Ch. 950 (within this habitat), to its new position at Ch. 900, which is 25m further east than the most westerly point of the Annex I saltmarsh. Furthermore, the proposed eco-cladding described under *KER 1 River Suir, including Annex I 'Estuaries'* will further safeguard saltmarsh habitats from future erosion by reducing flow velocities along the shoreline. There are no other areas of Annex I saltmarsh within the extents of the proposed development.

Other shoreline habitats include extremely narrow strips of ruderal vegetation on the existing quay wall and at the bottom of the same in places. This vegetation will be lost, but can be fully replaced through specification of an appropriate eco-cladding as described under *KER 1 River Suir, including Annex I 'Estuaries'*.

Disturbance

In order to provide further protection for 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' from disturbance during the construction stage, the areas of confirmed or potential Annex I saltmarsh habitats identified in this EIAR shall not be included within the lands made available to the Contractor and it shall be made clear on all contract drawings that these areas contain sensitive habitats and shall not be disturbed. The Site Environmental Manager (SEM) and Ecological Clerk of Works (ECoW) shall also highlight the sensitivity of these habitats (and need to avoid disturbance of the same) during tool-box talks and other relevant communications with site personnel.

Water Quality

The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the protection of water quality during the construction of the proposed development will ensure that the impact on shoreline habitats, including Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', arising from accidental pollution associated with the proposed development would not give rise to significant effects on those habitats in terms of habitat degradation.

Invasive Alien Species

Mitigation relating to biosecurity and the management of the risks associated with the spread of invasive alien species described under *KER 7 Invasive Alien Species*. Given the full and proper implementation of that mitigation, the proposed development does not pose a significant risk to shoreline habitats, including Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', in terms of the introduction or spread of invasive alien species, especially Common Cordgrass (*Spartina anglica*).

KER 4 Fish Species, including Annex II migratory species

Mitigation measures prescribed for fish species below are relevant for nocturnal and diurnal fish species, fish of small body size and hearing specialists (fish with highly specialised auditory organs). The rationale for this mitigation is fully detailed in the NIS for the proposed development (included as part of this Planning Application).

Habitat Loss

The only fish habitat will be lost is the c. 800m^2 of intertidal habitats on the left (north) bank of the River Suir where these are being reclaimed by the new flood defence wall. The mitigation which is being provided for the loss of these habitats includes the provision of eco-cladding, which is described in detail above in relation to *KER 1 River Suir, including Annex I 'Estuaries'*. The positive effects of the eco-cladding are relevant to fish species as follows:

- It will provide the physical habitat conditions for quick establishment of biological communities of hard intertidal substrates, supporting macroalgae ("seaweeds"), crustaceans and fish. The establishment of such communities and consequent production of planktonic larvae will provide food for fish, including species of conservation importance, e.g. Twaite Shad.
- It will mitigate against increased flow velocities at the channel edge resulting from the presence of the new sheet pile wall, which will facilitate movement against the tide by fish, especially small fish such as juvenile Twaite Shad.

Hydraulic Impacts

Predictions made from the hydrodynamic model for the proposed flood defences show that there would be a slight increase in flow velocity immediately adjacent to a sheet piled wall. While this will not lead to significant effects in the form of erosion of habitats within or on the banks of the River Suir, the rate of deposition will be slightly decreased. The measures described under *KER 2 Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide'* relating to installation of eco-cladding will ensure that the impact on shoreline habitats, including Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', is further reduced as the textured cladding will aid in slowing the rate of flow.

Hydroacoustic Impacts

The mitigation for hydroacoustic impacts is as follows ("piling event" means any period of continuous piling by one or two rigs; "quiet period" means any period in which there is no piling by any rig):

- Night-time piling shall be limited to the minimum number of shifts possible and shall only be permitted for landside piling.
- In-stream (riverside) piling shall be restricted to daytime shifts only.
- Vibratory piling shall be the standard method for the installation of all piles. Impact piling shall only be employed where the required depth below ground cannot be achieved by vibratory piling.
- No more than two piling rigs shall operate simultaneously at any time.
- The duration of any *vibratory* piling event shall not exceed 55 piling minutes, i.e. the duration of piling by one rig or the sum of the duration of piling by two rigs shall not exceed 55 minutes.
- The length of any *impact* piling event shall not exceed 200 strikes from one piling rig (or 200 strikes from *each* of two piling rigs, if piling simultaneously).
- Following every piling event, there shall be a quiet period of at least 30 minutes. Only following 30 minutes of no piling whatsoever can the cumulation of piling minutes be re-zeroed.
- The above limitations apply to all piling activity for the proposed development, riverside and landside, daytime and night-time, permanent and temporary.

Based on the expected time required for the installation of each pile (including ancillary processes), as described in Section 4.2.4, the limits prescribed above will not prolong the proposed programme for riverside or landside piling. Therefore, they are feasible within the proposed construction methodology and do not give rise to any additional effects on fish through extension of the total duration of impacts.

Based on the detailed hydroacoustic impact assessment presented in the NIS, there is no necessity for daily/nightly or seasonal restrictions on piling activities or the use of soft-start/ramp-up procedures.

Artificial Lighting

The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the artificial lighting during the construction of the proposed development will ensure that the impact on fish species, including Annex II migratory species, arising from artificial lighting from the proposed development will not give rise to significant effects on the populations of those species. There are no lighting impacts associated with the operational phase.

Water Quality

The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the protection of water quality during the construction of the proposed development will ensure that the impact on fish species, including Annex II migratory species, arising from accidental pollution associated with the proposed development will not give rise to significant effects on the populations of those species.

Fish Rescue

During de-watering of temporary cofferdams for the construction of drainage outfalls, any fish remaining within the cofferdams will be collected (by netting) and released into the River Suir outside the cofferdams. These fish rescue operations shall be carried out under the supervision of IFI. Given the Health and Safety implications of working within a stell cofferdam in a partially saline environment, the use of electrofishing is not considered to be appropriate in this case.

KER 5 Otter

Disturbance (Lighting and Noise)

The mitigation proposed under *KER 1 River Suir, including Annex I 'Estuaries'*, for lighting impacts, and under *KER 4 Fish Species, including Annex II migratory species*, for noise impacts, are considered sufficient to eliminate any risk of significant direct and indirect disturbance of otters during the construction of the proposed development. There are no sources of disturbance to otters arising from the operational phase.

Prey Biomass Availability

The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the protection of water quality during the construction of the proposed development will ensure that the impact on fish and other prey species for otters which might arise from accidental pollution associated with the proposed development will not lead to any reduction in the prey biomass available for otters.

Furthermore, the implementation of the general mitigation of impacts on the River Suir and intertidal habitats, i.e. the proposed eco-cladding for the riverside flood defence wall, will likely lead to a slight increase in the total biomass available to otters in the long term.

KER 6 Bats

Disturbance (Lighting and Noise)

The mitigation proposed under *KER 1 River Suir, including Annex I 'Estuaries'*, for lighting impacts, and under *KER 4 Fish Species, including Annex II migratory species*, for noise impacts, are considered sufficient to eliminate any risk of significant direct and indirect disturbance of bats during the construction of the proposed development. There are no sources of disturbance to bats arising from the operational phase.

KER 7 Invasive Alien Species

Terrestrial Plant Species

In order to minimise the risk of the introduction or spread of invasive alien plant species (IAPS) during construction, all land-based works shall be executed in accordance with best practice for biosecurity in construction. In particular, prior to commencement, the Contractor shall prepare a detailed Biosecurity Protocol describing his/her proposed approach to ensuring that IAPS are not imported or spread during the construction of the proposed development. The Contractor's Biosecurity Protocol shall be in accordance with *The Management of Invasive Alien Plant Species on National Roads – Technical Guidance* (TII, 2020) and subject to approval by the Ecological Clerk of Works (ECoW) prior to its acceptance and implementation. The Biosecurity Protocol shall include, as a minimum, the following measures to prevent the spread of invasive species:

- Good construction site hygiene will be employed to prevent the introduction and spread of problematic IAPS (especially Japanese Knotweed) by thoroughly washing vehicles prior to leaving any site.
- All plant and equipment employed on the construction site (e.g. excavators, piling equipment etc.) will be thoroughly cleaned down using a power washer unit prior to arrival on site to prevent the spread of IAPS.
- All washing must be undertaken in areas with no potential to result in the spread of IAPS, as detailed in the Construction Environmental Management Plan.
- Any soil and topsoil required on the site will be sourced from a stock that has been screened for the presence of any IAPS and where it is confirmed that none are present.

If possible, the known stand of Japanese Knotweed at the location of the proposed main construction compound should be eradicated prior to commencement of construction. Given the proximity of this stand to habitats of conservation importance, i.e. habitats within the Lower River Suir SAC, preference should be given to physical removal rather than chemical control.

If for programme or other reasons the known stand of Japanese Knotweed cannot be eradicated prior to construction, it should be fenced off (at a distance of 7m from all visible parts of the plant) at the outset and the access prohibited except for monitoring por treatment purposes. All site staff shall be made aware of the Contractor's Biosecurity Protocol and receive training in the importance of good site biosecurity.

<u>Pioneer Species</u>

The invasive pioneer species Common Cordgrass (*Spartina anglica*) was previously recorded on intertidal mudflats in the River Suir within 500 m of the construction site (in the vicinity of the North Quays Development site and Sustainable Transport Bridge). According to the *Saltmarsh Monitoring Project 2007-2008* (McCorry & Ryle, 2009):

> "*A general policy of active Common Cordgrass control in Irish saltmarshes is not recommended.* […] *It is recommended that instead of attempting to control or manage established populations of Common Cordgrass in Ireland, the primary policy should be that any available resources should be used to prevent the spread of this species to new sites.*"

In addition to the measures detailed below in relation to aquatic species, the following shall apply to all works on and adjacent to the mudflats:

- Vehicles, vessels, plant, equipment, PPE, construction materials or excavated material shall not be moved directly from areas known to contain Common Cordgrass, e.g. the mudflats in the vicinity of the approved Sustainable Transport Bridge and North Quays Development site, without first having been inspected by the Ecological Clerk of Works (ECoW) and authorised by the Site Environmental Manager (SEM).

- Any material excavated from the mudflats, e.g. for the construction of drainage outfalls, shall be stored in a location where it is not at risk of colonisation by Common Cordgrass and shall be reinstated as quickly as possible.

Aquatic Species

The use of barges during the construction of the proposed development poses the risk of introducing invasive alien species to the aquatic environment both in the vicinity of the works and in the wider Suir-Barrow-Nore Estuary. This has the potential to significantly affect the integrity of aquatic and intertidal habitats in the Zone of Influence. In order to minimise the risk of either the introduction or spread of aquatic invasive alien species and thereby avoid negative impacts on these habitats, the owner or operator of the barge or barges shall:

- Provide documentary evidence (in the form of a completed and signed Marine Institute "*Cleaning and Disinfection Declaration Form*") that the vessel was fully de-fouled within the 6 months immediately preceding its engagement in the construction of the proposed development; and,
- Submit travel records relating to the vessel's movements during, at a minimum, the 6 months immediately preceding its engagement in the construction of the proposed development.

In order to ensure full compliance with the above, authorisation to move the vessel to the construction area shall only be granted once the Ecological Clerk of Works (ECoW) has satisfied him/herself that the vessel does not pose a significant risk of importing aquatic invasive alien species to the Suir-Barrow-Nore Estuary. He/she shall do so by:

- Boarding the vessel;
- Speaking with the skipper;
- Inspecting the relevant documents; and,
- Carrying out a final inspection of the vessel.

In relation to other construction activities, including pre-construction surveys and any other site inspections, the principles and appropriate measures in the IFI guidance document *Biosecurity Protocol for Field Survey Work* (IFI, 2010) shall be followed and shall form part of the Contractor's Biosecurity protocol.

KER 8 Nationally Designated Sites

As explained in the assessment of impact above, due to the distances between the proposed development and the pNHAs in the Zone of Influence, the only complete source-pathway-receptor chains are those relating to water quality impacts, invasive alien species and migratory or highly mobile species, i.e. fish species and Otter. The mitigation measures proposed in relation to each of those is already described in detail under KERs 1, 4, 5 and 7 above and are deemed sufficient to eliminate any risk of such impacts on these sites.

7.7.3 Monitoring

Hydroacoustic Impacts

In order to allow for greater accuracy in the assessment of future plans and projects, it is recommended that hydroacoustic monitoring be undertaken for the full duration of the proposed development's construction. This monitoring should establish the ambient underwater noise levels in the estuary (and the rate of sound attenuation) and more accurately characterise the sound outputs in terms of both peak and root-mean-squared sound pressure level, as well as sound exposure level, at different frequencies arising from the different methods of pile driving and different types and sizes of piles. This monitoring shall be carried out by specialist underwater noise surveyors and the results will be frequently reviewed (at least fortnightly) by the Ecological Clerk of Works (ECoW).

Record of Habitats

In order to maintain an accurate and precise record of changes to intertidal and shoreline habitats, particularly mudflats and saltmarshes, a photographic record shall be made of these habitats. This record shall cover both sides of the river from 150m upstream of the new flood defence wall to 300m downstream. All photographs shall be taken at low tide, every 2 months, beginning 6 months prior to commencement of construction and finishing 12 months after completion.

In addition, in order to accurately and precisely record any change in the structure and composition of biological communities of hard and soft intertidal substrates, sampling and analysis of these habitats shall be carried out at 6 months, 1 year, 2 years and 5 years post-construction. To facilitate meaningful comparative analysis and evaluation of the impacts of the proposed development, the sampling and analysis should follow the methodology employed by BEC Consultants Ltd in carrying out the pre-planning benthic surveys on 15th March 2021 (see Brophy (2021) in Appendix 7.1).

Water Quality

Water quality monitoring will be undertaken in the River Suir, with monthly samples being taken from at least 6 months prior to commencement of construction until at least 24 months post-completion. Water samples will be taken from at least two locations. The final number and location of sampling points will be determined by the Site Environmental Manager (SEM). The results of the water quality monitoring programme will be reviewed by the SEM and the ECoW on an ongoing basis during construction. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation will be undertaken to identify the source of this non-compliance and corrective action will be taken where this is deemed to be associated with the proposed development.

7.7.4 Implementation

In order to give effect to the mitigation prescribed in this EIAR, it should be a condition of any consent granted in respect of the proposed development that all of the mitigation, including monitoring and enforcement, prescribed in this EIAR be binding, during the construction phase, on the Contractor and, during operational phase, on WCCC. Accordingly, all of the mitigation prescribed herein shall be transposed into the Contract Documents for the construction of the proposed development.

During construction, all works must comply with relevant legislation and guidelines in order to reduce and minimise environmental impacts and to protect all ecological receptors. In particular, there must be full compliance with the following:

- The Schedule of Commitments.
- The mitigation prescribed in this Chapter of the EIAR and in the NIS.
- Any conditions which might be attached to the proposed development's planning consent.
- Any requirements of stakeholders and statutory bodies, e.g. the NPWS and IFI, including:
    - *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016)

- All applicable legislative requirements in relation to environmental protection.
- All relevant construction industry guidelines, including:
    - o *C532 Control of water pollution from construction sites: guidance for consultants and contractors* (CIRIA, 2001)
- Any biosecurity requirements arising from the preceding points.
- The Transport Infrastructure Ireland (TII) and National Roads Authority (NRA) Environmental Assessment and Construction Guidelines, specifically:
    - o *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*
    - o *Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage for National Road Schemes*
    - o *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*
    - o *The Management of Invasive Alien Plant Species on National Roads – Technical Guidance*
    - o *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*
    - o *Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes*
    - o *Management of Waste from National Road Construction Projects*
    - o *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan*

This list is non-exhaustive. All environmental commitments/requirements and relevant legislation and guidelines which are current at the time of construction will be followed.

Environmental Operating Plan

Appendix 4.1 of this EIAR contains the Environmental Operating Plan (EOP) which shall be finalised by the Contractor, in agreement with Waterford City and County Council, prior to the commencement of the construction phase.

The EOP is a document that outlines procedures for the delivery of environmental mitigation measures and for addressing general day-to-day environmental issues that can arise during the construction phase of developments. Essentially the EOP is a project management tool. It is prepared, developed and updated by the Contractor during the construction stage and will be limited to setting out the detailed procedures by which the mitigation measures proposed as part of the EIAR and NIS and arising out of the Board's decision (if approving the proposed development) will be achieved. The EOP will not give rise to any reduction of mitigation measures or measures to protect the environment.

Before any works commence on site, the Contractor will be required to prepare an Environmental Operating Plan (EOP) in accordance with the TII/NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIAR and measures stipulated in the planning conditions. Details within the plan will include, as a minimum:

- All environmental commitments and mitigation stipulated in the planning documentation in respect of the proposed development, including sediment controls and other measures to ensure that water quality in the River Suir and Waterford Harbour is not degraded.

- Any requirements of statutory bodies such as the NPWS and IFI, including adherence to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016).
- A detailed Biosecurity Protocol.
- A list of all applicable legislative requirements in relation to environmental protection and a method of documenting compliance with these requirements.
- Outline methods by which construction activities will be managed in such a manner as to avoid, reduce or remedy potential negative impacts on the environment.

To oversee the implementation of the EOP, the Contractors will be required to appoint a person to ensure that the mitigation measures included in the EIAR, the EOP and the statutory approvals are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly.

The EOP has been appended (Appendix 4.1). This is a preliminary document, which will be updated and finalised by the successful Contractor. Appended to the EOP are the following constituent plans, also to be finalised by the Contractor:

Appendix A: Construction Environmental Management Plan (CEMP)

Appendix B: Construction and Demolition Waste Management Plan (CDWMP)

Appendix C: Incident Response Plan (IRP)

Each of these plans is discussed in the following sections. The obligation to develop, maintain and implement the EOP and all of the above-listed plans will form part of the contract documents for the construction phase.

Construction Environmental Management Plan

Prior to any demolition, excavation or construction a Construction Environmental Management Plan (CEMP) will be produced by the successful contractors for each element of the proposed development. The CEMP will set out the Contractor's overall management and administration of the construction project. A Construction Environmental Management Plan has also been prepared as part of this EIAR, see Appendix A of Appendix 4.1. The CEMP will be developed by the Contractors during the pre-construction phase, to ensure commitments included in the statutory approvals are adhered to, and that it integrates the requirements of the Environmental Operating Plan (EOP).

The CEMP will contain the following information of general importance:

- An overview of the proposed development.
- An organisational chart illustrating the structure of the Contractor's project team and the duties and responsibilities of the various members.
- The Contractor's communications strategy.
- The contact details of relevant persons/entities, e.g. the Safety Officer, the Site Environmental Manager and the emergency services.
- A list of the documents which will have informed the CEMP, including all relevant legislation and construction/environmental guidelines.

In relation to environmental management, the CEMP will provide and full list of the Contractor's environmental commitments and will detail the Contractor's approach to the following:

- Details of working hours and days.
- Details of emergency plan - in the event of fire, chemical spillage, cement spillage, collapse of structures or failure of equipment or road traffic incident within an area of traffic management. The plan must include contact names and telephone numbers for: Local Authority (all sections/departments); Ambulance; Gardaí and Fire Services.
- Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages).
- Details of construction plant storage, temporary offices.
- Traffic management plan (to be developed in conjunction with the Local Authority – Roads Section) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic; programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements;
- Truck wheel wash details (including measures to reduce and treat runoff).
- Dust management to prevent nuisance (demolition & construction).
- Control of sediment, run-off, erosion and pollution.
- Noise and vibration management to prevent nuisance (demolition & construction).
- Landscape management.
- Management of contaminated land and assessment of risk for same by suitably qualified, trained and licenced personnel.
- Management of waste arising from construction and demolition.
- Minimisation of artificial lighting and shading.
- Management of risk from invasive alien species
- Stockpiles.
- Project procedures & method statements for:
    - Site clearance, site investigations, excavations
    - Diversion of services.
    - Excavation and blasting (through peat, soils & bedrock).
    - Piling.
    - Temporary hoarding & lighting.
    - Borrow Pits & location of crushing plant.
    - Storage and Treatment of peat and soft soils.
    - Disposal of surplus geological material (peat, soils, rock etc.).
    - Earthworks material improvement.
    - Protection of watercourses from contamination and silting during construction.
    - Works from a barge, including protection of watercourses from contamination when working in-river
- Site Compounds.

- Monitoring, inspection and auditing of the Contractor's compliance with his/her environmental commitments.

The production of the CEMP will also detail areas of concern with regard to Health and Safety and any environmental issues that require attention during the construction phase. Adoption of good management practices on site during the construction and operation phases will also contribute to reducing environmental impacts.

Construction and Demolition Waste Management Plan

The CDWMP sets out the Contractor's strategy (and measures required) to ensure that waste arising during the construction and demolition phase of the proposed development will be managed and disposed of in a way that ensures the provisions of European and Irish waste legislation (particularly the Waste Management Acts 1996 – 2011) are complied with, and to ensure that waste is managed in accordance with waste hierarchy insofar as possible.

The finalised CDWMP will contain the following information:

- Material transport routes;
- Methods by which construction works shall be managed in accordance with the relevant legislative instruments, including but not limited to:
    - An analysis of the different waste streams expected to be generated;
    - A demolition plan, with the purpose of ensuring that demolition occurs in an orderly fashion so that the re-use and recycling of the resultant materials is given due priority;
    - Details of waste storage (e.g. skips, bins, containers) to be provided for different waste streams and collection times;
    - Details of where and how materials are to be disposed of, i.e. landfill or other appropriately licensed waste management facility;
    - Details of storage areas for waste materials and containers;
    - Details of how unsuitable excess materials will be disposed of, where necessary; and
    - Details of how and where hazardous wastes, such as contaminated land, hydrocarbons and other hazardous substances, are to be stored and disposed of in a suitable manner;
- Estimates of waste management costs;
- Specific waste management objectives for the project;
- Identification of the roles and responsibilities of the relevant personnel regarding waste management;
- Procedures for communication and training in relation to on-site waste management;
- Record keeping procedures; and
- Details of an audit system to monitor implementation of the CDWMP.

The CDWMP is appended to the EOP (i.e. Appendix B of Appendix 4.1). The plan shall be finalised by the successful Contractor, in agreement with WCCC, and in accordance with TII's guidelines on *The Management of Waste from National Road Construction Projects* (2017), the TII *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan* (2007) and the Department of the Environment, Housing and Local Government's *Best Practice Guidelines on the*

Preparation of Waste Management Plans for Construction and Demolition Projects (2006). This will be a live document, which will be amended and updated to reflect the policy context, as well as conditions on site, as the construction of the proposed development progresses.

Incident Response Plan

The Incident Response Plan (IRP) describes the procedures, lines of authority and processes that will be followed to ensure that incident response efforts during the construction stage of the proposed development are prompt, efficient, and appropriate to particular circumstances.

The Contractor will finalise the IRP prior to the commencement of the proposed works to include the following information, at a minimum:

- Contact names and telephone numbers for the local authority, i.e. WCCC (all sections and departments), An Garda Síochána and ambulance and fire services; and,
- Method statements for weather forecasting and continuous monitoring of water levels in the River Suir and Waterford Harbour. The plan must outline how the Contractor will respond to forecasted flood events, including but not limited to, details of removal of site materials, fuels, tools, vehicles and persons from flood zones.
- The measures to be taken to avoid or reduce the incident risk potential;
- Reference to the method statement and management plans for construction activities, insofar as they are relevant for the purposes of mitigating against health and safety and pollution incidents;
- Procedures to be adopted to contain, limit and mitigate any adverse effects, as far as reasonably practicable, in the event of a health and safety or pollution incident;
- Persons responsible for dealing with incidents and their contact details;
- Procedures for alerting key staff, appropriate emergency services, authorities, the Employer's Representative and clean-up companies, where required, and contact details of same;
- Procedures for notifying relevant statutory bodies, environmental regulatory bodies, local authorities and local water and sewer providers of pollution incidents, where required, and contact details of same;
- Standby / rota systems; and
- The types and location of emergency response equipment available and appropriate personal protective equipment to be worn.

An IRP has been appended to the EOP (i.e., Appendix C of Appendix 4.1). The document in its current form will be finalised by the successful Contractor prior to the commencement of the construction phase of the proposed development.

Site Environmental Manager

To ensure the successful development, implementation and maintenance of the EOP, the Contractor will appoint an independent Site Environmental Manager (SEM). He/she must possess training, experience and knowledge appropriate to the role, including a National Framework of Qualifications (NFQ) Level 8 qualification (or equivalent) or other acceptable qualification in environmental science, environmental management, hydrology or engineering. The principal functions of the SEM will be to ensure that the mitigation prescribed in the NIS, this EIAR, the CEMP, the EOP and the CDWMP, is fully and properly implemented and to monitor the construction stage from an environmental perspective. The SEM will also provide independently verifiable audit reports.

Separate from the on-going and detailed monitoring carried out by the Contractor as part of the EOP, the SEM will carry out the inspection and monitoring described below on behalf of WCCC. The results will be stored in the SEM's monitoring file and will be available for inspection or audit by WCCC, the NPWS or IFI.

- Daily reporting on weather and flood forecasting and daily reporting on the monitoring of water levels in the River Suir.
- Weekly inspections of the principal control measures described in the CEMP and reporting of findings to the Contractor.
- Daily inspections of surface water treatment measures.
- Daily inspections of all outfalls to watercourses.
- Daily visual inspections of watercourse to which there are discharges from the works and those in the vicinity of construction works.
- Weekly inspections of wheel-wash facilities.
- Daily monitoring of any stockpiles.
- Auditing at least six times per quarter of the Contractor's EOP monitoring results.

Ecological Clerk of Works

In order to ensure the successful development and implementation of the CEMP, an independent Ecological Clerk of Works (ECoW) will be appointed. The ECoW must possess training, experience and knowledge appropriate to the role, including:

- An NFQ Level 8 qualification or equivalent or other acceptable qualification in ecology or environmental biology; and,
- Demonstrable experience in the protection of European sites.

The principal functions of the ECoW are:

- To provide ecological supervision of the construction of the proposed development and thereby ensure the full and proper implementation of the mitigation prescribed in this Chapter 7 and in the NIS;
- To highlight the sensitivity of 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', and the need to avoid disturbance of the same, during tool-box talks and other relevant communications with site personnel.
- To regularly review the outcome of the ongoing monitoring during construction (as described in Section 5.2.7 of the NIS);
- To carry out inspections of all vehicles, vessels, plant, equipment, PPE, construction materials or excavated materials prior to their movement from areas known to contain invasive alien species; and,
- To carry out weekly inspections and reporting on the implementation of the Contractor's Biosecurity Protocol.

During the preparation of the Contractor's EOP, the SEM may, as appropriate, assign other duties and responsibilities to the ECoW. In exercising his/her functions, the ECoW will be required to keep a monitoring file and this will be made available for inspection or audit by WCCC, the NPWS or IFI at any time.

7.8 Residual Impacts on Key Ecological Receptors

Table 7.16 below asses the significance of the residual impacts on the Key Ecological Receptors following the inclusion of the mitigation measures described in Section 7.7.

Table 7.16 Assessment of significance of residual impacts, following EPA (2017) and NRA (2009).

Key Ecological Receptor	Pre-mitigation impacts	Ecological significance following mitigation
KER 1 River Suir, including Annex I 'Estuaries'	The disturbance to the River Suir, including Annex I 'Estuaries', associated with the construction of the proposed development is considered to constitute a **Temporary Slight-Imperceptible Negative Impact**. Water quality impacts which could arise in the event of accidental pollution from the proposed development could constitute **Short-term Significant Negative Impacts** if they were to occur. The permanent direct loss of estuarine habitats, including Annex I 'Estuaries', is considered to constitute a **Permanent Significant Negative Impact** on the River Suir. However, with regard to the impact of this loss at the National level will be **Imperceptible**. The reduction in habitat connectivity, zonation and heterogeneity would constitute a **Long-term Slight-Moderate Negative Impact**.	Disturbance to the River Suir, including Annex I 'Estuaries', from the construction of the proposed development will still constitute a **Temporary Slight-Imperceptible Negative Impact**. The mitigation described in Section 7.7 will significantly reduce the risk of accidental pollution, eliminating all of the most serious risks, including input of cementitious materials or hydrocarbons to the River Suir. Furthermore, any water quality impacts which could arise in the unlikely event of accidental pollution would constitute **Temporary Slight-Imperceptible Negative Impacts**, if they were to occur at all. The change in the nature of estuarine habitats constitutes a **Permanent Slight Positive Impact** on the River Suir. The impact on the conservation status of Annex I 'Estuaries' at the National level will be **Imperceptible**. The impact on habitat connectivity, zonation and heterogeneity would constitute a **Long-term Neutral Impact**.
KER 2 Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide'	The disturbance to intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide', associated with the construction of the proposed development is considered to constitute a **Short-term Slight-Moderate Negative Impact**. Water quality impacts which could arise in the event of accidental pollution from the proposed development could constitute **Short-term Significant Negative Impacts**, if they were to occur. The permanent direct loss of intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide' is considered to constitute a **Permanent Significant Negative Impact** in the River Suir. However, with regard to the impact of this loss at the National level will be **Imperceptible**. The reduction in habitat connectivity, zonation and heterogeneity would constitute a **Long-term Slight-Moderate Negative Impact**.	The disturbance to intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide', associated with the construction of the proposed development will still constitute a **Short-term Slight-Moderate Negative Impact**. The mitigation described in Section 7.7 will significantly reduce the risk of accidental pollution, eliminating all of the most serious risks, including input of cementitious materials or hydrocarbons to the River Suir. Furthermore, any water quality impacts which could arise in the unlikely event of accidental pollution would constitute **Temporary Slight-Imperceptible Negative Impacts**, if they were to occur at all. The permanent change in the nature of intertidal habitats is considered to constitute a **Permanent Slight Positive Impact** in the River Suir. The impact on the conservation status of Annex I 'Mudflats and sandflats not covered by seawater at low tide' at the National level will be **Imperceptible**.

Key Ecological Receptor	Pre-mitigation impacts	Ecological significance following mitigation
		The impact on habitat connectivity, zonation and heterogeneity would constitute a **Long-term Neutral Impact**.
KER 3 Shoreline Habitats, including Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)'	Water quality impacts which could arise in the event of accidental pollution from the proposed development could constitute **Short-term Significant Negative Impacts**, if they were to occur. The permanent direct loss of shoreline habitats is considered to constitute a **Permanent Slight-Imperceptible Negative Impact**.	The mitigation described in Section 7.7 will significantly reduce the risk of accidental pollution, eliminating all of the most serious risks, including input of cementitious materials or hydrocarbons to the River Suir. Furthermore, any water quality impacts which could arise in the unlikely event of accidental pollution would constitute **Temporary Slight-Imperceptible Negative Impacts**, if they were to occur at all. The permanent direct loss of shoreline habitats is considered to constitute a **Permanent Not Significant Negative or Neutral Impact**. Depending on the final specification of the eco-cladding, e.g. whether or not ledges or shelves are included, particularly at the high-water mark, this impact could be changed to a net **Positive** impact.
KER 4 Fish Species, including Annex II migratory species	In the event of prolonged periods of continuous piling or where breaks between pile drives are not sufficiently long, the hydroacoustic impacts on Twaite Shad and other fish species would constitute a **Short-term Moderate-Significant Negative Impact**. Given the short duration of the construction works and very short duration of nightworks, artificial lighting is considered to constitute a **Temporary Slight Negative Impact**. Water quality impacts which could arise in the event of accidental pollution from the proposed development could constitute **Short-term Significant Negative Impacts** if they were to occur. The loss of habitat and reduced habitat connectivity, zonation and heterogeneity are considered to constitute a **Permanent Significant Negative Impact**.	The hydroacoustic impacts on Twaite Shad and other fish species would constitute a **Short-term Slight-Imperceptible Negative Impact**. The impacts of artificial lighting would constitute a **Temporary Slight-Imperceptible Negative Impact**. The mitigation described in Section 7.7 will significantly reduce the risk of accidental pollution, eliminating all of the most serious risks, including input of cementitious materials or hydrocarbons to the River Suir. Furthermore, any water quality impacts which could arise in the unlikely event of accidental pollution would constitute **Temporary Slight-Imperceptible Negative Impacts**, if they were to occur at all. Depending on the final specification of the eco-cladding, the change in the physical structure and biological composition of the intertidal habitats could potentially constitute a net **Permanent Slight Positive Impact**.
KER 5 Otter	Disturbance of otters during the construction of the proposed development would constitute a **Short-term Slight-Moderate Negative Impact**. Water quality impacts, if they were to occur, would constitute a **Medium-term Slight Negative Impact**.	Disturbance of otters during the construction of the proposed development would constitute a **Short-term Slight Negative Impact**. The mitigation described in Section 7.7 will significantly reduce the risk of accidental pollution, eliminating all of the most serious risks, including

Key Ecological Receptor	Pre-mitigation impacts	Ecological significance following mitigation
	The loss of habitats on the northern edge of the River Suir would constitute a **Permanent Slight Negative Impact**. The reduction in aquatic habitat quality would constitute a **Permanent Slight-Imperceptible Negative Impact**.	input of cementitious materials or hydrocarbons to the River Suir. Furthermore, any water quality impacts which could arise in the unlikely event of accidental pollution would constitute **Temporary Slight-Imperceptible Negative Impacts**, if they were to occur at all. The loss of habitats, particularly the intertidal commuting corridor, on the northern edge of the River Suir would constitute a **Permanent Slight Negative Impact**. Depending on the final specification of the eco-cladding, e.g. the structure or texture of the cladding surface, the change in the biological composition of the intertidal habitats could potentially constitute a **Permanent Slight Positive Impact**.
KER 6 Bat Species	The impact of disturbance to bats during the construction of the proposed development is considered to constitute a **Temporary Slight Negative Impact**.	The impact of disturbance to bats during the construction of the proposed development will constitute a **Temporary Slight-Imperceptible Negative Impact**.
KER 7 Invasive Alien Species	The impacts of invasive alien species, if there were to be significant spread, could constitute **Long-term Very Significant Negative Impacts**. Without the implementation of an appropriate Biosecurity Protocol the risk of introduction or spread is considered to be **High**.	While the impacts associated with the introduction or spread of invasive alien species are unlikely to be significantly reduced, the implementation of an appropriate Biosecurity Protocol will ensure that the risk of introduction or spread occurring is **Negligible**.
KER 8 Nationally Designated Sites	All of the impacts on nationally designated sites relate to water quality impacts, invasive alien species or ecological connections to impacts on the other receptors, which have already been assessed above. The significance of these impacts is up to **Permanent Profound Negative Impacts** (invasive alien species).	Given the residual impacts above in relation to water quality impacts, invasive alien species or ecological connections to impacts on the other receptors, residual impacts on nationally designated sites are considered unlikely to exceed **Long-term Imperceptible Negative Impacts** in a worst-case scenario.

7.9 Assessment of Cumulative Impacts

7.9.1 Introduction and Methodology

The geographical boundary of 15km was selected for the assessment of cumulative impacts. This comprises a viable study area holding potential for feasible cumulative impacts whilst excluding those areas which are non-viable because of issues such as topography and distance. Significant projects known to WCCC that are not yet within the planning system but have the potential to interact with the proposed development are also considered.

Cumulative impacts result from incremental changes caused by other past, present or reasonably foreseeable projects together with the proposed Flood Defences West. Cumulative impacts were assessed by looking at previous plans and projects, current plans and projects in planning and proposed future plans and projects within 15km of the proposed development from 2010 to the present. There is too much uncertainty associated with development proposals beyond 5 years into the future and this EIAR can only be based on data that is readily available. This cumulative assessment has considered cumulative impacts that are:

(a) Likely;

(b) Significant; and,

(c) Relating to a future event which is reasonably foreseeable.

The following data sources have been consulted to identify the plans and projects within the 15km boundary:

- Waterford City and County Council;
- Kilkenny County Council;
- Wexford County Council;
- EIA Portal;
- An Bord Pleanála website (planning searches);
- Web search for major infrastructure projects in Waterford City and County and Co. Kilkenny;
- Waterford City Development Plan 2013-2019 (as extended);
- Waterford County Development Plan 2011-2017 (as extended);
- Draft Kilkenny County Development Plan 2021-2027;
- North Quays SDZ Planning Scheme 2018; and,
- Ferrybank Belview Local Area Plan 2009-2020 (including Amendment 1).

7.9.2 Potential Cumulative Impacts

The following projects were identified as having potential, in the absence of appropriate mitigation or controls, to give rise to significant impacts on Biodiversity in combination with the proposed Flood Defences West (the distances stated below are approximate distances from the proposed development):

- Port of Waterford Company – Dumping at Sea / Dredging (EPA Licence No. S0012-03) (distance: c. 15m)
- Waterford-New Ross Greenway (distance: 1.1km)
- River Suir Sustainable Transport Bridge (distance: c. 350m)

- Falcon Real Estate Development Ireland Limited SDZ Planning Application (distance: 0m)
- SDZ Transport Hub (distance: 0km)
- Rock Stabilisation and Rock Protection measures Plunkett Railway Station (distance: c. 10m)
- SDZ Access and Public Road Infrastructure (distance: 0m)
- Suir Shipping Ltd (distance: 5.4km)
- Bellvue Port Services (Waterford) Ltd (distance: 6.2km)
- Upgrade of Rail line east of Plunkett train Station to the Proposed Transport Hub (distance: 0m)

These projects were identified as having potential to result in cumulative impacts with the proposed Flood Defences West due to their nature, proximity to the proposed development, and likelihood of being implemented during approximately the same timeframe as the proposed development. The potential cumulative impacts of concern relate to habitat disturbance, underwater noise, artificial lighting, hydrological and water quality impacts, and invasive alien species. However, given the mitigation and control measures proposed as part of these projects and the proposed development, significant cumulative impacts are unlikely.

The complete assessment of the potential cumulative impacts between the proposed Flood Defences West and other plans and projects is presented in Chapter 17 Interactions and Cumulative Impacts.

7.10 Conclusion

This chapter has assessed the ecological impacts of the construction and operation of the proposed Flood Defences West on Biodiversity. The assessment described herein has examined the receiving natural environment and identified eight Key Ecological Receptors likely to be impacted upon by the proposed development, namely:

- River Suir, including Annex I 'Estuaries'
- Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide'
- Shoreline Habitats, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)'
- Fish Species, including Annex II migratory species
- Otter
- Bat Species
- Invasive Alien Species
- Nationally Designated Sites

Each Key Ecological Receptor was characterised and its ecological importance was evaluated on a geographical scale. This Chapter has analysed the potential impacts of the proposed development on the Key Ecological Receptors, characterised them in terms of their magnitude, extent, duration, frequency and reversibility, and assessed their significance on a geographical scale. Where negative impacts were identified, mitigation measures have been proposed to avoid or minimise these impacts. In addition, enhancement measures have been proposed to maximise the Biodiversity value of the proposed development, in accordance with national, regional and local policy, and ensure that there will be No Net Loss of Biodiversity as a result.

Provided that the proposed development is constructed and operated in accordance with the mitigation measures described in this Chapter and the NIS, there will be no significant residual impacts on ecological receptors which are of Local (Higher Value), County, National or International Importance, either from the proposed development individually or in combination with other past, present or reasonably foreseeable plans or projects. While there will be a permanent loss of c. 800m^2 of two Annex I habitats, namely 'Estuaries' and 'Mudflats and sandflats not covered by seawater at low tide' (which are not Qualifying Interests of the Lower River Suir SAC), there will be no effect on the conservation status of these habitats nationally.

Based on the assessment of the pre- and post-mitigation impacts from the proposed development, including the ecological enhancement measures described, the overall conclusion is that there will be No Net Loss of Biodiversity within the Zone of Influence as a result of the proposed development. Furthermore, appropriate final specification of the design for the eco-cladding presents an opportunity to achieve an overall Net Gain for Biodiversity in relation to the Flood Defences West.

The NIS for the proposed development concluded, in view of best scientific knowledge and the Conservation Objectives of the relevant European sites, that the Flood Defences West, either individually or in combination with other plans or projects, will not adversely affect the integrity of the Lower River Suir SAC, the River Barrow and River Nore SAC, or any other European site.

7.11 References

Bailey, M. and Rochford, J. (2006) Otter Survey of Ireland 2004/2005. *Irish Wildlife Manuals* 23. National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.

Brophy, J.T. (2021) *Waterford Flood Defence West – Intertidal Survey.* Unpublished report by BEC Consultants Ltd for Waterford City and County Council.

CIEEM (2018) *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine.* Chartered Institute of Ecology and Environmental Management, Winchester.

CIRIA (2001) *C532 Control of water pollution from construction sites: guidance for consultants and contractors.* Construction Industry Research and Information Association.

CIRIA (2006) *C648 Control of water pollution from linear construction projects: technical guidance.* Construction Industry Research and Information Association.

Gilbert, G., Stanbury, A. and Lewis, L. (2021) Birds of Conservation Concern in Ireland 2020-2026. *Irish Birds* 43:1-22.

Collins, J. (ed.) (2016) *Bat Surveys for Professional Ecologists: Good Practise Guidelines (3rd Edition).* The Bat Conservation Trust, London.

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive). Official Journal of the European Communities, *L206/7*.

DAHG (2017) *National Biodiversity Action Plan 2017-2021.* Department of Arts, Heritage and the Gaeltacht, Dublin.

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (the Birds Directive). Official Journal of the European Union, *L20/7*.

EC (2001) *Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC*. Environment Directorate-General of the European Commission.

EC (2013) *Interpretation Manual of European Union Habitats – EUR28*. Environment Directorate-General of the European Commission.

EPA (2003) *Advice notes on Current Practice (in the preparation of Environmental Impact Statements).* Environmental Protection Agency, Wexford.

EPA (2017) *Draft Guidelines on the Information to be Contained in Environmental Impact Statements.* Environmental Protection Agency, Wexford.

EPA (2021) *Unified GIS Application* <https://gis.epa.ie/EPAMaps> [Accessed 27/01/2021]. Environmental Protection Agency, Wexford.

European Communities (Birds and Natural Habitats) Regulations, 2011. *SI No. 477/2011.*

European Communities (Birds and Natural Habitats) (Amendment) Regulations, 2013. *SI No. 499/2013.*

European Communities (Birds and Natural Habitats) (Amendment) Regulations, 2015. *SI No. 355/2015.*

Flora (Protection) Order, 2015. *SI No. 356/2015.*

Fogarty, P. (2020a) *Environmental Impact Assessment Report [May 2020 Update] for the Waterford North Quays Development.* Report by Openfield Ecological Services for Falcon Real Estate Development Ireland Ltd.

Fogarty, P. (2020b) *Natura Impact Statement [May 2020 Update] for the Waterford North Quays Development.* Report by Openfield Ecological Services for Falcon Real Estate Development Ireland Ltd.

Fossitt, J. (2000) *A Guide to Habitats in Ireland*. The Heritage Council, Kilkenny.

Gallagher, T., O'Gorman, N.M., Rooney, S.M., Coughlan, B., and King, J.J. (2016) *National Programme: Habitats Directive and Red Data Book Species Executive Report 2015.* Inland Fisheries Ireland, Dublin.

Gallagher, T., O'Gorman, N.M., Rooney, S.M., Coghlan, B. and King, J.J. (2017) *National Programme: Habitats Directive and Red Data Book Species Summary Report 2016.* Inland Fisheries Ireland, Dublin.

Gallagher, T., O'Gorman, N.M., Rooney, S.M., Coghlan, B. and King, J.J. (2019) *National Programme: Habitats Directive and Red Data Book Species Summary Report 2017.* Inland Fisheries Ireland, Dublin.

Gallagher, T., O'Gorman, N.M., Rooney, S.M. and King, J.J. (2020) *National Programme: Habitats Directive and Red Data Book Species Summary Report 2018.* Inland Fisheries Ireland, Dublin.

Harrington, A. (2017) *R & H Hall Flour Mill, Ferrybank, Waterford City - Bat survey report.* Report for Waterford City and County Council.

Hydro Environmental (2021) *Hydraulic Modelling of the Proposed Waterford Flood Defences West. Report No. HEL212202v1.1. April 2021.* Report by Hydro Environmental Ltd for Roughan & O'Donovan Consulting Engineers.

IFI (2010) *Biosecurity Protocol for Field Survey Work.* Inland Fisheries Ireland, Dublin.

IFI (2011) *Sampling Fish for the Water Framework Directive – Transitional Waters 2010: Barrow, Nore and Suir Estuaries.* Inland Fisheries Ireland, Dublin.

IFI (2012) *National Programme: Habitats Directive and Red Data Book Fish species. Executive Report 2011. IFI Report Number: IFI/2012/1-4103.* Inland Fisheries Ireland, Dublin.

IFI (2016) *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters*. Inland Fisheries Ireland, Dublin.

IFI (2021a) *Twaite Shad* <https://www.fisheriesireland.ie/fish-species/twaite-shad .html> [Accessed 01/03/2021]. Inland Fisheries Ireland, Dublin.

IFI (2021b) *Juvenile Shad Monitoring* <https://www.fisheriesireland.ie/Habitats-and-Red-Data-Book/juvenile-shad-monitoring.html> [Accessed 01/03/2021]. Inland Fisheries Ireland, Dublin.

IFI (2021c) *Adult Shad Monitoring* <https://www.fisheriesireland.ie/Habitats-and-Red-Data-Book/adult-shad-monitoring.html> [Accessed 01/03/2021]. Inland Fisheries Ireland, Dublin.

Invasive Species Ireland (2021) *Species Accounts: Chinese mitten crab* <https://invasivespeciesireland.com/.../chinese-mitten-crab> [Accessed 02/04/2021]. Invasive Species Ireland.

IWDG Consulting (2018) *Marine Mammal Risk Assessment of the River Suir Sustainable Transport Bridge.* Report by IWDG Consulting for Roughan & O'Donovan Consulting Engineers.

Kelleher, C. (2014) *Bat Fauna Study*. Report by Aardwolf Wildlife Surveys for Waterford City and County Council.

Kelly, F., Harrison, A., Connor, L., Matson, R., Morrissey, E., Feeney, R., Wogerbauer, C., O'Callaghan, R. and Rocks, K. (2011) *Sampling Fish for the Water Framework Directive – Summary Report 2010*. Inland Fisheries Ireland, Dublin.

Kennedy, R. (2008) *Benthic Biotope classification of subtidal sedimentary habitats in the Lower River Suir candidate Special Area of Conservation and the River Nore and*

River Barrow candidate Special Area of Conservation (July 2008). Atlantic Resource Managements Solutions, Kinvara.

King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. (2011) *Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish.* National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

King, J.J. and Linnane, S.M. (2004) The status and distribution of lamprey and shad in the Slaney and Munster Blackwater SACs. *Irish Wildlife Manuals* 14. National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

McCorry, M. and Ryle, T. (2009) *Salt Marsh Monitoring Project 2007-2008*. Research Branch, National Parks & Wildlife Service, Department of Housing, Local Government and Heritage, Dublin.

NBDC (2021) *Biodiversity Maps* <https://maps.biodiversityireland.ie> [Accessed 27/01/2021]. National Biodiversity Data Centre, Waterford.

NIEA (2020) *ID Guide: Chinese Mitten Crab.* Northern Ireland Environment Agency.

NPWS (2009) *Threat Response Plan: Otter (2009-2011).* National Parks & Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin.

NPWS (2019) *The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessment.* National Parks & Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Dublin.

NPWS (2021) *Designations Viewer <http://webgis.npws.ie/npwsviewer/>* [Accessed 27/01/2021]. National Parks & Wildlife Service, Department of Housing, Local Government and Heritage, Dublin.

NRA (2006a) *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes.* National Roads Authority, Dublin.

NRA (2007) *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.* National Roads Authority, Dublin.

NRA (2008a) *Environmental Impact Assessment of National Road Schemes – A Practical Guide. Revision 1.* National Roads Authority, Dublin.

NRA (2008b) *Guidelines for Ecological Survey Techniques for Protected Flora and Fauna during the Planning of National Road Schemes.* National Roads Authority, Dublin.

NRA (2008c) *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes.* National Roads Authority, Dublin.

NRA (2008d) *Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes.* National Roads Authority, Dublin.

NRA (2009) *Guidelines for Assessment of Ecological Impacts of National Road Schemes.* Transport Infrastructure Ireland, Dublin.

O'Gorman, N.M., Rooney, S.M., Cierpial, D. and King, J.J. (2015) *National Programme: Habitats Directive and Red Data Book Species Executive Report 2014.* Inland Fisheries Ireland, Dublin.

Regulation (EU) No. 1143/2014 of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species. Official Journal of the European Union, *L317/35*.

ROD (2018a) *River Suir Sustainable Transport Bridge – Environmental Impact Assessment Report.* Report by Roughan & O'Donovan Consulting Engineers for Waterford City and County Council.

ROD (2018b) *River Suir Sustainable Transport Bridge – Natura Impact Statement.* Report by Roughan & O'Donovan Consulting Engineers for Waterford City and County Council.

Rooney, S.M., O'Gorman, N.M. and King, J.J. (2013) *National Programme: Habitats Directive and Red Data Book Species Executive Report 2012.* Inland Fisheries Ireland, Dublin.

Rooney, S.M., O'Gorman, N.M., Cierpial, D. and King, J.J. (2014) *National Programme: Habitats Directive and Red Data Book Species Executive Report 2013.* Inland Fisheries Ireland, Dublin.

Rooney, S. and King, J.J. (2015) *A poster on acoustic tracking of twaite shad by the Habitats Directive and Red Data Book Species team presented at the 3rd International Conference on Fish Telemetry (ICFT) in Halifax, Nova Scotia in 2015.* Inland Fisheries Ireland, Dublin.

Smith, G, F., O'Donoghue, P., O'Hora, K. and Delaney, E. (2011) *Best Practice Guidance for Habitat Survey and Mapping.* The Heritage Council, Kilkenny.

Southern Regional Assembly (2019) Regional Spatial and Economic Strategy for the Southern Region.

TII (2020) *The Management of Invasive Alien Plant Species on National Roads – Technical Guidance.* Transport Infrastructure Ireland, Dublin.

Waterford City Council (2012) Waterford City Development Plan 2013-2019 (as extended) (as varied).

Wildlife Act, 1976. No. 39 of 1976.

Wildlife Act, 1976 (Protection of Wild Animals) Regulations, 1990. SI No. 112/1990.

Wildlife (Amendment) Act, 2000. No. 38 of 2000.

Wildlife (Amendment) Act, 2012. No 29 of 2012.

Wyse Jackson, M., FitzPatrick, Ú., Cole, E., Jebb, M., McFerran, D., Sheehy Skeffington, M. and Wright, M. (2016) *Ireland Red List No. 10: Vascular Plants.* National Parks & Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin.

Appendix 7.1
Intertidal Survey Report

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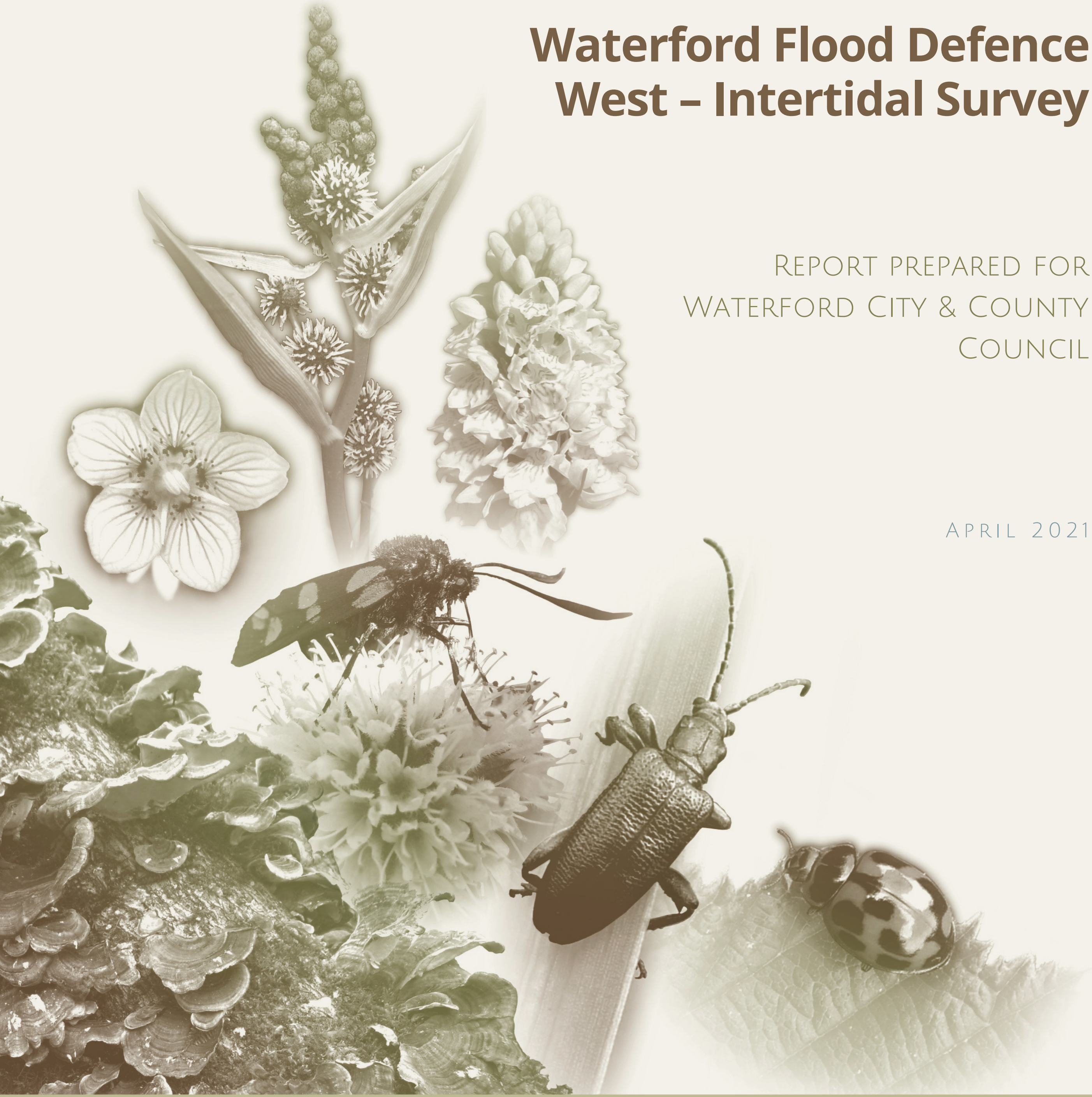
Waterford Flood Defence West – Intertidal Survey



Report prepared for
Waterford City & County Council

April 2021

John T. Brophy

Waterford Flood Defence West – Intertidal Survey

April 2021

Botanical, Environmental & Conservation Consultants Ltd,
65 Holywell, Dundrum, Dublin 14, D14 P5W0.
Website: www.botanicalenvironmental.com
Email: info@botanicalenvironmental.com

CONSULTANTS

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JB	SB	JM	Final	12/04/2021

Table of Contents

1 Introduction

BEC Consultants Ltd was contracted by Roughan & O'Donovan on behalf of Waterford City & County Council to carry out an intertidal survey in relation to the Waterford Flood Defence West project.

2 Project description

The proposed development aims to develop flood defence measures for the protection of critical infrastructure including the existing Plunkett Train Station, the railway line east and west of Plunkett Station and the future SDZ Transportation Hub which will provide a connection to the North Quays SDZ site via the railway line. The project will involve the installation of sheet piles approximately 1 m in front of the existing quay wall along much of the study area, and the gap backfilled.

3 Study area

The study area was the northern bank of the River Suir estuary upstream of Rice Bridge, Waterford City, Co. Waterford. The survey area is within the Lower River Suir Special Area of Conservation (SAC) (Site code: 002137) (Figure 1).

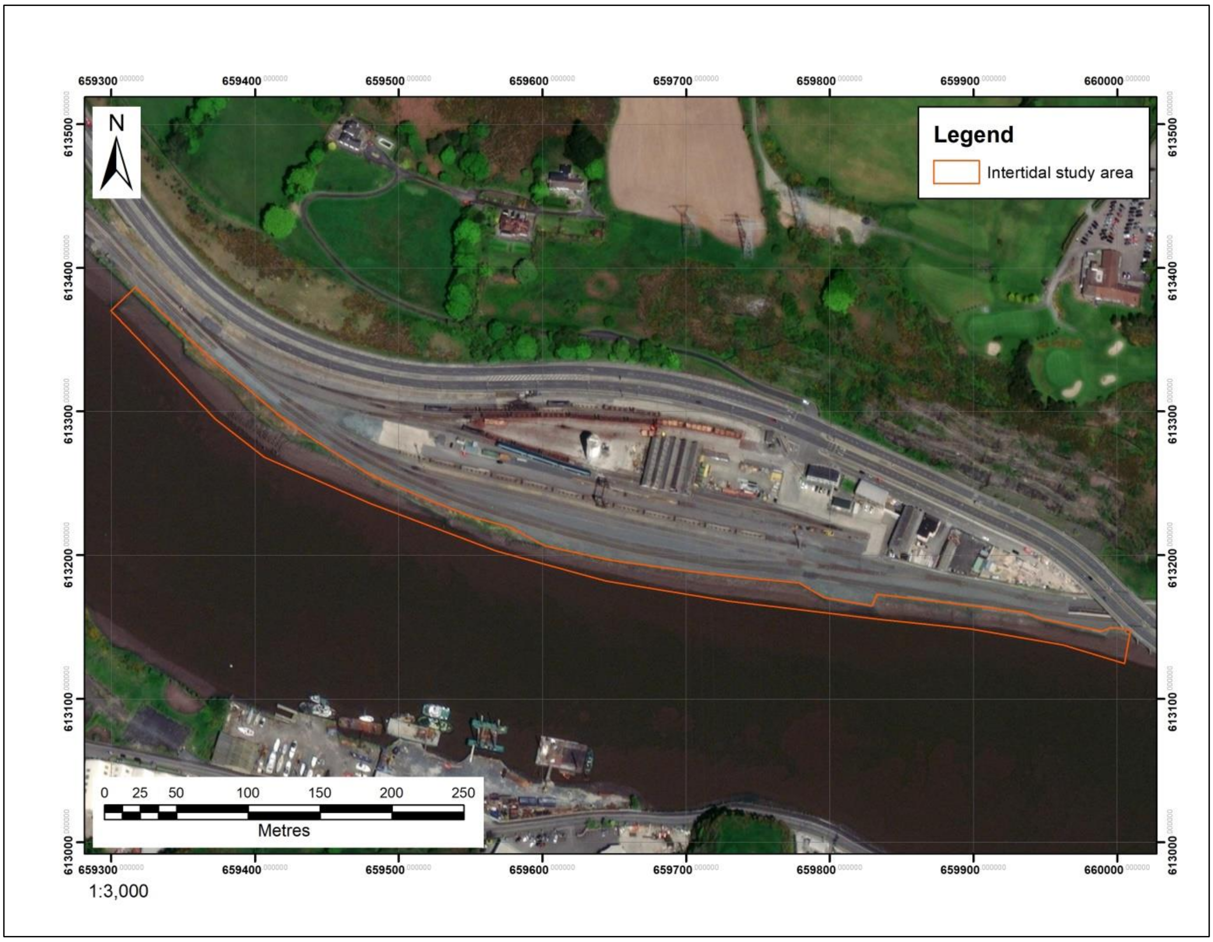


Figure 1. Waterford Flood Defence West intertidal survey study area within the River Suir Estuary

3.1 Lower River Suir SAC

The Lower River Suir SAC is one of the Natura 2000 sites designated to fulfil Ireland's obligations under the Habitats Directive (92/43/EEC) which is transposed into Irish legislation by the European

Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. 477/2011). The site is designated for a number of terrestrial, freshwater and coastal habitats and species, which are listed in Table 1.

Table 1. Qualifying interests of the Lower River Suir SAC (NPWS, 2017)

EU habitat/species	EU code
Margaritifera margaritifera (Freshwater Pearl Mussel)	1029
Austropotamobius pallipes (White-clawed Crayfish)	1092
Petromyzon marinus (Sea Lamprey)	1095
Lampetra planeri (Brook Lamprey)	1096
Lampetra fluviatilis (River Lamprey)	1099
Alosa fallax fallax (Twaite Shad)	1103
Salmo salar (Salmon)	1106
Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	1330
Lutra lutra (Otter)	1355
Mediterranean salt meadows (Juncetalia maritimi)	1410
Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation	3260
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	6430
Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles	91A0
Taxus baccata woods of the British Isles	91J0
Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)	91E0

4 Methodology

An intertidal field survey was carried out on 15th March 2021 during low water spring tides by John Brophy and Simon Barron of BEC Consultants Ltd.

4.1 Intertidal mudflat survey

Intertidal core samples were taken in soft sediment using a 0.01 m^2 core to a depth of 25 cm at five locations. The methodology for the survey generally followed that of the Marine Monitoring Handbook (Davies *et al*., 2001). Sample stations were chosen to provide a spread of sites from the along the length of the project area across the upper and lower shore (Figure 2).

Three replicate cores were taken at each sample station. Each replicate was sieved through a 1 mm sieve and the residue retained for macroinvertebrate analysis. The samples were preserved in 70% industrial methylated spirits and placed in containers labelled inside and out, before being returned to the laboratory for sorting, identification and enumeration. One small core to a depth of 10 cm was taken for sediment analysis, placed in a labelled container and stored in a cooler box before being returned to the laboratory where the samples were frozen prior to analysis for Particle Size Analysis (PSA) and Total Organic Carbon (TOC).

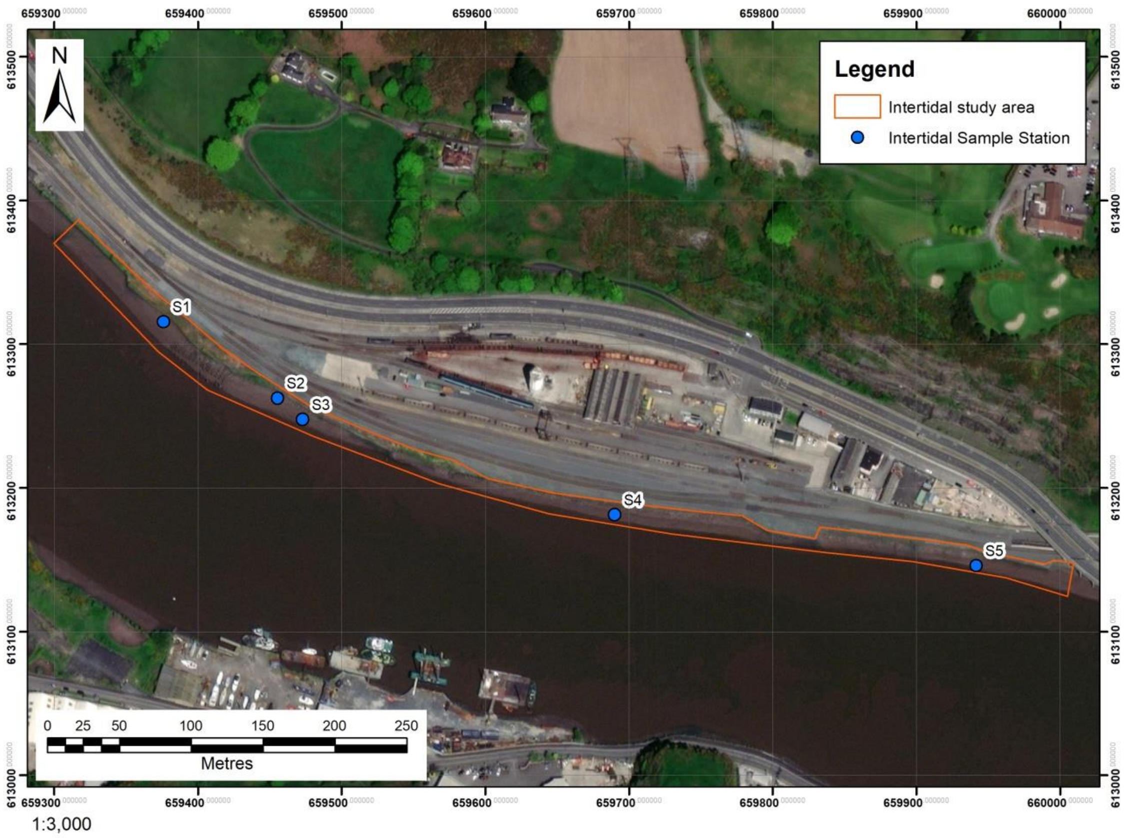


Figure 2. Map showing location of intertidal sample stations within the Waterford Flood Defence West study area.

The following data was recorded on standard field sheets at each sample station:

- Location
- Surveyors
- Sampler type
- Weather
- Date
- Time
- Station
- Irish Grid Reference
- Exposure
- Sieve size (mm)
- Core depth (cm)
- Sediment description
- Photo reference numbers

The mudflat biotope was assigned based on the fauna and sediment type recorded following the JNCC Marine Habitat Classification for Britain and Ireland (Connor *et al*., 2004).

4.2 Intertidal hard substratum survey

Intertidal hard substrata biotopes were recorded during a walkover survey following the JNCC Marine Habitat Classification for Britain and Ireland (Connor *et al*., 2004). The biotopes were mapped in the field onto recent satellite imagery and digitised using ArcGIS 10.0 on return to the office. A handheld GPS was used to locate features and record target note locations. Photographs were taken to provide a visual record of the existing habitats.

4.3 Saltmarsh survey

The survey area was walked and any areas conforming to Annex I saltmarsh habitat were mapped in the field onto recent satellite imagery and digitised using ArcGIS 10.0 on return to the office. A handheld GPS was used to locate features and record target note locations. Photographs were taken to provide a visual record of the existing habitats.

4.4 Macroinvertebrate analysis

Samples were sorted in a white tray, with macroinvertebrates being transferred to labelled containers and preserved with 70% IMS prior to identification. The species list was checked against the Pan-European Species directory Infrastructure (PESI, 2021).

Identification was carried out using stereoscopic and compound microscopes and appropriate keys.

4.5 Sediment sample analysis

Sediment analysis for PSA and TOC (by Loss on Ignition (LOI)) was carried out by Nautilus, Dublin.

5 Existing environment

5.1 Intertidal Mudflats

The intertidal mud of the study area is all classified as '*Tubificoides benedii* and other oligochaetes in littoral mud' (LS.LMu.UEst.Tben) under the JNCC Marine Biotope Classification (Appendix I, Figure A1-A3). This biotope is species-poor and found in upper estuarine locations where the salinity is reduced, with wave exposure ranging from sheltered to extremely sheltered (Connor *et al*., 2004). The substratum is one of fine sandy mud, and extends from the lower shore to the upper shore (Connor *et al*., 2004). Within the study area, the nature of the mudflat in the upper shore differed from lower down. The upper shore along much of the length comprised firm, anoxic mud, with rubble and debris dumped onto it from the land side, with quite a steep profile (Appendix II, Plate 1). Burrows were visible in this upper shore mud surface and Horned Wrack (*Fucus ceranoides*) was growing on rocks scattered along the shore. The lower shore was one of soft mud, with the anoxic layer often deeper than the 25 cm reached by the core and a flatter profile (Appendix II, Plate 2 & 3).

In the current survey, only four species were recorded across the five sampling locations (Appendix III, Table A1). The oligochaete worm *Baltidrilus costatus* was recorded at the uppermost sample station S1, which was located on the upper shore. The true fly (Diptera) larva of the Family Dolichopodidae was found at sample station S2, forming burrows in the upper shore. A single mayfly *Baetis rhodani* was recorded at sample station S3; this must have washed down from upstream as there is no suitable habitat present in the estuary for this species. Similarly, a larva of the water beetle *Esolus parallelepipedus* recorded at S5 must also have been washed down, as, again, no suitable habitat for this species is present within the estuary. No fauna were recorded from sample station S4. Sample station environmental data are presented in Appendix III, Table A2.

The granulometric analysis classified all stations as 'Sandy Mud', with the mud content ranging from 59.6% (S3) to 79.3% (S1) (Appendix III, Table A3). Total Organic Carbon ranged from 7.37% (S2) to 8.20% (S5) (Appendix III, Table A4).

5.2 Intertidal hard substrata

The hard substrata biotopes of the study area were limited to artificial surfaces in the form of the historical retaining wall separating the estuary from the rail line. The biotopes here were typical of the sheltered location in a reduced salinity environment on an artificial substratum. The eastern end of the study area showed the most developed zonation of intertidal hard substratum biotopes. From bottom to top, this area included a band of '*Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity mid eulittoral rock' (LR.LLR.FVS.AscVS) up to 1.5 m wide (Appendix II. Plate 4), '*Fucus ceranoides* on reduced salinity eulittoral rock' (LR.LLR.FVS.Fcer) approximately 30cm wide (Appendix II, Plate 5), sparse and intermittent '*Enteromorpha* spp. on freshwater-influenced and/or unstable upper eulittoral rock' (LR.FLR.Eph.Ent) (Appendix II, Plate 5) and 'Yellow and grey lichens on supralittoral rock' (LR.FLR.Lic.YG) (Appendix II, Plate 5), which is similarly sparse and intermittent. Heading west, the LR.LLR.FVS.AscVS zone rapidly disappears, as the upper mud shore covers its potential substratum along the base of the retaining wall, leaving only the upper three biotopes. There is often a strip of bare stone between the LR.LLR.FVS.Fcer and the LR.FLR.Eph.Ent above it.

The barnacle *Austrominius modestus* was recorded on some of the wooden posts found emerging from the mudflat (Appendix II, Plate 6) and occasionally on rocks on the mud.

5.3 Saltmarsh habitat

A small area (approximately 100m^2) of saltmarsh habitat was recorded within the study area (Appendix I, Figure A1-A2. Appendix II, Plate 7). This saltmarsh formed in the shelter provided by an outward projection of the retaining wall. The saltmarsh was mainly lower saltmarsh, dominated by Common Saltmarsh-grass (*Puccinellia maritima*), with Sea Plantain (*Plantago maritima*), with the strip closest to the sea wall dominated by Creeping Bent (*Agrostis stolonifera*), making it more of an upper fringe saltmarsh. There were dead stems of what was most likely last year's Sea Aster (*Aster tripolium*) present in both zones. Flood debris in the form of Common Reed (*Phragmites australis*) covered much of the saltmarsh. There was no *Spartina* spp. present.

Based on the species present, the area corresponds to the Annex I habitat Atlantic salt meadows (1330), which is a qualifying interest for the Lower River Suir SAC.

The remaining grassy areas within the study area, including along the area of collapsed retaining wall, were dominated by Couch Grass (*Elytrigia repens*), with occasional Butterfly-bush (*Buddleja davidii*), Gorse (*Ulex europaeus*) and Bramble (*Rubus fruticosus* agg.) (Appendix II, Plate 8).

6 Discussion

The biotopes and species of the study area are typical of upper estuarine areas around Ireland, and are indicative of a variable salinity environment, with a strong freshwater influence. The low species richness is the result of the challenges relating to life in the upper estuary, with salinity varying with tidal cycle and river flow conditions. The two infaunal species that were found to be living within the mudflat biotope of the study area (*Baltidrilus costatus* and Family Dolichopodidae), were found in the upper shore, where conditions are more stable. The remaining fauna recorded were single specimens washed down from true freshwater habitat upstream.

The more stable and firm sandy mud of the upper shore had been impacted by deposited waste in the form of stone and metal, scattered along the shore. The anoxic layer of the upper shore was very close to the surface, due to its stable nature preventing oxygen penetration. This contrasted with the soft sandy mud of the lower shore, where the anoxic layer began much deeper. This is likely due to the water currents stirring up the mud and the fact that it is covered by water for more of the tidal cycle.

The hard substratum biotopes found within the study area are common around the Irish coast, particularly in sheltered areas with a strong freshwater influence, where there is rock available for colonisation. They are also low in species richness.

A notable presence within the study area is the patch of Annex I saltmarsh habitat Atlantic salt meadows (1330). While this area is small in size (approximately $100m^2$), the habitat is a qualifying interest for the Lower River Suir SAC. The establishment of this area of saltmarsh was facilitated by an outward turn in the existing retaining wall, which provided shelter from the river current. Due to its small size, the full development of saltmarsh zonation could not be achieved, and so it consists of a Creeping Bent-dominated upper saltmarsh community on the landward side of a Common Saltmarsh-grass-dominated lower saltmarsh community.

Brophy *et al.* (2019) recorded 19.34 hectares of Atlantic salt meadows within the Lower River Suir SAC. Based on this figure, the area of Atlantic salt meadows within the study area is 0.05% of the total area of the habitat within the SAC.

In summary, the study area has low species richness and contains biotopes common in upper estuarine areas around Ireland, which are indicative of a variable salinity environment, with a strong freshwater influence. The most notable feature is the small area of Annex I Atlantic salt meadow habitat along the retaining wall; a habitat that is a qualifying interest for the Lower River Suir SAC.

7 References

Brophy, J.T., Perrin, P.M., Penk, M.R., Devaney, F.M. & Leyden, K.J. (2019) Saltmarsh Monitoring Project 2017-2018. *Irish Wildlife Manuals*, No. **108**. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

Connor, D.W., Allen, J.H. Golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O. and Reker, J.B. (2004) The Marine Habitat Classification for Britain and Ireland Version 04.05. In: JNCC (2015) The Marine Habitat Classification for Britain and Ireland Version 15.03 [Online]. Available from: jncc.defra.gov.uk/MarineHabitatClassification

Davies, J., Baxter, J., Bradley, M., Connor, D., Khan, J., Murray, E., Sanderson, W., Turnbull, C. and Vincent, M. (2001) Marine Monitoring Handbook. Joint Nature Conservation Committee, Peterborough, UK. http://archive.jncc.gov.uk/default.aspx?page=2430

NPWS (2017) Conservation Objectives: Lower River Suir SAC 002137. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin.

PESI (2021) Pan-European Species directories Infrastructure. Accessed through www.eu-nomen.eu/portal on 30/03/2021.

Appendix I – Map

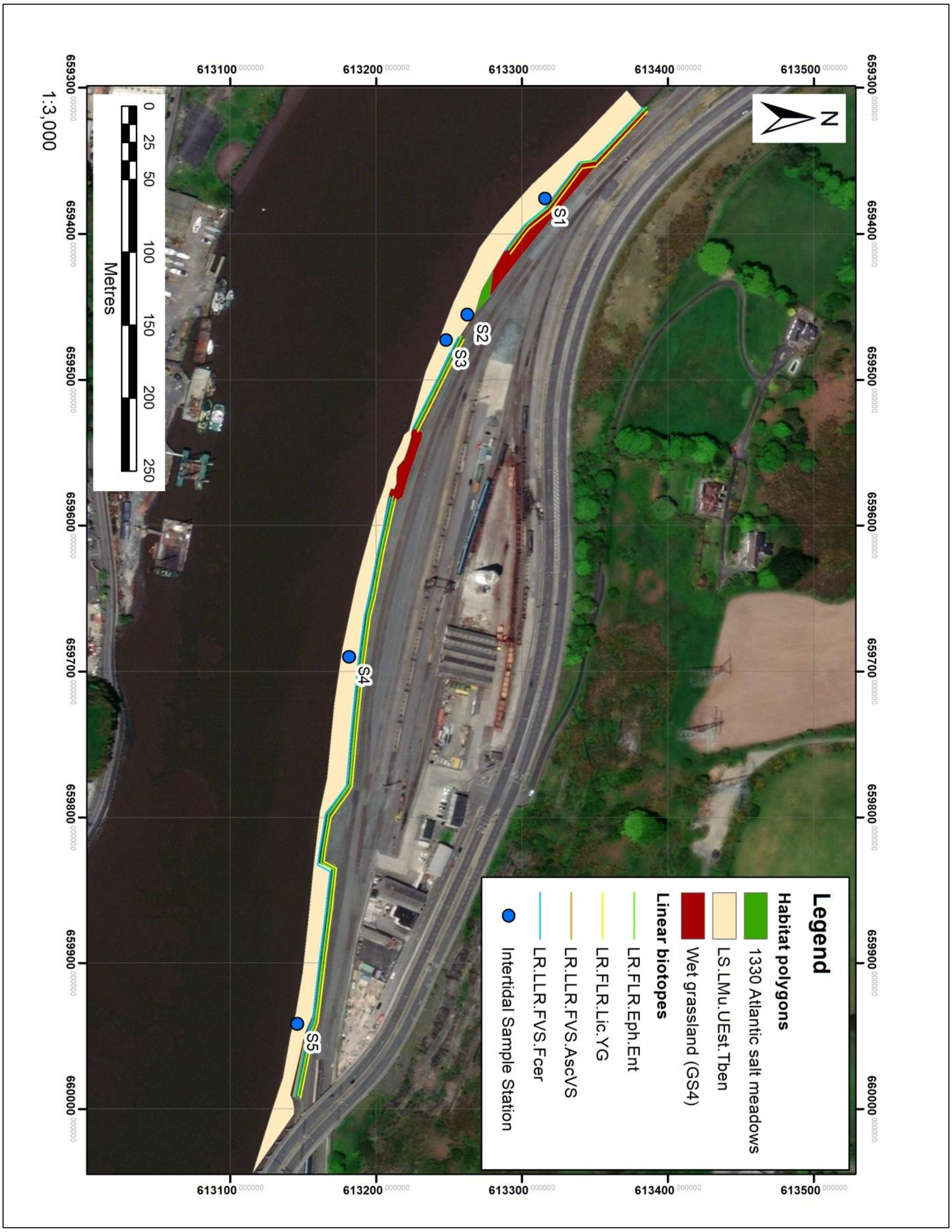


Figure A1 Overview biotope/habitat map of the intertidal zone within the study area on the River Suir estuary, Waterford City, Co. Waterford. Linear biotopes on near vertical surfaces are necessarily schematic.

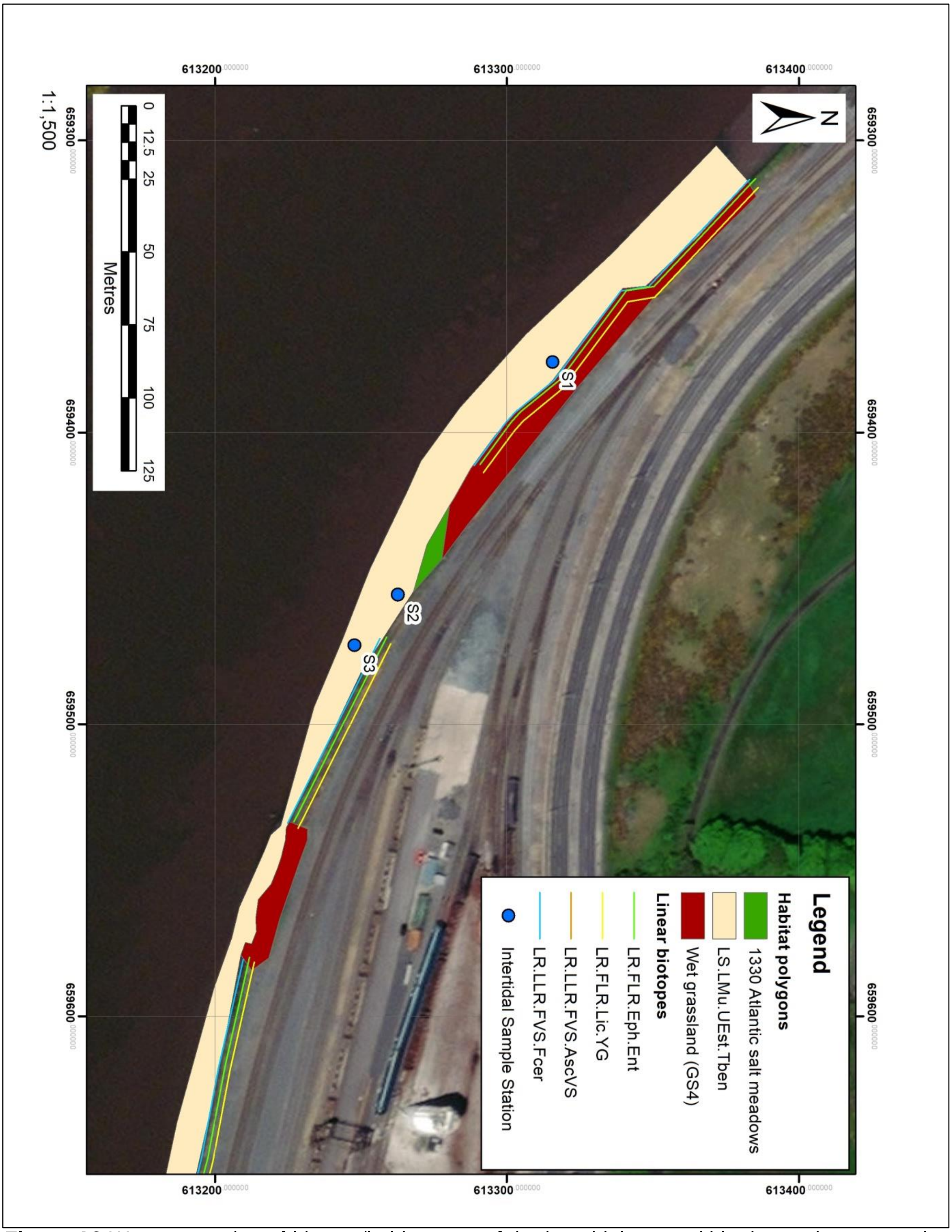


Figure A2 Western section of biotope/habitat map of the intertidal zone within the study area on the River Suir estuary, Waterford City, Co. Waterford. Linear biotopes on near vertical surfaces are necessarily schematic.

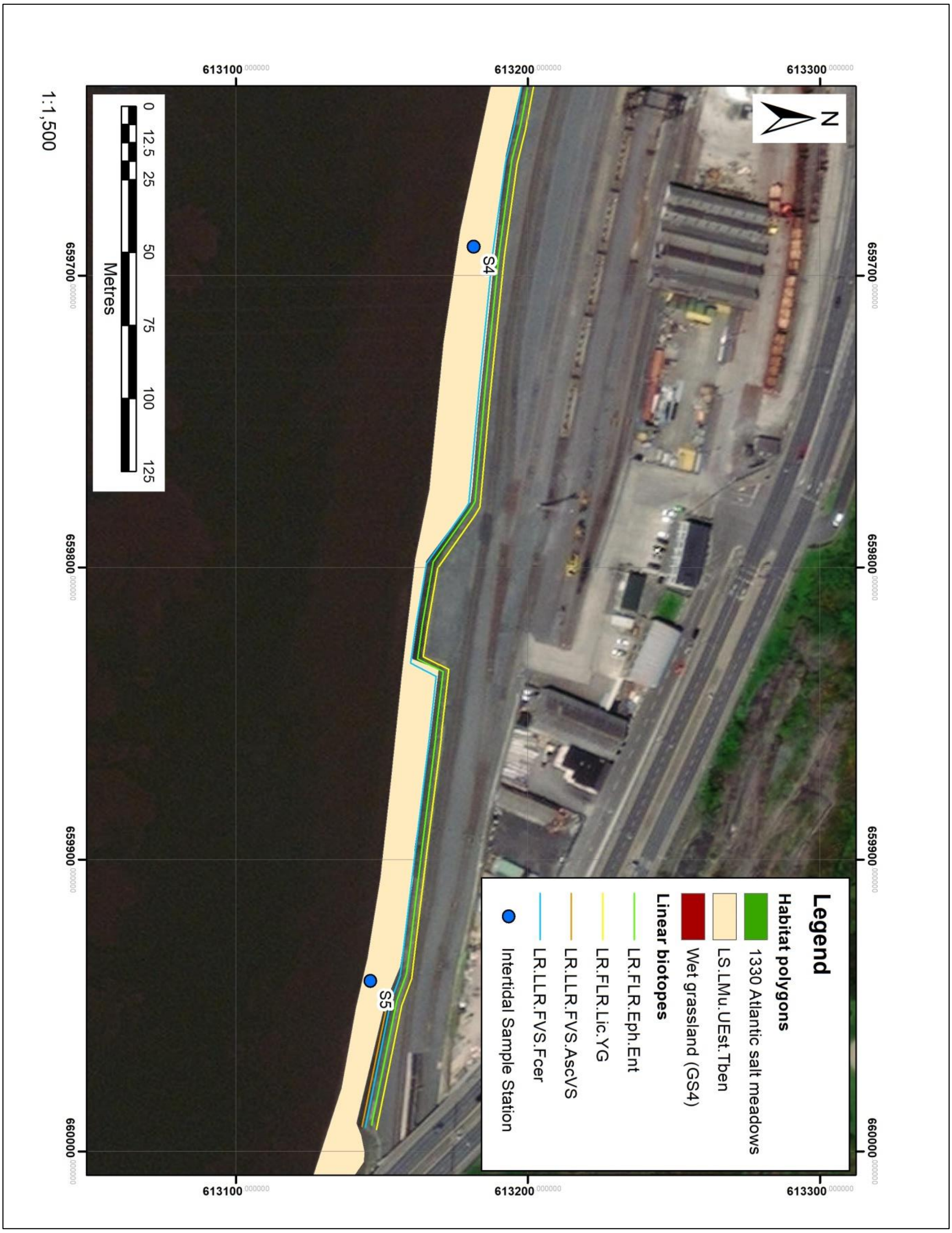


Figure A3 Eastern section of biotope/habitat map of the intertidal zone within the study area on the River Suir estuary, Waterford City, Co. Waterford. Linear biotopes on near vertical surfaces are necessarily schematic.

Appendix II – Plate

Plate 1.Upper shore of firm mud and rubble/ stone

Plate 2. Lower shore with soft mud

Plate 3. Soft mud surface at S5

Plate 4. The biotope LR.LLR.FVS.AscVS on the retaining wall at the southern end of the study area

Plate 5.The biotopes LR.LLR.FVS.Fcer, LR.FLR.Eph.Ent and LR.FLR.Lic.YG on the retaining wall

Plate 6. The barnacle *Austrominius modestus* on a wooden post, with *Fucus ceranoides*

	
Plate 7. Area of 1330 Atlantic salt meadows	**Plate 8**. Grassland areas above retaining wall alongside railway

Appendix III – Tables

Table A1. Results of intertidal core survey carried out in the River Suir Estuary, Waterford City, Co. Waterford on 15/03/2021

Station	S1			S2			S3			S4			S5			Total
Replicate	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
ANNELIDA																
Oligochaeta																
Baltidrilus costatus	3	30	5	-	-	-	-	-	-	-	-	-	-	-	-	**38**
INSECTA																
Ephemeroptera																
Baetis rhodani	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	**1**
Diptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0**
Dolichopodidae	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	**1**
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0**
Esolus parallelepipedus (larva)	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	**1**
Total individuals	**3**	**30**	**5**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**41**
Total species	1	1	1	1	0	0	1	0	0	0	0	0	0	1	0	**4**

Table A2. Environmental data collected at sample stations on the River Suir Estuary, Waterford City, Co. Waterford on 15/03/2021

Station	Time	Sampler type	Core depth (cm)	Sieve size (mm)	Weather	ITM_X	ITM_Y	Exposure	Sediment description*
S1	15:52	Sediment core	25	1	Dry, bright	659328	613355	Sheltered	SM, 3, 5, 1, n/a, 5 burrows (upper shore)
S2	15:15	Sediment core	25	1	Dry, bright	659456	613263	Sheltered	SM, 5, 5, 1, n/a, 5 burrow (upper shore)
S3	14:52	Sediment core	25	1	Dry, bright	659473	613253	Sheltered	SM, 3, 4, 4, n/a, 3. No casts
S4	13:47	Sediment core	25	1	Dry, bright	659690	613189	Sheltered	SM, 3, 4, 4, n/a, 3 No casts
S5	13:03	Sediment core	25	1	Dry, bright	659941	613155	Sheltered	SM, 4, 4, 4, n/a, 1 No casts

*Sediment Type: Mud(M), Sandy Mud (SM), Muddy Sandy (MS), Sand (S), Gravelly Sand (GS), Sandy Gravel (SG), Gravel (G).

*Site features: (1-5 scale): Surface relief (even-uneven), firmness (firm-soft), stability (stable-mobile), sorting (well-poor), black layer (1 = not visible, 2 = >20 cm, 3 = 5-20 cm, 4 = 1-5 cm, 5 = <1 cm)

Table A3. Results of particle size analysis carried out on samples from the River Suir Estuary, Waterford City, Co. Waterford on 15/03/2021

Station	% Coarse sand	% Medium sand	% Fine sand	% Very fine sand	% Mud
S1	0.0	0.1	0.4	20.1	79.3
S2	0.1	0.1	0.4	21.2	78.3
S3	0.0	0.1	1.7	38.6	59.6
S4	0.0	0.1	1.7	28.6	69.6
S5	0.0	0.1	1	25.0	73.8

Table A4. Results of Loss On Ignition analysis carried out on samples from the River Suir Estuary, Waterford City, Co. Waterford on 15/03/2021

Station	% Loss on Ignition
S1	7.83
S2	7.37
S3	7.41
S4	7.91
S5	8.20

CONSULTANTS

BEC Consultants Ltd.
65 Holywell, Dundrum,
Dublin 14, D14 P5W0

Email: info@botanicalenvironmental.com
Web: www.botanicalenvironmental.com

Chapter 8
Soils and Geology

Chapter 8 Soils and Geology

8.1 Introduction

This chapter describes the natural characteristics of the receiving environment of Flood Defences West (hereafter the 'proposed development') and its immediate surroundings, in terms of soils and geology. The likely significant impacts of the proposed development on these resources are assessed and where required, mitigating measures are put in place to avoid, reduce or minimise the impact of the proposed development on soils and geology.

This chapter outlines the existing ground conditions, with the predicted impacts assessed on the basis of the relevant construction methodology and particular soil characteristics.

Measures to mitigate the likely significant adverse impacts of the proposed development are detailed, and residual impacts are described. This chapter initially sets out the methodology used (Section 8.2), describes the existing soils and geology environment (Section 8.3), examines the predicted impacts of the proposed development (Section 8.4), proposes mitigation measures (Section 8.5), and identifies residual impacts (Section 8.6).

8.2 Methodology

8.2.1 Methodology, Directives and Guidance documents

This chapter is prepared having regard to the Environmental Impact Assessment (EIA) Directive 2011/92/EU (as amended by Directive 2014/52/EU) and the following guidance documents:

- Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (TII, 2008);
- Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA, 2017);
- Advice Notes for Preparing Environmental Impact Statements (EPA, 2015);
- Advice notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003); and
- Guidelines on the information to be contained in environmental impact statements (EPA,2002).

8.2.2 Available Information and Data Collection

Site Walkover

The extent of the proposed development area was walked by the chapter author (ROD's senior geotechnical engineer) in December 2018, under lookout protection by Iarnród Éireann (IÉ) staff. An inspection of the existing masonry quay walls and drainage outlet was conducted separately by ROD's structural and drainage engineers from a boat on the River Suir in August 2018.

Mapping and Aerial Photography

Geological mapping from the Geological Survey of Ireland (GSI), covering the subsoils and solid geology of the location of the proposed development was reviewed using the online viewer at www.gsi.ie/mapping.

Open source (Google Earth, Bing Maps) and Ordnance Survey Ireland (OSI) aerial photography was interrogated in order to identify large scale ground characteristics and built environment in the area.

Historical maps dating back to 1830s were reviewed using online viewer at www.map.geohive.ie in order to identify the changes to topography, extents, land use and built environment.

Ground Investigations

Historical ground investigation information for the proposed development area was collated and reviewed using the National Borehole Database available on GSI's Geotechnical web viewer. In-river ground investigations previously carried out for the nearby River Suir Sustainable Transport Bridge, approved by An Bord Pleanála and currently at Detailed Design stage, were also consulted, to provide an additional body of data to inform the assessment.

Ground investigations specific to the proposed development were commissioned by ROD and carried out by IGSL Ltd. in Q2 and Q3 of 2019. The ground investigations were undertaken across the entire proposed development area, with density of investigation points suitable for planning phase and detailed design (IGSL, 2019). The ground investigation briefly comprised of:

- 15 no. cable percussion boreholes;
- 2 no. rotary core boreholes;
- 4 no. trial pits;
- 10 no. dynamic probes, two of which included window sampling;
- 5 no. groundwater monitoring standpipes, one of which included a datalogger; and
- A suite of laboratory testing; including environmental/contamination tests.

A Ground Interpretative Report (IGSL, 2020) and Waste Characterisation Report (O'Callaghan Moran, 2020) were prepared on the basis of the data acquired from this ground investigation campaign, which have fed into the soils and geology assessment of the proposed development.

8.3 Description of Receiving Environment

8.3.1 General Description

The proposed development comprises c.1.1km of flood protection measures. The location of the proposed development is along the north bank and within the foreshore of the River Suir in Waterford City, Co. Waterford. The R680 Rice Bridge and the Waterford railway station, Plunkett Station are located at the easternmost extent of the site while the Iarnród Éireann (IÉ) rail corridor and the Sallypark industrial park bound the site to the north. The River Suir and the existing quay wall run immediately to the south of the site.

The western end of the study area, including the proposed temporary compound location, is at the industrial estate and level crossing approximately 1500m northwest of Plunkett Station.

The photograph depicting the typical receiving environment is shown in Plate 8.1. Flat topography with rail corridor running roughly parallel to the existing quay wall is visible, as is the surficial deposit of Made Ground (rail ballast) on landside and cohesive alluvium in mudflats. The photograph was taken by G-NET 3D in March 2021 from Terminus Street overbridge (at approx. Ch.360, see Figures 4.1 to 4.6 in Volume 3 for chainage reference points) looking westwards.

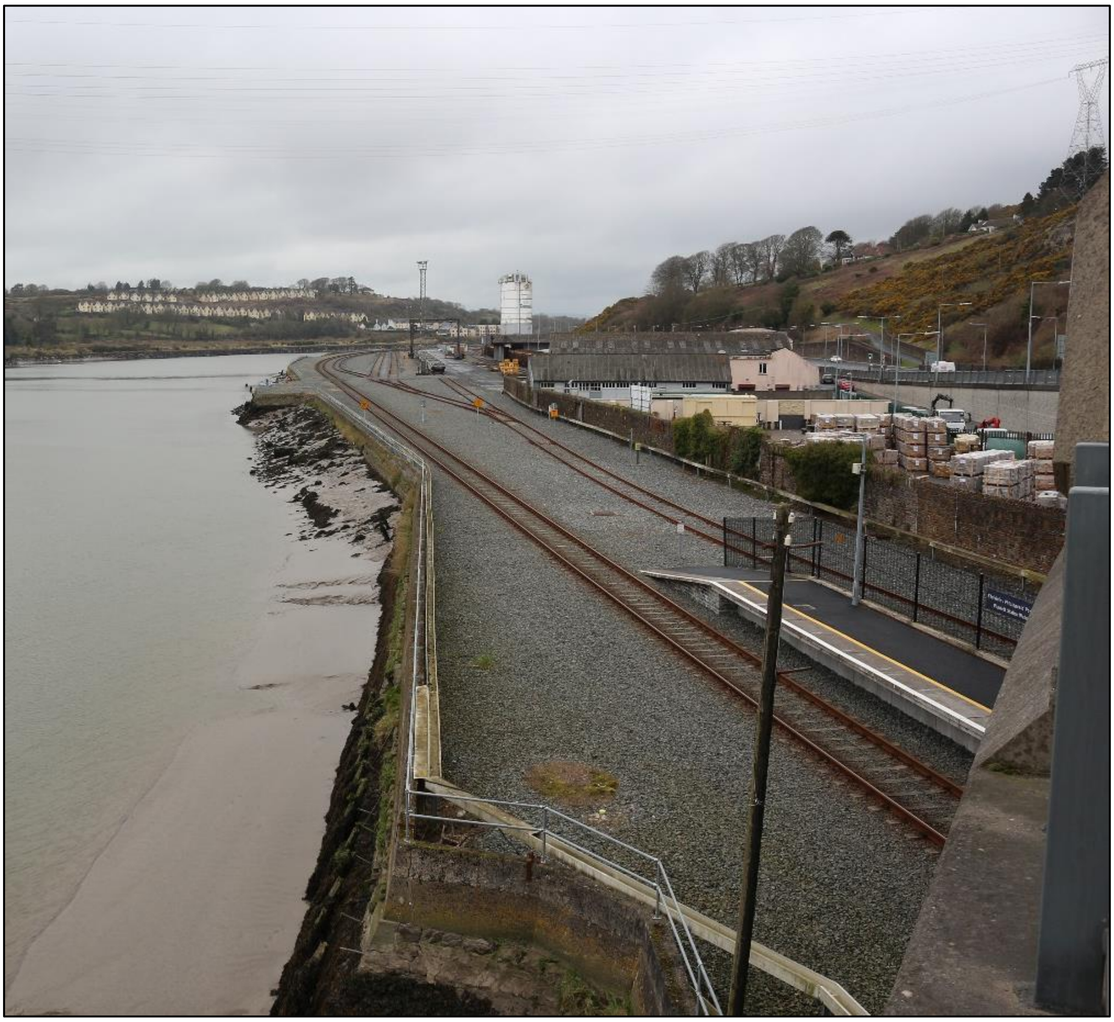


Plate 8.1 View of a receiving environment. Photo taken by G-NET 3D in March, 2021

The historical maps show that up to 1850s, the land use of the area was a mix of disused and agricultural land. The site of the current Plunkett Station was residential. The shoreline at the time was similar to the current quay wall alignment, although in some areas the northern bank of the river was set back up to 10m from its current position. With the introduction of rail infrastructure in the second half of 19th century, the land use within the site of proposed development was changed into railway. The current quay wall alignment was set by fortifying the existing shoreline and extending up to 10m into the river in some areas by filling the area with Made Ground. During 20th century, the landing stages built in the mudflats were gradually demolished. The latest major changes to the site were made in the 1990s at the eastern end of the proposed development, when the road infrastructure in front of Plunkett Station was upgraded, including the construction of Terminus Street bridge and Rice Bridge roundabout.

No Geological Heritage sites are present within or in vicinity of the study area.

8.3.2 Topography

The area is flat, with elevations typically ranging between +2.1 mOD in vicinity of the Plunkett station and +3.9 mOD at the western end of the proposed development. The terrain generally falls very gently from west to east but contains some local undulations. The highest point of mudflats in front of the existing quay wall ranges between -1.00 mOD and +0.5 mOD. To the north of the railway lines and the R448, outside the site extents, the topography rises very steeply along the Mount Misery hill.

8.3.3 Bedrock Geology

The bedrock geology was inferred from the GSI's Bedrock Geology maps and confirmed by visually observing the outcrops in the vicinity of the proposed development by means of a site visit.

From the eastern end, approximately two thirds of the proposed development area is underlain by laminated green to grey slates and shales, interbedded with green or pale-grey siltstones and occasional andesitic flows and tuffs of the Ballylane Formation from the Ordovician period. A significant outcrop of this formation is visible immediately to the north of Plunkett Station, on the southern slope of Mount Misery hill. This slope has a history of slope instability (landslides and rockfalls). A Part VIII planning application was approved by WCCC in January 2019 to carry out remedial works to the slope, in order to reduce the risk of future landslides. The likelihood of significant impacts to the proposed development is as low as reasonably practicable (ALARP), as described in Chapter 18 Major Accidents and Disasters of this EIAR.

The bedrock was encountered at very shallow depths of between 1 and 3 m below ground level during ground investigation in front of (to the south of) Plunkett Station, in the area where an impermeable trench is proposed. West of R448 Terminus Street bridge the depth to bedrock is significantly deeper (typically larger than 10m), as the area is at a further distance from Mount Misery hill.

From the western end, the extents of the remaining area of the proposed development (from approximately Ch.920 westwards) are underlain by the red and brown conglomerates and sandstones of Carrigmaclea Formation from Upper Devonian period, sitting unconformably over the Ballylane formation (see Figure 8.1 in Volume 3 of this EIAR). The Carrigmaclea Formation outcrop is visible north of R448 where rock benching works are visible. The depth to bedrock in the western third of the area is larger than 10m below ground level.

8.3.4 Quaternary Sediments

At the eastern end of the proposed development, to the south of the Plunkett Station and below its ancillary car parks, the quaternary sediments typically consist of dense granular Made Ground (gravels and cobbles) on top of shallow siltstone/shale bedrock.

From the Terminus Street bridge to the western end of the proposed development, the ground model is relatively homogenous, consisting of three major layers as described in Table 8.1 below. The table refers to the ground profile along the cess, between the existing masonry wall and the nearest rail tracks.

Table 8.1 Quaternary sediments summary profile from Ch.370 to Ch.1090

Soil Layer	Thickness	Description
Made Ground	1.0 – 6.2 m	Heterogenous non-engineered fill placed to extend the shoreline, level the topography and provide backfill to quay wall and foundation to rail tracks. Typically described as silty sandy GRAVEL with cobbles. Permeable, groundwater described as tidal-responsive. Thickness typically decreasing east to west.
Alluvium	5 - 15 m	Soft to very soft sandy slightly gravelly SILT, occasionally organic in upper layers. Isolated pockets of PEAT present locally. Occasional granular alluvium lenses – described as loose silty sandy GRAVEL.
Glacial overburden	1 – 5 m	Typically medium dense to dense SAND and GRAVEL overlying weathered bedrock.
Bedrock	n/a	Ballylane Formation and Carrigmaclea Formation - see description in section above.

Figure 8.1 shows a geological long section taken from the Geotechnical Interpretative Report (IGSL, 2020) which supports and illustrates the typical sediment profile outlined in Table 8.1 above. For reference, the area in the long section relates to approximate chainages Ch.1450 on the left moving towards Ch.380 on the right (see Figures 4.2 – 4.6 in Volume 3 for chainage references).

The thickness of the layers in Table 8.1 above decrease and the rockhead level increases, as you travel north throughout the site, perpendicularly to the quay wall.

To the south of (in front of) the quay wall in the mudflats and the riverbed, the ground layer descriptions are similar to those outlined in Table 8.1, except that no Made Ground is present. The thickness of alluvium varies within the mudflats and the riverbed, while the rockhead level continues to fall as you approach the centreline of the river.

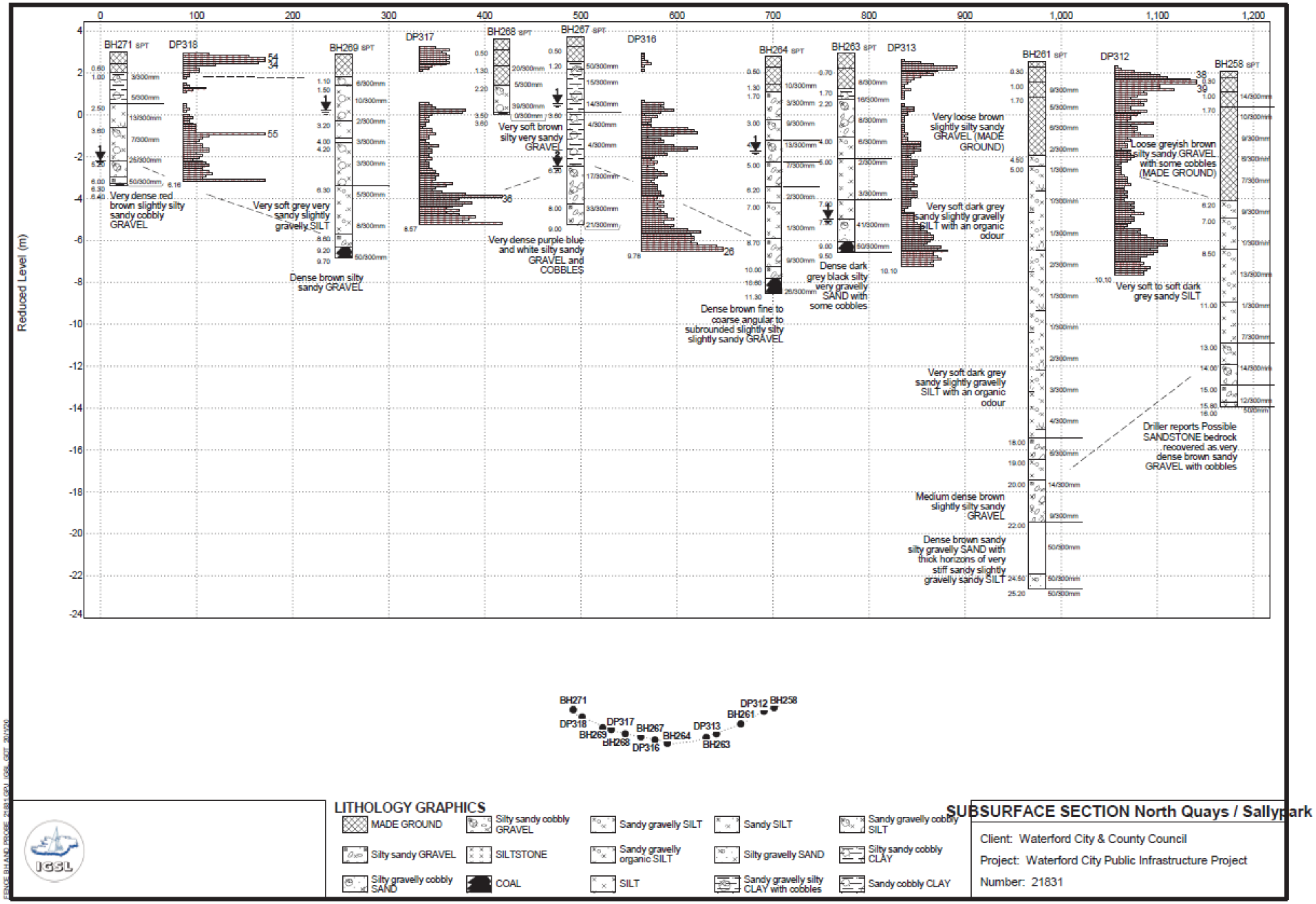


Figure 8.1 Geological long section at Sallypark Industrial Site (taken from IGSL, 2020)

8.3.5 Contaminated Soil

Waste Classification and Waste Acceptance Criteria (WAC) analysis were carried out on 36 samples from across the proposed development area. WAC is undertaken on samples for the purpose of determining which landfill can receive the generated waste. The samples are tested for an array of geochemical determinants and the results compared to established limits, typically classifying samples as inert, exceeding inert and hazardous.

All samples were classified as non-hazardous. Traces of asbestos were detected in a single sample, but the sample is classified as non-hazardous as the level detected was <0.001%. This sample was taken at one of the historical landing stages at Ch.570, see Figures 4.1 to 4.5 in Volume 3 for chainage references.

Half of the samples (18 out of 36) meet the inert WAC. Such material is suitable for recovery at a licensed/permitted soils recovery facility, or disposal to an inert waste licensed landfill. Twelve samples meet the inert WAC with increased limits. Such material is suitable for disposal at an inert landfill with increased limits. Five samples exceed the threshold of inert WAC with increased limits. Such material is suitable for disposal to a non-hazardous waste landfill. A single sample containing asbestos also exceeded inert WAC with increased limits, and as such, the material must be sent for disposal outside of Ireland to a facility licenced to accept such material. These materials will all be subject to review and approval of the facility operator.

The determinants that exceeded inert WAC were chloride, sulphate, total dissolved solids (TDS), antimony, mercury, fluoride and Total Organic Carbon (TOC).

No environmental samples were taken in front of the Plunkett Station and the adjacent car parks, where shallow bedrock was encountered. Due to the traffic usage of the area, there is a potential for elevated levels of contaminants in the ground, particularly hydrocarbons. Contamination testing during works in that area are planned and are described in subsequent sections.

8.4 Description of Potential Impacts

8.4.1 Construction Phase

8.4.1.1 Structural elements

A large extent of the flood defence measures proposed comprise driven steel sheet piles. These linear driven elements, with very slim thickness (up to 20mm) will not require pre-boring, excavation or preparation of in situ ground, and as such, the impact from sheet piling to soils and geology will be neutral. The selected installation method (vibration rather than impact driving) and the designed offset from the existing quay wall will ensure there is no impact to stability of soils.

8.4.1.2 Imported Fill

Where sheet piles will be driven on the river side of the existing quay wall, a gap between the quay wall and sheet piles, typically 1m wide from the face of the quay wall to the back of the sheet pile wall, will be infilled with imported clean granular fill to the existing ground level. Approximately 2,000m^3 of fill will be placed over a length of 540m of sheet pile wall. It is noted that a quantity of non-engineered fill already exists in this 1m wide strip of mudflats, emanating from collapsing quay wall blocks and similar. Additionally, approximately 2,500m^3 of imported selected granular fill will be imported for drainage trench material, for the drainage system being built between the existing quay wall and the rail tracks. The importation of fill will result in a likely *negative, non-significant* and *permanent* impact.

Up to 350 m^3 of concrete will need to be imported and placed for filling the impermeable trench. Approximately 50 m^3 of in-situ concrete will be required for raising of existing quay wall. A further approx. 70m^3 fill of concrete surround for pump chambers of the pumping stations will be required.

8.4.1.3 Excavations and Disposal of Material

Approximately 2,600m^3 of shallow made ground will be excavated for the purpose of installing the drainage system and pumping stations. To minimise the disposal impacts, approximately half of the excavated made ground will be reused elsewhere on site, typically to level the cess areas behind landside sheet pile wall and the existing quay wall where the ground is falling steeply, or local depressions exist. The receiving ground is of the same composition to the one being deposited. The other half of the excavated material (approx. 1,300m^3) will be disposed of in a suitable licensed facility, in accordance with current regulations.

Approximately 650 m^3 of construction and demolition waste will be generated during the demolition of the handrails and the upper portion of the existing quay wall, with the additional 70 m^3 generated during the removal of a 25m section of the wall to facilitate the construction of pumping station. All of this waste will be considered waste for disposal off-site. The waste will be disposed of in licensed landfills that will receive inert WAC and material exceeding inert WAC.

This will result in *negative, imperceptible* and *permanent* impact.

8.4.1.4 Impermeable trench

A maximum volume of 350m^3 material will be excavated during the construction of the impermeable trenches. The excavated material will be tested to determine the contaminant level and disposed of in a suitably licensed facility according to current regulations. The trench will be infilled with the same quantity of lean mix concrete or similar grout. This new material will have lower permeability than the original excavated material. At specific locations, where trenching would prove to be technically challenging, particularly at the area below the Terminus Street viaduct, the trench will be replaced with low pressure (permeation) grouting behind the existing wall. The grout will be carefully designed and placed to avoid seepage into the River Suir. The characteristics of the ground will change, as the strength will be increased and permeability decreased. The overall trenching operation will result in *negative, imperceptible* and *permanent* impact to soils and geology.

8.4.1.5 Organic matter, erosion, compaction and sealing

Very small quantities of organic matter were encountered in the proposed development area, mainly in small traces in organic silt layer and in the isolated minor peat lenses. These ground layers are typically found at depth of more than 3 m below ground level. They will not be subject to excavation and thus will not be impacted by the proposed development.

Current pathway for erosion includes the waterborne erosion of fine and coarse particles from behind the existing quay wall towards the River Suir. This will be prevented in operational phase by the new sheet pile wall. The impact of the proposed development on erosion is *positive, slight and permanent*. More details are included in section 8.4.2 Operation Phase. The proposed development will have no significant impact to current levels of mudflat erosion, scour and deposition as detailed in the Hydraulic Modelling Report (see, Appendix 10.2 of this EIAR).

The proposed development does not include embankments, or load bearing structures, that would induce the compaction of in-situ material. Furthermore, there will be no compaction of ground from construction machinery as the site boundary primarily contains existing road network and the railway corridor with minimal exposed ground.

It is proposed to infill the area between the existing quay wall and the new riverside sheet pile wall comprising a narrow stretch of ground (up to 1m) over approx. 540m. As the infill material is granular in nature, it will allow continued percolation of surface water into the ground.

Overall, there will be no significant impact related to compaction and sealing from the proposed development.

8.4.1.6 Spillages of Fuel, Oil, Solvents and Paints

Unmitigated, there is a potential risk of localised contamination from construction materials leeching into the underlying soils by exposure, dewatering or construction related spillages resulting in a permanent negative impact on the soils. In the case of soils, the impact is *negative* and *slight* as the requirement of good construction practices will necessitate the immediate excavation/remediation of any such spillage resulting in a very low risk of pollution to the soils and consequently the underlying aquifers.

There is a potential risk of localised contamination of groundwater bodies due to construction activities i.e., construction spillages, leaks from construction plant and material etc. resulting in a *temporary, negative* impact on these water bodies.

8.4.2 Operation Phase

The proposed sheet pile walls will also function as a retaining wall by creating a cut-off for unwanted materials entering the River Suir. These materials include sediment-laden flood and tidal waters receding into the River Suir over or through the existing quay wall which is in poor condition, as well as potential contaminants from the railway yards. The backfilled sheet pile wall will also prevent further fouling of the mudflats and riverbed from the collapsed blocks and parts of the existing quay wall. This will constitute a *positive, slight* and *permanent* impact.

8.5 Mitigation & Monitoring Measures

8.5.1 Mitigation by Design

The construction works will be carried out with the least feasible disturbance of soils. The main flood defence elements, sheet pile wall and remedial works to the existing quay wall, directly avoid any requirement for excavation of in-situ ground and creation of waste.

The quantity of imported backfill for the gap between the sheet piles and the existing quay wall (where sheet piles are installed on the riverside), is minimised by design, as the alignment of the sheet pile wall was carefully selected as close as possible to the existing wall without compromising wall stability. Sheet piles were designed to be constructed on the landside of the existing wall wherever the width of cess allowed for safe day-time works without impact to rail operations, thus further minimising the backfill quantity.

The amount of waste from the excavations required for constructing the drainage system is minimised by reusing approximately a half of this material as a non-structural fill to even out the ground level across the site, wherever possible.

The potential impacts (ground displacement/settlement) on the Dublin to Waterford railway line have been mitigated by design, whereby the works are designed at a sufficient distance from the line, and are such that no temporary or permanent excavation in immediate proximity to the rail line is required, with the exception of shallow trenching for the construction of the drainage system. The potential impacts to the mudflats and riverbed from further deterioration of the existing masonry quay wall are also mitigated by design through the construction of the sheet pile wall and backfill in front of the quay wall at the most critical locations.

8.5.2 Specific Mitigation Measures

The construction works will be carried out with the least feasible disturbance of the soils, minimising the amount of excavated soil with the inert excavated soil will be re-used on site insofar as possible.

Approximately 1,650m^3 of excavated ground material will be exported from the site. In addition to this, approximately 720 m^3 of construction and demolition waste will be generated during the demolition of the handrails and the upper parts of the existing quay wall which will be exported from site. The quantity is very small given the scale of the project, and will be disposed of by the Contractor who will ensure that all subsurface materials excavated during the construction phase of the proposed development are managed in accordance with the relevant waste management legislation. The successful Contractor will ensure that all subsurface materials are removed from the site and sent to authorised waste management facilities (i.e. which hold all relevant, valid permits / licences) which accept the corresponding types of waste. The contractor will be required to submit a Construction and Demolition Waste Management Plan (CDWMP) to the local authority for approval, which should address all types of material to be disposed of. The contractor will undertake the environmental testing of the material to be disposed of in order to determine the waste acceptability characteristics.

All imported material will be sourced from the nearest possible locations. A number of suitable active quarries with all necessary statutory consents exist across County Waterford and southwest County Wexford, such as Oaklands Quarry in Ballykelly, New Ross, Co. Wexford and Cappagh Quarry in Cappagh, Dungarvan, Co. Waterford. Both quarries are accessible from the N25 which links to the site of proposed development via the R448 Terminus Street.

A project-specific Construction Environmental Operating Plan (CEMP) will be prepared for the development by the Contractor for approval by WCCC. It will be maintained by the Contractor for the duration of the construction phase. The CEMP will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the site will be trained in the implementation of the procedures. As a minimum, the CEMP for the proposed development will be formulated in consideration of the standard best practice. The CEMP will include a range of site-specific measures which include:

- Safety measures for working from barges in-river, including but not limited to risk of pollutants from the machinery stationed on the barge and operating with bulk materials such as backfill gravel on the barge;
- Runoff will be controlled and treated to minimise impacts to groundwater and River Suir.

- Temporary storage of any contaminated material on-site shall be carefully managed so as to limit any risk of contaminated surface water runoff leaving the site or infiltrating to groundwater. Runoff from the material shall be directed to a lined pond or temporary sewer/tank and the water shall be disposed of off-site for treatment at an appropriate licenced facility in accordance with the relevant waste management legislation. Alternatively, the material shall be covered while stored to remove the risk of surface water contamination.
- All hazardous materials will be stored within secondary containment, designed to retain at least 110% of the storage contents. Temporary bunds for oil/diesel storage tanks will be used on the site during the construction phase.
- The successful Contractor will ensure that spill kits and hydrocarbon absorbent packs are stored in the site compound, and that operators will be fully trained in the use of this equipment.
- The successful Contractor will ensure that silt and sediment barriers are installed (and maintained in proper working order) at the perimeter of earthworks areas to limit transport of erodible soils to watercourses.
- Where soils are being excavated and removed from site, the successful Contractor will ensure that dust generation will be avoided, by damping down material during excavation and loading onto trucks for off-site removal, if necessary.
- Safe materials handling of all potentially hazardous materials will be emphasised to all construction personnel employed during construction, including the usage of appropriate PPE.
- The successful Contractor will prepare an Incident Response Plan (IRP) which outlines measures to be implemented to prevent and address spillages of hazardous substances.

8.6 Residual Impacts

Residual impacts to soil and geology include the permanent addition of backfill material (clean imported granular TII Specification for Road Works Series 600 Class 6 material) between the sheet pile wall and existing quay wall. Residual impacts will be *negative, non-significant and permanent* as a result of covering the soft silts in the mudflats. In addition, residual impacts will be *positive, slight and permanent* as a result of preventing the uncontrolled debris from further quay wall deterioration from reaching and fouling the mudflats.

8.7 Difficulties Encountered

No difficulties were encountered in the preparation of this Chapter. The ground investigation data, Geotechnical Factual Report, Geotechnical Interpretative Report and Waste Characterisation report, as well as proposed development description, were of sufficient quality to enable the assessment of impacts.

Additionally, three standpipes with dataloggers have just been installed in September 2021 in the area surrounding Plunkett Station and will provide more refined groundwater data that will inform the detailed design of impermeable trench. The results may suggest the omission of the part of the proposed extent of the trench outlined in this EIAR and shown in Figures 4.1 to 4.5 in Volume 3 and will not result in enlarging of the extent of trench.

8.8 References

IGSL (2019) Geotechnical Factual Report, Waterford City Public Infrastructure Project Ground Investigation, project no. 21831

IGSL (2020) Geotechnical Interpretative Report, Waterford City Public Infrastructure Project Ground Investigation, project no. 21831

O'Callaghan Moran & Associates (2020) Waste Characterisation Assessment, North Quay Waterford – Railway

GSI maps: www.gsi.ie/mapping, accessed 01/03/2021

GeoHive historical mapping: http://map.geohive.ie/, accessed 01/03/2021

Chapter 9
Hydrogeology

Chapter 9 Hydrogeology

9.1 Introduction

This chapter considers and assesses the likely significant effects with regard to Hydrogeology associated with both the construction and operational phases of the proposed Flood Defences West, hereafter referred to as the 'proposed development'. The chapter initially sets out the methodology used (Section 9.2), describes the existing hydrogeological environment (Section 9.3), examines the predicted impacts of the proposed development (Section 9.4), describes measures to mitigate identified significant effects (Section 9.5), and details the residual impacts (Section 9.6).

9.2 Methodology

This chapter has been prepared having regard to the Environmental Impact Assessment (EIA) Directive 2014/52/EU and the following guidelines:

- Institute of Geologists of Ireland (IGI) (2013) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- Environmental Protection Agency (EPA 2015) Draft Advice Notes for Preparing Environmental Impact Statements; and
- Environmental Protection Agency (EPA 2017) Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports.

9.2.1 Study Area

The range criteria for assessing the importance of hydrogeological features within the study area (site boundary + 250m) and the criteria for quantifying the magnitude of impacts follow the TII guidelines and the EPA (2017) Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports.

9.2.2 Desk Study

A desk study of the study area of the proposed development was carried out in order to establish baseline conditions. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the area. This included consultation with the following sources of information:

- Geologic maps, Geologic Survey of Ireland (GSI) (www.gsi.ie);
- Teagasc Subsoils Map (gis.epa.ie/Envision);
- Water Features, Rivers, and Streams, EPA (gis.epa.ie/Envision);
- Geological Survey of Ireland – Groundwater Body Characterisation Reports;
- Department of Environmental, Community, and Local Government on-line mapping viewer (www.myplan.ie);
- Protected areas, Biodiversity Ireland (maps.biodiversityireland.ie);
- Historic Maps from Ordnance Survey of Ireland (www.osi.ie);
- Aerial Photography from the Ordnance Survey of Ireland (www.geohive.ie).

9.2.3 Site Investigations

Ground investigations specific to the proposed development were commissioned by ROD and carried out by IGSL Ltd. in Q2 and Q3 of 2019 and included the collection of 36 samples comprised of:

- 15 no. cable percussion boreholes;
- 2 no. rotary core boreholes;
- 4 no. trial pits;
- 10 no. dynamic probes, two of which included window sampling;
- 5 no. groundwater monitoring standpipes, one of which included a water level datalogger; and

A suite of laboratory testing; including environmental/contamination tests.

The following ground investigation reports have been prepared in respect of the GI investigations and have been consulted in the preparation of hydrogeology impact assessment:

- IGSL (2019): Geotechnical Factual Report, Waterford City Public Infrastructure Project Ground Investigation.
- IGSL (2020): Geotechnical Interpretative Report, Waterford City Public Infrastructure Project Ground Investigation.
- O'Callaghan Moran & Associates (2020): Waste Characterisation Assessment, North Quays Waterford Port.

9.3 Description of Receiving Environment

9.3.1 Soils & Subsoils

Teagasc Mapping

The Teagasc soil mapping identifies Made Ground for the area surrounding and within in the study area. It is likely that the river is underlain by Alluvium and that the made ground on the north bank is underlain/mixed with Alluvium material. The parent material is listed as non-calcareous bedrock at surface within the lithosols and regosols soil group. These soils tend to be shallow, well drained mainly acidic minerals in the area.

9.3.2 Bedrock Geology

GSI Mapping

The bedrock geology of the surrounding area is complex, characterised by a faulted sequence of sediments and volcanics. The study area is predominantly underlain by green, green grey and grey slaty mudstones and green or pale grey siltstones of the Ballylane Formation. A single fault line is recorded running from the northwest to southeast across the study area. It is likely that the historic faulting in the vicinity of the site has either extended existing fracturing and/or has created additional fractures in the rock.

Geotechnical Investigations (GI)

The ground investigations and reports outlined in section 9.2.3 have been consulted in the preparation of this EIAR.

Ground Investigations (GI) samples have been taken from areas to the west of Terminus Street Bridge to the westernmost section of the study area (between Ch.360 and Ch.1500, see Figure 4.1 in Volume 3 of this EIAR for chainage reference points). The findings of the GI are detailed in Chapter 8 Soils and Geology of this EIAR. In general, the subsoils found within the study area consisted of made ground typically found within the top 1 to 6.2m of the soils which consisted of a mixture of railway ballast, various granular, stone or cohesive fill, concrete and heterogenous waste. The made ground was underlain by silt which were typified by cohesive alluvial fines followed by a thin layer of organics and peat with an underlying layers of sandy gravelly silt to sandy gravel from cohesive glacial tills. The tills were underlain with weathered bedrock that was dense sand or gravel and cobbles.

Monitoring of groundwater levels at Plunkett Station

A Water level logger was installed in borehole (BH302) by IGSL in late 2019 to provide an insight as to whether this area was also susceptible to underground flooding from tidal ingress. Ground water level readings from this date are being provided by IGSL in regular intervals, with the last data batch received on the 22nd December 2020.

The borehole record for BH302 indicates bedrock very close to ground level, typically 1m to 3m below ground level (with potential local minima of 3m below ground level as suggested in some less detailed logs) with a relatively thin layer of granular overburden and made ground below existing pavement.

These findings are positive from a flood protection perspective, as bedrock is typically seen as a low permeability medium, except in localised zones where it is very weathered. As a comparison, the thicknesses of the granular overburden at the Flood Defence East and West locations which needed flood cut-off protection exceed 7m locally, with bedrock sometimes found over 15m below ground level.

A piezometer (with datalogger) was installed in BH 302 with a response zone in the granular overburden material in order to track the change of groundwater levels in this material. A groundwater level observation graph was produced using the datalogger readings. This graph was superimposed onto a graph of the River Suir levels for the same period to investigate if there was a correlation between the datasets. Based on the finding produced from the available datasets it would appear that:

i. The tidal fluctuations in the River Suir during the normal conditions (high tide up to 2.0m OD) have a near-negligible impact on the groundwater levels in BH302, which seem stable at around +1.00m OD.
ii. Tidal maxima during high water (above 2.0m OD) induces the rise in BH302 to the level of approximately 0.9-1.0m below the tidal maxima. The maximum reading in BH302 also lags behind the tidal maximum by approximately 3 hours.

9.3.3 Ground Contamination

As part of the intrusive ground investigations undertaken previously at the site, samples of the made ground (sample depths between 0.5 – 7m below ground level) were taken via the sources described in section 9.2.3, as part of the investigations by IGSL and were tested by ChemTest Laboratories, accredited Laboratory facility. Details of these ground investigations are outlined in Chapter 08.
The main findings from the soil analysis were as follows:

- All of the soil samples are classified as non-hazardous
- The pH of the soil samples ranged between 8.2 – 9.4;
- Elevated levels of Sulphate were noted in only one soil sample;

- Elevated levels of Chloride were noted in 6 of 15 soil samples
- Elevated levels of Total Organic Carbon (TOC) where recorded in 5 of the 15 soil samples above the hazardous Waste Acceptance Criteria (WAC).

No ground investigations were carried out within the car parking area(s) of Plunkett Station at this time however, as addressed in Chapter 8 Soils and Geology, soil sampling will be carried out to categorise the excavated material within the shallow impermeable trenches as per Waste Assessment Criteria (WAC) to ensure that the material is properly disposed of.

9.3.4 Groundwater Bodies and Bedrock Aquifers

Groundwater is defined as water, which is stored in, or moves through, the cracks and pores of geologic formations of soils, rocks, and sand. The potential of rocks to transport and store water underground is highly dependent on the degree of permeability: the more permeable the rock, the greater the water transport ability. Sections 9.3.3.1 to 9.3.3.5 below provide a description of the groundwater features identified within the study area of the proposed development.

Groundwater monitoring was conducted with the installation of two (2) boreholes (BH301 and BH302) in late 2019 as part of the investigation for the proposed flood measures in front of Plunkett Station (IGSL, 2019) to determine if the area was susceptible to underground flooding from tidal ingress. Piezometers were installed in each of the boreholes to monitor groundwater levels using dataloggers with data recorded at regular intervals from May 2020 to December 2020. Data from the boreholes indicated that bedrock was within 1m to 3m below ground level (bgl) which would be indicative of a positive flood protection with the exception of localised areas where it is weathered and would provide groundwater flow pathways. Normal tidal influences (below 2.0 m OD) were found to have a near negligible impact on groundwater levels while tidal maxima at high tides above 2.0m OD induced a rise in groundwater up to 1.0m with a lag time of 3 hours behind high tide.

9.3.4.1 Aquifer Classification

The River Suir forms a groundwater divide which divides groundwater bodies connectivity in terms of flow and productivity. Between Chainage Ch.0.000 to Ch.950 of the proposed development (see Figure 4.1 in Volume 3 of this EIAR for chainage references), the bedrock underlying the study area is categorised as a Poor Aquifer (Pl) - bedrock which is generally unproductive except for local zones. The remaining portion of the study area, between Ch.950 and Ch.1500 falls within an area categorised as a Locally Important Aquifer (LI) in which the bedrock is moderately productive only in local zones. The bedrock aquifer classifications for the study area were found using the Geological Survey Ireland (GSI) mapper website.

9.3.4.2 Groundwater Quality

The Mullinavat Groundwater body (GWB) (European Code IE_SE_G_149) is located within the north quays area of Waterford City and encompasses the study area of the proposed development in its entirety. The Waterford GWB (European Code IE_SE_G_155) contains areas within the south quays of the city stretching between Rice Bridge and the Waterford Distillery. Under Water Framework Directive (WFD), both the Waterford and Mullinavat GWBs were classified as having an overall good status for water quality and quantity for the 2013-2018 assessment period. The Mullinavat GWB is described as “Not at Risk” of not achieving at least good ecological or good chemical status/potential. The objective for Waterford City GWB is currently under review with regard to risk status.

9.3.4.3 Groundwater Vulnerability

The Geological Survey of Ireland (GSI) uses a matrix comprising four groundwater vulnerability categories to classify aquifer vulnerability. These categories are extreme (E), high (H), moderate (M) and low (L). The categories are based on the thickness of overburden which provides some reduction for contaminants migrating toward the groundwater table from the surface or near sub-surface. The 'Extreme' vulnerability classification is defined as overburden depths of less than 3m. A subset of the 'extreme' category termed 'Extreme with bedrock outcrop/subcrop' (X), relates to areas of bedrock outcrop or sub-crop of less than 1m, or within 30m of a location of point recharge i.e., a karst feature.

Groundwater vulnerability within the study area (see Figure 9.2 in Volume 3 of this EIAR) ranges from moderate to extreme vulnerability to pollution at the ground surface. This signifies that the subsoil cover along the northern banks of the River Suir forms a thin layer (generally <5m) of low to moderate permeability subsoil or made ground. A section of the proposed drainage works at located Plunkett Station is within the (X) groundwater vulnerability category. Table 9.1 below identifies the groundwater vulnerability of areas where the proposed development requires underground works such as excavation and piling.

Table 9.1 Groundwater Vulnerability Within Study Area

Proposed Works	Groundwater Vulnerability Rating
Underground Impermeable Trench	Extreme (E)
Sheet Pile Installation (Riverside)	High (H)
Sheet Pile Installation (Landside)	High (H)
Drainage	High (H) to Extreme (X)

Groundwater Recharge

Groundwater recharge differs throughout the study area. Between Ch.0.50 and Ch.950 (see Figure 4.1 in Volume 3 of this EIAR for chainage references), the average groundwater recharge rate is 100 mm/year. This area of proposed development consists of Made Ground within the PI Bedrock Aquifer zone. The average groundwater recharge rate is 126 mm/year for the remaining section of the study area between Ch.950 and Ch.1100 due to the presence of Made Ground in the subsoil.

9.3.4.4 Groundwater Abstractions

There are no recorded public groundwater supplies or public water schemes located within the study area. Within the exception of two boreholes located on the south bank of River Suir, approx. 750m to 1km west of the study area, no other abstraction areas have been identified within 1.5km of the study area. The two (2) boreholes are listed as 2311SEW014 and 2311SEW017, both of which had been installed in June 1968. According to the GSI records, both boreholes are categorised as poor yield classes with yields below 40m^3/day. The 2311SEW014 abstraction area was listed for domestic use only while the 2311SEW017 is listed for industrial use and are for private use.

9.3.4.5 Site Hydrogeology

Given the proximity to the river and the topographical orientation towards the Suir valley, discharge from the Mullinavant GWB will be to the River Suir. Groundwater flow paths in the area north of the river will be very short due to the bedrock generally being poorly permeable with the exception of fracture zones. Flow paths to the south may be longer however, as the proximity to the river is the dominant flow control.

9.3.5 Groundwater Dependant Terrestrial Ecosystems (GWDTE) /Special Areas of Conservation (SAC)

The hydrogeological sensitivity of European Sites which form part of the Natura 2000 Network were assessed with regard to the proposed development. The Lower River Suir Special Area of Conservation (SAC) (site code 002137) is the only European site located within the study area of the proposed development (see Chapter 7 Biodiversity for a detailed assessment of all European sites). This SAC consists of the freshwater stretches of the River Suir immediately south of Thurles, the tidal stretches as far as the confluence with the Barrow/Nore immediately east of Cheekpoint in Co. Waterford. The Suir and its tributaries flow through the counties of Tipperary, Kilkenny and Waterford.

There are no GWDTE present within the vicinity of the site.

9.3.6 Summary of Hydrogeological Features

The main features of importance identified at the site and in the study area are summarised in Table 9.1.

Table 9.2 Features of Importance

Feature	Importance	Criteria / Justification
Bedrock aquifer classified by the GSI as a Poorly Productive Aquifer which is productive only in local zones (Pl)	Low	A poorly productive aquifer is considered to be of low value on a local scale.
Bedrock aquifer classified by the GSI as a Locally Important aquifer which is moderately productive in local zones	High	A regionally important aquifer is considered to have a high quality or value on a regional scale
Lower River Suir SAC	High	European Site forming part of the Natura 2000 network*

* The River Suir is a hydrological feature of importance. The IGI guidance does not designate importance ranking to hydrological features, however the Transport Infrastructure Ireland (TII) (Guidelines for Hydrology for National Road Schemes, TII 2019) guidance states that if groundwater supports a river or surface water body ecosystem protected by EU legislation (e.g., Lower River Suir Special Area of Conservation (SAC)) that it should be considered an attribute of extremely high importance.

9.4 Description of Potential Impacts

This section describes the potential construction and operational impacts associated with the proposed development before mitigation measures are applied. Both direct and indirect impacts will be addressed for the construction and operation of the proposed development. The nature, extent and duration of the impacts will also be assessed.

The proposed development will involve the following activities that are being considered as part of the hydrogeology impact assessment:

- Excavation of made ground and soils to install a shallow impermeable trench from Ch.0.0 to Ch.360.

- The remediation of existing quay wall from Ch.285 to Ch.360 which includes the raising of the existing wall to meet the design level of 4.30mOD (Ordnance Datum).
- The installation of new steel sheet piles from Ch.360 to Ch.1090. The sheet piles will be installed from riverside (Ch.360 to Ch.900) and landside (Ch.900 to Ch.1090) c.1 metre in front and behind the existing quay wall respectively. The space between the front face of existing quay wall and the riverside sheet piles will be filled with Class 6 clean material.
- Upgrade works to the existing drainage system from Ch.0.0 to Ch.1090 and the provision of new drainage system consisting of 2 no. underground pumping stations and outfall structures.

See Figures 4.1 to Figure 4.20 in Volume 3 of this EIAR for chainage reference points.

9.4.1 Construction Phase

During the construction phase, the following activities may pose a potential impact on the hydrogeological regime:

- Excavation of Made Ground;
- Contamination of Soils; and
- Contamination of Groundwater.

The potential impacts pertaining to each of the aforementioned activities is detailed in the following sections.

Excavation of Made Ground

Excavation of made ground will be required for the construction of shallow underground impermeable trenches within the car park areas of Plunkett Station, and for the installation of two pumping stations within the Waterford to Dublin railway corridor. The excavated soil may be contaminated from leaks and spillage of fuels from road traffic within the car parking areas and from rail operations within the railway corridor.

The excavation of material is likely to have a *negative*, *imperceptible* and *permanent* impact on the soils environment due to the requirement to remove the material off-site and dispose or treat it in accordance with relevant legislation. However, any improvement to the quality of soils within the site of proposed development will have a corresponding benefit to the underlying groundwater resources due to the removal of a potential source of contamination for percolating water. Therefore, the overall likely impact of excavation activities on hydrogeology is *positive, slight* and *permanent*.

Contamination of Soils

There is the potential risk of localised soil contamination through leeching from construction plant and materials, spillages associated with construction activities, and dewatering within cofferdams. Best construction practices will be adhered to during construction phase and will minimise the risk of pollution to soils and consequently to the underlying aquifers. The potential impact is *negative, imperceptible* and *temporary*.

Should contaminated soils be encountered during the construction phase of the project their subsequent removal and disposal to an off-site licensed facility will be considered a *positive, slight to moderate* and *permanent* impact.

Contamination of Groundwater

Construction runoff from the site can pose a risk to groundwater due to potential infiltration of contaminated surface water to groundwater. The installation of sheet pile walls at depths to approximately 10m to 15m below ground surface (bgs) may provide a pathway to the shallow groundwater table from overlaying soils. There is a risk that the contaminants present in the made ground across the site may be brought to the surface during excavation works or driven down into underlying aquifer. The impact associated with driven piles is slight, as contaminated material will be dragged down into the underlying soil layers by shaft friction, however the displacement of these contaminants is not likely to be significant. The potential impact is *negative, slight* and *short-term*.

As sheet piles move through soils in order to reach their target depths, they may penetrate previously impervious soils that acted as a confining layer to contaminants, preventing their mobilization into the groundwater. This potential is considered slight negative effect on a localised area immediately surrounding the impacts due to the minimal amount of contaminants that could be transmitted to the underlying groundwater.

The Lower River Suir SAC is hydrologically linked to the proposed development as a section of the proposed flood defence measures is located within the mudflats of the SAC. Given that this SAC is predominantly a surface water system and is not sensitive in relation to groundwater flows, the main potential impact would relate to construction related contamination of the aquifer impacting the SAC water quality. The potential impact to the SAC water quality from construction related groundwater contamination would be *negative, imperceptible* and *temporary*.

9.4.2 Operation Phase

The potential for impacts during the operation phase have been assessed under the following headings:

- Groundwater Flow/Seepage;
- Contamination of Groundwater.

Groundwater Flow/Seepage

The steel sheet pile wall will be placed to a depth of up to 8.5m for landside and between 11 – 16m for the riverside sections and may act as barrier for natural groundwater flow towards the River Suir during low tide and may locally impact groundwater levels. While the groundwater seepage into the river at a local level may be restricted, it will be of minimal significance given that the majority of the outfall into the river is from precipitation and surface run-off from stormwater conveyance systems. Groundwater flow and seepage behind the proposed sheet pile wall will be redirected to the east and west behind the sheet pile wall. Any localised groundwater conduit flow will be managed by the upgraded trackside drainage. The potential effect of proposed development on groundwater flow is likely to be *negative, localised, imperceptible to slight,* and *permanent*.

During extreme weather events, the proposed sheet pile walls and the underground impermeable trench will reduce the risk of groundwater seepage into the rail infrastructure. The inclusion of filter drainage pipes along with the extension of existing stormwater pipes to the River Suir as part of the proposed development will help prevent backflow of the groundwater in the study area and help to mitigate flooding while only minimally impacting local hydrogeology. The significance of this impact is considered *positive, slight,* and *permanent*.

The sheet pile walls will also act as a barrier to saltwater intrusion into the groundwater within localised area along with stabilizing groundwater levels which are currently tidally influenced due to the direct connection with the River Suir. The sheet pile walls in this regard will have a *positive, slight* and *permanent* impact on groundwater seepage.

Contamination of Groundwater

During the operational phase, the area will be an urban environment covered in hard standing (sheet piles on the water edge with hard standing on the landward side of the piles). There are therefore no perceived activities which pose a risk of contamination to the hydrogeological features of importance during the operational phase of the proposed development.

9.5 Mitigation & Monitoring Measures

A project-specific Environmental Operating Plan (EOP) and a Construction Environmental Management Plan (OCEMP) have been prepared and appended to Chapter 4 of this EIAR (see Appendix 4.1 and 4.1A respectively). They will be maintained by the Contractor for the duration of the construction phase. The EOP will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the site will be trained in the implementation of the procedures. As a minimum, the EOP for the proposed development will be formulated in consideration of the standard best practice. The EOP will include a range of site - specific measures that include:

- The successful Contractor will ensure that spill kits and hydrocarbon absorbent packs are stored in the site compound, and that operators will be fully trained in the use of this equipment.
- Earthworks shall be carried out such that surfaces promote runoff and prevent ponding and flooding.
- Runoff will be controlled and treated to minimise impacts to surface and groundwater.
- Temporary pumping of groundwater, if required, shall be treated by means of a temporary sedimentation tanks prior to discharge
- All hazardous materials will be stored within secondary containment designed to retain at least 110% of the storage contents.
- Temporary bunds for oil/diesel storage tanks will be used on the site during the construction phase.
- Contaminated material will be disposed of off-site for treatment at an appropriate licensed facility in accordance with the relevant waste management legislation. Alternatively, the material shall be covered while stored to remove the risk of surface water contamination.
- Safe materials handling of all potentially hazardous materials will be emphasised to all construction personnel employed during construction.
- Mitigation measures during the construction phase will include implementing best practice during excavation works to avoid sediment entering the River Suir (refer to Chapter 10 'Hydrology' of this EIAR for details).

Operation Stage

There are no mitigation measures associated with the operation phase of the proposed development with regard to Hydrogeology.

9.6 Residual Impacts

9.6.1 Construction Phase

The incorporation of the mitigation measures outlined in Section 9.5 results in the magnitude of any impacts during construction to be considered as *negative, imperceptible* and *temporary*.

9.6.2 Operation Phase

As there are no mitigation measures for the operation phase of the proposed development, the residual impacts remain as per the potential impacts outlined in section 9.4.1.

9.7 Difficulties Encountered

There were no difficulties were encountered during the hydrogeological impact assessment.

9.8 References

GSI maps: www.gsi.ie/mapping, accessed 01/03/2021

GeoHive historical mapping: http://map.geohive.ie/, accessed 01/03/2021

TII (2020) Light Rail Environment - Technical Guidelines for Development
Ireland

EPA (2017) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports

Chapter 10
Hydrology

Chapter 10 Hydrology

10.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) presents the hydrological assessment of the proposed construction and operational phases of the Flood Defences West (hereafter referred to as the 'proposed development'). This chapter sets out the methodology used in the assessment (Section 10.2), details the likely significant impacts associated with the construction and operational phase of the proposed development (Section 10.4), describes measures to mitigate identified significant impacts (Section 10.5) and details residual impacts post mitigation (Section 10.6).

10.2 Methodology

10.2.1 Legislation and Guidelines

This chapter has been prepared having due regard to relevant legislation guidance documents which are listed below:

- Environmental Protection Agency (EPA 2002) Guidelines on the Information to be contained in Environmental Impact Statements;
- Environmental Protection Agency (EPA 2003) Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) ;
- Draft Guidelines on the Information to be contained in Environmental Protection Agency (EPA 2017) (referred to where appropriate);
- Environmental Protection Agency (EPA 2015) Draft Advice Notes for Preparing Environmental Impact Statements;
- Transport Infrastructure Ireland (TII 2009) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes; and
- Transport Infrastructure Ireland (TII 2008) Guidelines for the crossing of watercourses during the construction of National Road Schemes.
- DoEHLG (Nov 2009) The Planning System and Flood Risk Management – Guidelines for Planning Authorities;

10.2.2 Hydrology Assessment Methodology

The hydrological impact assessment methodology is in general agreement with the guidance outlined in Sections 5.6 and 5.7 of the TII 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, 2009'. The impact category, duration and nature of impact have been assessed in this chapter, as per the guidelines. The range of criteria for assessing the importance of hydrological features within the study area (site boundary + 250m) and the criteria for quantifying the magnitude of impacts follow the TII guidelines and the EPA (2017) Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports'.

The hydrological assessment includes a review of published literature available from various sources including a web-based search for relevant material. Site specific topographical information and aerial photography has been reviewed to locate any potential features of hydrological interest, and these have been investigated on the ground by a walkover survey undertaken on the 16th May 2018, in order to assess the significance of any likely environmental impacts on them.

Available topographical and hydrometric information (field and desk based) has been used to perform hydrological impact assessments of the proposed flood defences development. All watercourses and water bodies which could be affected directly (i.e., crossed or realigned/ diverted) or indirectly (i.e., generally those that lie within 250m of the proposed development) were assessed through previous site walkover visits followed up by a detailed desk study and hydrological assessment.

10.2.3 Hydrology Impact Assessment Methodology

Types of hydrological impact for the proposed development fall into two broad categories of quantitative and qualitative impacts.

Quantitative Impacts

Hydraulic structures such as flood defences, culverts, channel diversions and outfalls can, if not appropriately designed, impact negatively on upstream water levels and downstream flows. If the conveyance area of a river is significantly reduced it may impede flow during times of floods thus causing water levels within the vicinity of the structure to be raised above what would occur in the absence of the structure and potentially increase flooding of undefended lands.

Surface water drainage from the defended lands can potentially be cut off from discharging to the receiving water body, potentially increasing surface water/pluvial flooding in relatively frequent events.

Qualitative Impacts

The nature of the proposed development as a flood defence barrier on the banks of a watercourse poses an inherent risk of surface water contamination during the construction phase. Construction works has the potential to mobilise silts and sediments in the water column. Additionally, the proposed drainage network may convey contaminants to receiving waterbodies.

10.2.4 Field Surveys

Field surveys and walkover assessments were carried out to assess the hydrological impacts of the proposed development. A detailed bathometric survey recording bed level to Malin OD (including floodplain topographical surveys, where required) were made in February 2021 at areas where hydrological impacts were likely to occur.

10.2.5 Desk Study

A desk study was completed in order to obtain information on the receiving hydrological environment using the following sources:

- Geological Survey of Ireland (GSI) – Bedrock Geology;
- Teagasc – Subsoil Map;
- Aerial Photography;
- Environmental Protection Agency (EPA) Surface Water Quality;
- EPA Viewer WFD Scores for Rivers, Transitional Water Bodies and Coastal Waters;
- OPW (Office of Public Works) Preliminary Flood Risk Assessment Mapping (pFRA);

- OPW Catchment Flood Risk Assessment and Management Mapping (CFRAMs);
- Floodmaps web mapping;
- Waterford North Quays SDZ Flood Risk Assessment 2018; and
- Geological Survey of Ireland (GSI) Web Mapping

10.3 Description of Receiving Environment

10.3.1 Regional Overview of Hydrology

The proposed development is located on the northern bank of the River Suir in Waterford City and is bound to the north by the Iarnród Éireann rail yards and R448 regional road. Plunkett Station is bounded to the north by a steep rock slope which is subject to rock stabilisation works as part of the overall Waterford City Public Infrastructure Project.

The headwaters of the Suir are located on the eastern slopes of Benduff, North West of Templemore in Co. Tipperary. The Suir becomes tidal just before reaching Carrick-on-Suir and is joined by a number of rivers between this point and Waterford city including the Lingaun, Portlaw Clodiagh, Pil, and Kilmacow Blackwater. It then makes its way to the confluence with the Nore and Barrow Rivers, downstream and east of Waterford City. The Suir estuary then turns south, flowing out to sea through Waterford Harbour between Dunmore East and Hook Head.

The River Suir is tidal at the location of the proposed development. Surface water features located in the vicinity of the proposed development are entirely within the South Eastern River Basin District. The proposed development is located within Hydrometric Area No.16 (Suir). This catchment includes the area drained by the River Suir and all streams entering tidal water between Drumdowney and Cheekpoint, Co. Waterford, draining a total area of 3,542km^2. The largest urban centre in the catchment is Waterford City.

10.3.2 Existing Drainage

The lands directly adjacent to the proposed development comprise an area of existing hard standing that drains directly into the River Suir either through the existing drainage system or overland flow.

10.3.3 Flood Risk

The Flood Risk at the site of the proposed Flood Defences West has been assessed as part of this study. Previous flood studies have been undertaken as part of the PFRAMs, CFRAMS, Waterford Flood Alleviation Scheme and Waterford North Quays SDZ Planning Scheme.

10.3.3.1 OPW Preliminary Flood Risk Assessment

To inform the Flood Risk Assessment (FRA), the OPW Preliminary Flood Risk Assessment (PFRA) mapping was consulted as an initial screening. As required by the EU Floods Directive, the OPW carried out a PFRA to identify areas where the risk of flooding may be significant. The PFRA is a broad scale assessment based on historic flooding, predictive analysis and consultation with local communities and experts. As part of the PFRA, maps of the country were produced showing the indicative fluvial, pluvial and tidal flood extents, following which, Areas for Further Assessment (AFA's) were identified.

The PFRA map at the location of proposed development indicates that the site is subject to fluvial 1 in 100 years Annual Exceedance Probability (1% AEP) and coastal 1 in 200 years Annual Exceedance Probability (0.5% AEP) flood extents. The PFRA mapping does not indicate any pluvial or groundwater flooding within or in the vicinity of the proposed development. The PFRAM mapping identified Waterford City as a probable AFA.

10.3.3.2 OPW Catchment Flood Risk Assessment and Management.

Following on from the PFRA study, the OPW commissioned The South Eastern CFRAM Study Flood Risk Review which highlighted Waterford City as an AFA for fluvial and coastal flooding. This was based on a review of historic flooding and the extents of flood risk determined during the PFRA study. The Waterford City AFA incorporates the River Suir and its associated tributaries, including the Johns River as it flows through Waterford City before joining the River Suir from the south.

The published Final CFRAM (02/08/2016) mapping (extract reproduced in figure 10.1 below) indicates that the location of the proposed development currently has the potential to flood in 1% Fluvial AEP and 0.5% Tidal AEP flood events. The CFRAM mappings shows that the southern quays are defended to the 1% AEP event. The Waterford City Flood Alleviation Scheme was constructed prior to the CFRAM publication and therefore the CFRAM mapping incorporates the benefit of the flood alleviation scheme. Calculated maximum flood depths in the 0.1%AEP event (as per the CFRAMS) for the study area are between 1-1.5m.

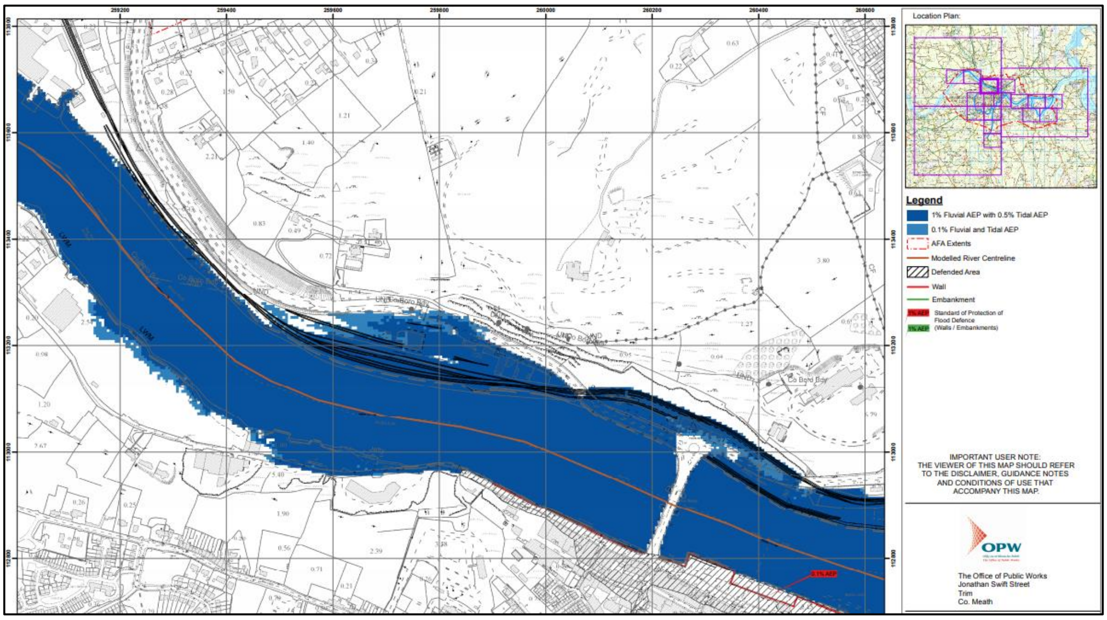


Figure 10.1 CFRAMS Flood Mapping Extract

10.3.3.3 Waterford Flood Alleviation Scheme

Waterford City and County Council and the OPW have implemented a significant flood alleviation scheme in Waterford City. Historically, Waterford City suffered recurring flooding with the River Suir and John's river experiencing out of bank flood events on multiple occasions in the latter half of the 20th Century. The flooding of the South Quays inundated the city's main thoroughfares and adjoining premises. The OPW and Waterford City Council commissioned consultants to undertake the Waterford City Flood Alleviation Scheme. The Scheme focused on containment of the watercourses within their channels. This was achieved through the construction of a series of flood defences in the form of reinforced concrete walls, glass walls, sheet piled walls, embankments, stormwater pumps, etc. The works were constructed in three separate civil works contracts and on completion is protecting the city from flooding from the rivers for events up to the 0.5% AEP in tidal areas and up to the 1% AEP in non-tidal areas. A section of flood barrier along the south quays is shown in Figure 10.2 below.

Figure 10.2 Section of Waterford Flood Relief Barrier (Carey Glass)

The flood defences devised as part of the Waterford Flood Alleviation Scheme are a maximum of 1.1 - 1.2m above ground levels to preserve river views. The design heights were increased from the modelled flood heights to accommodate the effects of climate change and uncertainty in flow estimation. A freeboard of 0.5m and 0.3m was implemented in tidal and non-tidal areas respectively. The design for Waterford South Quays flood defences features glass flood defences prominently. The implemented design height for the Waterford South Quays flood defence wall is +3.7mOD.

10.3.3.4 Waterford North Quays SDZ Planning Scheme – Strategic Flood Risk Assessment

As part of the Waterford North Quays SDZ Planning Scheme (2018) WCCC produced a flood risk assessment of the SDZ lands. A one-dimensional (1D) model was prepared to ascertain the effects of extreme tidal and combination tidal/fluvial events. A 1D model was utilised as it was determined that the Suir Estuary is dominated by tidal flows in the longitudinal flow direction.

The model was developed using surveyed topographic and channel cross-sections and OPW cross-sections. GSI / Marine Institute Infomar Sea bed survey data of the Waterford Harbour Area were also used to develop the model along with LiDAR data and a detailed hydrological assessment of the catchment. A medium range sea level rise scenario was adopted which is in keeping with the current OPW recommendations.

The findings from the hydraulic model were that critical flooding and flood levels in the estuary and at the location of the proposed development are as a consequence of the tidal storm surge conditions. Fluvial flood flows at this location contribute very little to increasing the peak flood levels in the Suir. Flood levels were derived from the hydraulic assessment conducted as part of Waterford North Quays Strategic Flood Risk Assessment. These are summarised in Table 10.1 below.

Table 10.1 Flood levels derived Waterford North Quays SFRA

Return Period – 1 in XX year	Existing Flood Level (excl. Climate Change (mOD)[Note 1]	MRFS Flood Level (mOD)[Note 2]
2	2.663	3.213
10	2.943	3.493
20	3.053	3.603
50	3.163	3.713
100	3.273	3.823
200	3.393	3.943
1000	3.633	4.183

Notes:

1. Flood Levels given above are taken from the hydraulic model based on a combined analysis of the tidal 1 in XX-year event / 1 in 2-year fluvial event at an upstream location at the confluence of the River Blackwater.
2. MRFS climate change allowance = (+0.55m which consists of +0.50m for climate change and +0.05m for isostatic tilt)

10.3.4 EPA Monitoring River Programme

The EPA carries out water quality assessments of rivers, transitional and coastal water bodies as part of a nationwide monitoring programme. Data is collected from physico-chemical and biological surveys, sampling both river water and the benthic substrate (sediment).

Water sampling is carried out throughout the year and the main parameters analysed include: conductivity, pH, colour, alkalinity, hardness, dissolved oxygen, biochemical oxygen demand (BOD), ammonia, chloride, ortho-phosphate, oxidised nitrogen and temperature.

As is the case for rivers and lakes, the impact of nutrient enrichment and the process of eutrophication is also a major concern in the tidal waters environment. The direct negative effects of excessive nutrient enrichment include increases in the frequency and duration of phytoplankton blooms and excessive growth of attached opportunistic macroalgae. The subsequent breakdown of this organic matter can lead to oxygen deficiency which in turn can result in the displacement or mortality of marine organisms. As such the effects of over enrichment can severely disrupt the normal functioning of tidal water ecosystems.

The status of individual estuarine and coastal water bodies is assessed using the EPA's Trophic Status Assessment Scheme (TSAS). This assessment is required for the Urban Waste Water Treatment Directive and Nitrates Directive. The scheme compares the compliance of individual parameters against a set of criteria indicative of trophic state (see Table 10.2). These criteria fall into three different categories which broadly capture the cause-effect relationship of the eutrophication process, namely nutrient enrichment, accelerated plant growth, and disturbance to the level of dissolved oxygen normally present.

Table 10.2 Biological River Water Quality Classification System

Trophic Status	Pollution Status	Condition
Unpolluted	Unpolluted	Unpolluted water bodies are those which do not breach any of the criteria in any category.
Intermediate	Unpolluted	Intermediate status water bodies are those which breach one or two of the criteria.
Potentially Eutrophic	Slightly polluted	Potentially Eutrophic water bodies are those in which criteria in two of the categories are breached and the third falls within 15 per cent of the relevant threshold value.
Eutrophic	Polluted	Eutrophic water bodies are those in which criteria in each of the categories are breached, i.e., where elevated nutrient concentrations, accelerated growth of plants and undesirable water quality disturbance occur simultaneously.

The River Suir at Waterford City had an EPA Transitional Surface Water Quality Status of "Eutrophic" from 2010-2012 and a Water Framework Directive (WFD) Status of "Poor" from 2013-2018. The "Poor" Status is indicated to be as a result of poor Phytoplankton Status as per the EPA Catchments website. Additionally, there appears to have been a deterioration across some parameters from the 2010-2015 to the 2013-2018 monitoring periods, these include Nutrient and Hydromorphological conditions in the River Suir.

The EPA Catchments.ie website mapping section provides details on the assessments of the water bodies / sub catchments in the study area. This data was reviewed as part of this assessment and a summary is given in Table 10.3. It should be noted that the WFD assessment considers the entire waterbody sub-catchment whereas the EPA monitoring results are point measurements at discrete locations.

Table 10.3 WFD Classification of Transitional Waters Near the Proposed Flood Defences West (2013-2018 Sampling period, EPA)

Waterbody		Code	WFD Status	Objective	Risk	Heavily Modified Status
Upper Suir Estuary	Upstream of Waterford City	IE_SE_100_0600	Poor	Restore	At Risk	No
Middle Suir Estuary	Waterford City located within Middle Suir Estuary	IE_SE_100_0550	Poor	Restore	At Risk	No
Lower Suir Estuary	Downstream of Waterford City	IE_SE_100_0500	Good	Protect	At Risk	Yes

The status of the Lower Suir Estuary as a "Heavily Modified" water body also changes the criteria for assessment, whereby the amended criteria generally have higher tolerances for pollutants etc. Water quality in the catchment is mainly "at risk" from diffuse sources of pollution such as agriculture and on-site wastewater treatment systems. Point sources of pollution in the town of Waterford City are also highlighted as "a risk" to the water quality status across the wider catchment.

10.4 Description of Potential Impacts

Flood Defence projects, given their scale and nature, have significant potential for causing impact to the hydrological environment both during their construction and operation and consequently require careful planning and detailed assessment to ensure the best solution is obtained. This section will describe the potential impacts associated with the proposed development before mitigation measures are applied. Both direct and indirect impacts will be addressed for the construction and operation of the proposed development. The nature, extent and duration of the impacts will also be assessed.

The assessment of hydrological impacts for the proposed flood defences development has been based on the analysis and interpretation of the data acquired during the site-specific investigations undertaken as part of the EIA, including the biodiversity surveys, intrusive site investigation, material assets survey, topographical survey, hydrodynamic modelling and hydrological walkover surveys. The procedure follows the guidelines set out in the publication 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes', TII, 2009.

Key hydrological receptors identified in the vicinity of the proposed flood defences include:

- The Lower River Suir SAC (European Designated Site);
- Ecologically sensitive surface water features and catchment systems; and,
- Flood Risk Areas.

10.4.1 Construction Phase

Construction activities pose a significant risk to watercourses, particularly works within the channel and contaminated surface water runoff from construction activities entering the watercourse.

10.4.1.1 Impact on Water Quality

Construction activities associated with flood defence construction, within and alongside surface waters, can contribute to the deterioration of water quality and can physically alter the river bed and bank morphology with the potential to alter erosion and deposition rates locally and downstream. Activities (such as sheet piling) within or close to the watercourse channels can lead to increased turbidity through re-suspension of bed sediments and release of new sediments from earthworks.

The main contaminants likely to arise from construction include:

- Elevated silt/sediment loading within watercourses from construction site runoff and sheet piling. Sheet piling will be undertaken both from the land side and primarily from a barge for river-side installation. Additionally, 3 No. temporary cofferdams will be required to construct 1 No. proposed surface water outfall structure and to upgrade 2 No. existing outfall structures. Effects on erosion and deposition processes during construction are likely to be *negative, temporary, imperceptible to slight* and highly localised to the temporary outfall cofferdams. Runoff from landside works is envisaged to be limited due to the existing high infiltration surfaces of the railway and the associated lands, the exception to this are the hardstanding areas in the vicinity of rice bridge and Plunket station. Elevated silt loading can lead to long-term damage to aquatic ecosystems by smothering spawning grounds and gravel beds and clogging the gills of fish. Increased silt load in receiving watercourses stunts aquatic plant growth, limits dissolved oxygen capacity and overall reduces the ecological quality with the most critical period associated with low flow conditions. Other pollutants in the watercourse can bind to silt which can lead to increased bioavailability of these pollutants.

- Spillage of concrete, grout and other cement-based products. These cement-based products are highly alkaline (releasing fine highly alkaline silt) and extremely corrosive and can result in significant impact to watercourses altering their pH, smothering the stream bed and physically damaging fish through burning and clogging of gills due to the fine silt.
- Accidental Spillage of hydrocarbons from construction plant and refuelling operations at storage depots / construction compounds, which can reach watercourses.
- Faecal contamination arising from inadequate treatment of on-site toilets and washing facilities.

In the absence of mitigation measures, the potential impact is *negative, temporary moderate to significant*.

10.4.1.2 Impact on Flooding

There is potential for flood events to occur during the construction phase. The construction works will increase the number of people near a known source of flooding, thus increasing the potential for flood risk related impacts on human health. This has the potential to have a *negative, temporary, imperceptible to slight* impact.

There is also potential for pollutants derived from construction materials to be mobilised by flood waters and has the potential to have a *negative, temporary, slight to moderate* impact on receiving watercourses.

The volumes displaced by the proposed flood defences during construction is extremely small relative to the volumes of the receiving waterbodies and will result in a*n imperceptible* impact on flood levels and subsequent flood risk in the vicinity of the subject site.

10.4.2 Operational Impacts

Hard flood defences, by design, cause permanent disturbance to river channels, floodplains and the flood regime. These structures can, if not appropriately designed, create an obstacle to flow, particularly under flood conditions resulting in increased flood risk and damage in the vicinity of the proposed structures. Such structures can locally alter channel morphology resulting in changes in flow velocity and water depth. These structures can also result in localised riverbed and riverbank erosion, resulting in long-term changes to the morphology of the river channel.

10.4.2.1 Impact on Water Quality

New surface water outfalls which collect surface water run-off from the railway area shall pass through a Class 1 by-pass separator prior to discharge to the River Suir. This will limit the potential for impacts to the water quality of receiving waterbody and has the potential to have a *positive, long term, slight to moderate* impact.

Additionally, operational phase maintenance works could result in accidental spillage of paint which will be used in the periodic (approximately every 10 years) repainting of the exposed sections of the new sheet pile flood defence wall. In order to control this risk, the paint specified for this purpose shall not contain lead or tributyltin (TBT) or shall be otherwise approved for use near water. This has the potential to have a *negative, temporary, imperceptible to slight* impact.

10.4.2.2 Erosion and Sediment Transport

A computational model was undertaken to assess the hydrodynamics of Suir Estuary and to assess the effects of the proposed development on the circulation patterns of the estuary (see Appendix 10.2 for further details). The hydrodynamic simulations run for both normal tidal conditions and extreme flood events show an increase in velocity magnitude along localised sections of the flood wall alignment on both ebb and flood flows and a reduction in velocity locally in the vicinity of the outfall structures. The greatest increases in velocity between existing and proposed cases occur on the spring tides and on the flooding tide with a general local increase of 0.05m/s and larger increases along the toe of the Flood wall of 0.075 to 0.1m/s. These are highly localised changes and are not significant in comparison to the computed baseline velocity magnitudes under the existing situation. There is no perceptible change in flow velocities in the main, deeper channel section or at the far bank. The predicted upstream and downstream changes to the flow velocity magnitude at the near bank is local and not very extensive.

The conclusion reached from this analysis is that the computed velocity increases from the proposed vertical sheet piled wall are relatively small and of insufficient magnitude to produce sufficient shear stresses (i.e. generally <0.7Pa) that would result in any potential significant erosion of the permanent consolidated sediments on the channel bed and banks in the vicinity of the affected area. Unconsolidated silts will be mobile under tidal ebb and flood conditions both for the proposed and existing cases and a slight reduction in silt deposition adjacent to the sheet piled wall is anticipated. This has the potential to have a *negative, long-term, imperceptible to slight* impact.

It should be noted that the post development scenario simulation represents the defence wall as bare sheet piles and not with cladding as proposed. Therefore, the aforementioned hydraulic models are inherently conservative in their estimation of erosion given that the proposed cladding will have an increased surface roughness similar to the existing quay wall.

10.4.2.3 Coastal / Fluvial Flooding

Hydraulic flood modelling was carried out to estimate the design flood level (see Appendix 10.2 for further details). In this respect, the design flow and flood levels are based on the Index Flood Estimate (Qmed) using Flood Studies Update (FSU) Estimation Method and Tidal Gauge flood level analysis.

The FSU Research Programme was implemented by the OPW and provides a substantial update of the Flood Studies Report (FSR). The FSU is an upgraded method for providing estimates at a network of hydrometric nodes throughout Ireland and has a factorial error of 1.38. The method uses a pooled growth curve of hydraulically similar catchments as the subject catchment which differs from the FSR which uses a single national growth curve.

A water level gauging station is present directly downstream (~500m) of the proposed flood defences at Adephi Quay (no. 16160). A short continuous water level record is available from 1999 to 2015 (a 17-year annual maxima series). The median water level at the Adelphi Quay hydrometric gauge was +2.58 mOD in 2018 and highest recorded water level was +2.89 mOD which occurred on the 27th October 2004.

A one-dimensional (1D) model has been prepared to ascertain the effects of extreme tidal and combination tidal/fluvial events. A 1D model was utilised as it was determined that the Suir Estuary is dominated by tidal flows in the longitudinal flow direction. The model was developed with surveyed topographic and channel cross-sections, OPW Cross-sections and GSI / Marine Institute Infomar Sea-bed survey of the Waterford Harbour Area, LiDAR data and a detailed hydrological assessment of the catchment.

The findings from the hydraulic model are that critical flooding and flood levels in the estuary and on the site are as a consequence of the tidal storm surge conditions. Fluvial flood flows at this location contribute very little to increasing the peak flood levels in the Suir. The removal of the defended lands as a tidal inundation area will have a negligible effect on the flood depths and will not have any perceivable effects on adjacent lands. Details of the modelled flood levels at the proposed flood defences are given in Table 10.4 below.

A Design Flood Level (200-year flood including Climate Change) of +4.30mOD has been calculated for the proposed Flood Defences West based on:

- 0.5% annual exceedance probability combined tidal-fluvial event (+3.45m OD);
- An additional 0.55m to allow for climate change and isostatic tilt; and,
- 0.30m freeboard, including local wave wake effects.

The proposed flood defences will have a minimum top of wall level of +4.30mOD.

The combination of the 1000-year tide and 2-year fluvial flood level including climate change is +4.240mOD. The proposed Design Flood level of +4.30mOD is above the 1000-year flood including climate change level which is a requirement for "Highly Vulnerable developments", such as the rail infrastructure as per the 2009 OPW Guidelines.

Table 10.4 Modelled Flood Levels West of Plunkett Station

Return Period – 1 in XX year	Existing Flood level (excl. climate change) (m OD) Note 1	MRFS Flood Level (m OD) Note 2
2	2.72	3.27
10	3.00	3.55
20	3.11	3.66
50	3.22	3.77
100	3.33	3.88
200	3.45	4.00
500	3.58	4.13
1000	3.69	4.24

Notes:

1. Flood Levels given above are taken from the hydraulic model based on a combined analysis of the tidal 1 in XX-year event / 1 in 2 year fluvial event at an upstream location at the confluence of the River Blackwater.
2. MRFS climate change allowance = (0.55m which consists of 0.50m for climate change and 0.05m for isostatic tilt)

The proposed flood defences will defend lands to the north from flooding including sections of the rail line, the existing Plunkett Station and Rice Bridge roundabout. The overall predicted impact is therefore *positive, significant* and *long-term*.

10.4.2.4 Surface water and Pluvial Flooding

The proposed flood defences will restrict drainage by gravity of the surface water drainage network in extreme fluvial/tidal events to the River Suir due to the proposed non-return valves and will also restrict reciprocal groundwater flows due to the cut-off sheet pile wall. Nonetheless, as part of the standard drainage design, pumping stations are incorporated to ensure the continued drainage of the subject lands during exceptional flood events within the River Suir. The potential *negative* impact is *permanent, imperceptible to slight* in magnitude.

10.4.2.5 Predicted Impact of Storm Discharge on Flooding / Morphology

The existing drainage pathways for the defended lands will be maintained as part of the development during operation. All drainage outfalls will be fitted or retrofitted with non-return valves to prevent tidal water ingress and 2 no. existing drainage outfalls in the River Suir bank will be upgraded with new headwalls and improved erosion control measures to facilitate long-term operation and maintenance of outlets. The potential impact is a *positive, slight* and *permanent*.

10.4.2.6 Predicted Impact of Storm Discharge of Pollutants

Existing drainage paths are to be maintained, including those within contributing catchments. The implementation of new filter drains and carrier drains trackside may decrease the time taken for surface water bourn pollutants to enter the River Suir imperceptibly. Nonetheless, there are no envisaged changes to sources of pollution within the drainage network catchments. The minor amendments to the existing drainage networks will be likely have a *negative, imperceptible,* and *permanent* impact.

10.5 Mitigation & Monitoring Measures

10.5.1 Construction Mitigation

As is normal practice with infrastructure projects, an Environmental Operating Plan (EOP) and Construction Environmental Management Plan will be prepared for the Flood Defences West and are included in Appendix 4.1 and Appendix 1.4 A, respectively. These will be developed by the selected contractor to suit the detailed construction methodology and allocate responsibilities to individuals in the construction team. In doing so, the measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the current drafts of the Plans is sufficient to allow an assessment of the anticipated impacts including residual impacts.

The following will be implemented as part of this plan:

- An Incident Response Plan (see Appendix 4.1 C) will be finalised detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, non-compliance with any permit or license, or other such risks that could lead to a pollution incident, including flood risks.
- All necessary permits and licenses for in stream construction work for provision of the flood defences will be obtained prior to the commencement of construction.
- Inform and consult with Inland Fisheries Ireland and Waterways Ireland.

During construction, cognisance will have to be taken of the following guidance documents for construction work on, over or near water.

- *Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites* (Eastern Regional Fisheries Board)

- *Central Fisheries Board Channels and Challenges – The enhancement of Salmonid Rivers.*
- *CIRIA C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors.*
- *CIRIA C648 Control of Water Pollution from Constructional Sites.*
- *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (TII, 2006).*

Based on the above guidance documents concerning the control of construction impacts on the water environment, the following outlines the principal mitigation measures that will be adhered to for the construction phase, in order to protect all catchment, watercourse and ecologically protected areas from direct and indirect impacts:

General Mitigation Measures

- Site works will be limited to the minimum required to undertake the necessary elements of the project.
- Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels or cut-off ditches.
- Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and bunding.
- Protection of waterbodies from silt load will be carried out through the use of gully silt/sediment filters and shallow berms in hardstanding areas to provide adequate treatment of runoff to watercourses.
- Settlement tanks, silt traps/bags and bunds will be used. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap.
- The anticipated site compound/storage facility will be fenced off at a minimum distance of 5m from the top of the edge of the quay wall/river edge. Any works within the 10m buffer zone will require measures to be implemented to ensure that silt laden or contaminated surface water runoff from the compound does not discharge directly to the watercourse. CEMP has been drafted and will need to be finalised by the appointed Contactor See the EOP and Construction Environmental Management Plan (CEMP) in Appendix 4.1 and 4.1 A of this EIAR for further detail.
- Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with the TII document "*Guidelines for the crossing of watercourses during the construction of National Road Schemes*". All chemical and fuel filling locations will be contained within bunded areas and set back a minimum of 20m from watercourses.
- Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner, off site, to prevent pollution.
- The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses.
- Water quality monitoring will be undertaken in the River Suir, with monthly samples being taken from at least 6 months prior to commencement of construction until at least 24 months post-completion. Water samples will be taken from at least two locations. The final number and location of sampling

points will be determined by the Site Environmental Manager. The results of the water quality monitoring programme will be reviewed by the Site Environmental Manager and Ecological Clerk of Works on an ongoing basis during construction. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation will be undertaken to identify the source of this non-compliance and corrective action will be taken where the this is deemed to be associated with the proposed development.

Specific Mitigation Measures - Concrete Works

Remedial works to the existing masonry quay wall and increasing its height will require the use of in-situ concrete. The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. As the use of concrete cannot be avoided, the following control measures will be employed:

- Hydrophilic grout and quick-setting mixes or rapid hardener additives shall be used to promote the early set of concrete surfaces exposed to water;
- When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used;
- Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters;
- Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW);
- The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if inclement weather is forecast such that precipitation may make it difficult to maintain a dry working area.
- There will be no spills of concrete, cement, grout or similar materials hosed into surface water drains. Such spills shall be contained immediately and runoff prevented from entering the watercourse;
- Concrete waste and wash-down water will be contained and managed on site to prevent pollution of all surface watercourses ;
- On-site concrete batching and mixing activities will only be allowed at the identified construction compound areas;
- Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the manufacturer);
- Chute washout will be carried out at designated locations only. These locations will be signposted. The Concrete Plant and all Delivery Drivers will be informed of their location with the order information and on arrival to site; and
- Chute washout locations will be provided with an appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste in accordance with the Contractor's Waste Management Plan.

10.5.2 Flooding

The Contractor will provide method statements for weather and tide/storm surge forecasting and continuous monitoring of water levels in the River Suir and Waterford Harbour. The Contractor will also provide method statements for the removal of site materials, fuels, tools, vehicles and persons from flood zones in order to minimise the risk to persons working on the site as well as potential input of sediment or construction materials into the river during flood events.

10.5.3 Operational Phase Mitigation

There are no mitigation measures proposed for the operational phase of the proposed development.

10.6 Residual Impacts

The residual hydrological impacts associated with the Flood Defences West following the implementation of the mitigation measures outlined in section 10.5, are outlined below.

10.6.1 Construction phase

Water Quality

Following the implementation of the measures outlined in the Environmental Operation Plan in Appendix 4.1 of this EIAR, there will be a *negative, slight, temporary* residual impact on water quality during the construction of the Flood Defences West.

Flood Risk

Mitigation in place during the construction phase will limit flood risk and reduce the potential for pollution events. With the inclusion of mitigation during the construction phase, the proposed flood defences scheme will have a net *significant positive* impact.

10.7 Difficulties Encountered

There were no difficulties associated with this assessment.

10.8 References

EPA (2017a). Environmental Protection Agency Envision WFD Status

EPA (2017b) Environmental Protection Agency Envision Surface Water Quality

GSI (2017a). Geological Survey of Ireland Groundwater Data Viewer

GSI (2017b). Geological Survey of Ireland (GSI) – Bedrock Geology;
Teagasc – Subsoil Map;

OPW (2010). Irish Coastal Strategy Study Phase 2 – South East Coast – Work Packages 2, 3 & 4A – Technical Report

Appendix 10.1
Flood Defences West Site-Specific Flood Risk Assessment

Prepared by
Roughan & O'Donovan
Arena House, Arena Road, Sandyford, Dublin 18
Tel: +353 1 2940800 Fax: +353 1 2940820
Email: info@rod.ie www.rod.ie

WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT

FLOOD DEFENCES WEST
Site-Specific Flood Risk Assessment | October 2021

WPIP-ROD-ENV-S1_AE-RP-CD-30001_[S4-P02]

ROD
ROUGHAN & O'DONOVAN

Waterford City Public Infrastructure Project

Flood Defences West

Site-Specific Flood Risk Assessment

TABLE OF CONTENTS

1. INTRODUCTION

As part of the preliminary design process, Roughan & O'Donovan Consulting Engineers has carried out a Flood Risk Assessment for the Waterford Flood Defences West located on the periphery of Waterford City. This report has been prepared to assess the flood risk to the subject site and adjacent lands as a result of the proposed development.

1.1 Description of Study Area

The proposed development is located on the north quays of Waterford City and is bound to the north by the Iarnród Éireann railway corridor serviced by the Plunkett Station, the Waterford railway station. The Plunkett Station is bounded to the north by a steep rock slope which is subject to rock stabilisation works as part of the overall Waterford City Public Infrastructure Project. The proposed flood defences are bounded to the south by the River Suir. The River Suir rises in South Tipperary, flowing south east for 185km before discharging into the Atlantic Ocean at Waterford Harbour. The Suir Catchment is approximately 3,600km^2. Waterford City is on lower reaches of the Suir which exhibits a tidal influence at this point due to its proximity to the sea. The R448 Dual Carriageway is located further north of the proposed development and the railway corridor (see Figure 1.1 below).

The land profile typically falls towards the River Suir, and the lands south of the railway line form a gently inclined floodplain.

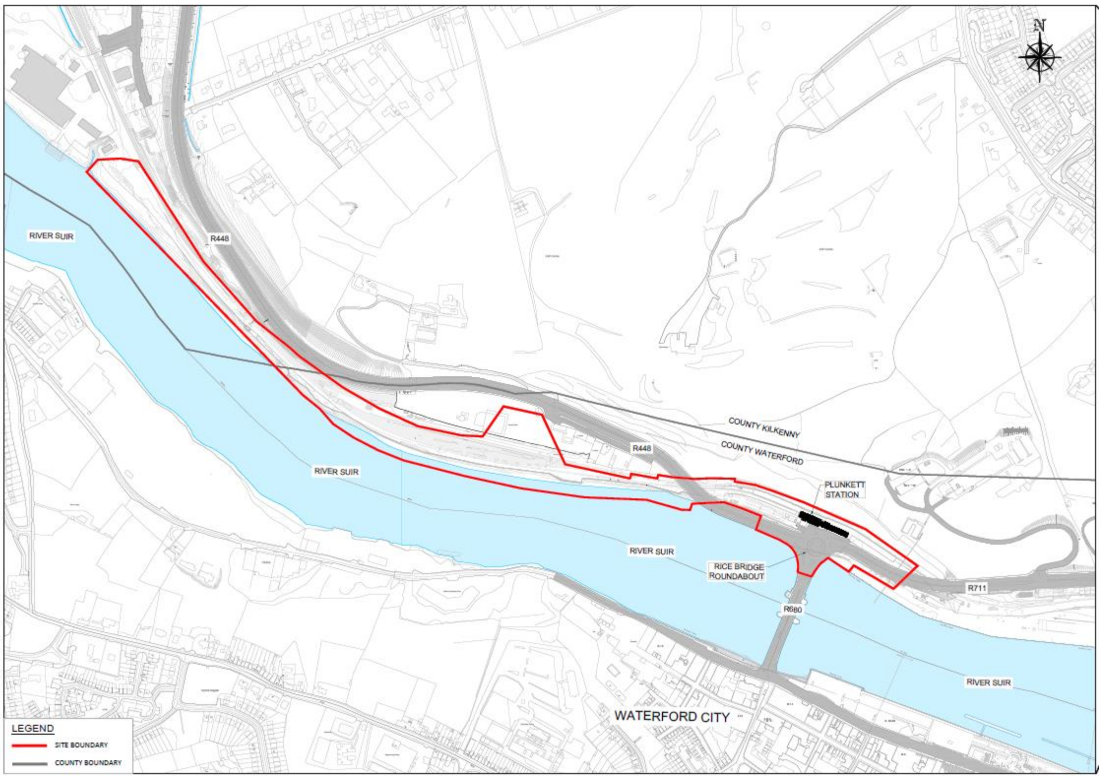


Figure 1.1 Flood Defences West Proposed Development

1.3 Description of Proposed Development

The proposed development aims to develop flood defence measures for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the future SDZ Transportation Hub which will provide a connection to the North Quays SDZ site via the railway line. The proposed top-of-wall level for the flood protection measures is 4.30m OD (metres above Ordnance Datum Malin). The following allowances are integrated into the proposed height of the flood defence walls:

- 0.5% annual exceedance probability combined tidal-fluvial event (+3.45m OD);
- An additional 0.55m to allow for climate change and isostatic tilt; and,
- 0.30m freeboard to the wall, including local wave wake effects.

1.3.1 Proposed Above Ground Flood Protection Measures

1.3.1.1 Remedial Works to the Existing Quay Wall

Between Ch.285 and Ch.360, the existing quay wall located in front of the car park (immediately to the west of the existing Plunkett Station) stretching c. 75m to the west under the R448 overbridge will be raised to add between 0.6m and 1.2m in height in order to attain the required height of +4.3 mOD.

Between Ch.285 and Ch.300, the works will only involve the construction of a reinforced concrete wall add-on, as the existing quay wall is reinforced concrete, and no significant defects were found in this segment of the wall during inspections. This is envisaged to be done as cast in-situ reinforced concrete, anchored into the existing wall below through post-installed chemical anchors.

A similar solution will be applied to the existing quay wall between Ch.300 and Ch.360. The wall add-on will be complemented, by an impermeable trench (possibly constructed by fill replacement, fill improvement with cement or low-pressure grouting techniques). The impermeable trench will be constructed behind the existing quay wall to prevent the seepage through the deteriorating existing quay wall that is in poor condition at this segment of the wall.

1.3.1.2 Flood Defences at Rice Roundabout

The ground levels at the Rice Bridge roundabout and the entrance to Plunkett Station (between chainages Ch.0.40 and Ch.210) are lower than the design flood level of 4.0mOD. A system of overground flood protection measures is proposed for the Rice Bridge Roundabout and along the three roundabout arms; Rice Bridge (R680), Terminus St. (R448) and Dock Rd. (R711).

The overground flood defence measures will comprise of approximately 170m of glass flood barriers, 15m of demountable flood barriers, sealing of the roundabout and approach structure roadway movement joints, and the provision of flap valves on the existing road drainage gullies.

The glass barriers will be located on the river side of the road edge vehicular parapets and will be supported off the existing concrete parapet edge beams.

1.3.2 Proposed Groundwater Flood Protection Measures

1.3.2.1 Impermeable Trench

In front of the existing Plunkett Station building and adjacent to the parking areas, starting from chainage Ch.0.0 and going westwards to approximately Ch.365, the ground conditions are such that the risk of underground seepage during flood events are expected to be comparatively lower than within the rest of the proposed development area. It is envisaged that the potential risk from groundwater flooding is reduced due to this section being dominated by shallow bedrock and an abundance of built structures that pose obstructions to water flow, such as the historical quay walls and new boundary walls. However, with climate change and the risk of rising tide levels there is a risk of increased groundwater flooding at the low points in the railway line in front of Plunkett Station in the future. To prevent groundwater seepage at this location, it is proposed to construct an impermeable shallow trench (approximately 0.35m wide and up to 3m deep trench filled with lean mix concrete); blocking of disused drainage pipes; and retrofitting the other drainage pipes with non-return valves.

It is noted that groundwater monitoring is currently ongoing as a part of the risk-based approach for this section, and it is possible that parts of these underground flood protection measures may be omitted during detailed design or may be implemented on a phased basis with ongoing monitoring of groundwater levels in the interim.

The impermeable trench's depth, width and required permeability have been designed on the basis of the local ground and groundwater model, and were determined using long-term monitoring and seepage design in accordance with IS EN 1997-1:2005 Eurocode 7: Geotechnical design General rules (Including Irish National Annex).

1.3.2.2 Underground Isolation Structure

The western end of the flood defences at Ch.1090 is set at a natural high point of the terrain and the rail track. The ground at this point is still slightly below the design flood level of +4.30mOD so an underground transverse isolation structure will be constructed in order to prevent both underground and overground flooding parallel to the rail line, i.e., it will create a cut-off return to complete the flood defences and protect from the floodwaters coming in from west to east along the rail lines. The underground isolation structure across and under the rail-line indicated at Ch.1090, will be approximately 20m in length. The underground isolation structure will consist of a sheet pile wall fully embedded in the ground, to a depth of approximately 6m below ground level. Where the sheet pile footprint is directly below rail tracks, a segment of the rail tracks will be temporarily removed to enable the piling and then reinstated back. The typical width of sheet pile profile is 450mm. The sheet pile wall proposed for the underground transverse isolation structure cannot protrude above ground at this location as its positioned directly below the existing rail tracks and would impede on the operation of the rail line. As such the sheet piles here will include a concrete capping beam finished to existing ground level. The concrete capping beam will facilitate the installation of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event. The use of demountable barriers at this location is proposed to address the long-term residual risk of flooding (when the impact of climate change on the rising tide level begins to come into effect). The use of overground flood barriers will form part of a long-term strategy to address the flood risk which will include monitoring and operation and emergency planning to be put in place. At present there is no record of flooding at this location, and the ground levels are above the current 0.5% AEP flood levels. In the shorter term (20-40 years) it is unlikely that overground flood barriers will be required to be deployed at this location. Continuing flood defences further to the west of this point would require extending them further, to a minimum distance of 1km until the next natural topographical flood cut off, hence the selection of Ch.1090 for the westernmost end of the flood defences.

1.3.3 Proposed Above and Below Ground Flood Protection Measures

1.3.3.1 Sheet - Piled Flood Defence Wall – Riverside

Between Ch.360 and Ch.900, construction of approximately 540m of new flood defence wall within the foreshore of the River Suir will be required (in-river sheet piles). This section of the driven sheet pile wall will be constructed using a piling rig on a spud-can barge situated in-stream for the duration of works.

The sheet pile wall will be constructed approximately 1m in front of the existing quay wall within the River Suir mudflats and the gap will be backfilled with clean imported granular (Class 1 or 6) earthworks fill material.

1.3.3.2 Sheet-Piled Flood Defence Wall – Landside

Between Ch.900 and Ch.1090, the works will involve the construction of a sheet piled flood defence wall on land, 1m behind the existing quay wall, but in front of the rail tracks and will meet the IÉ clearance requirements. The landside sheet piles will be installed using a piling rig. The permanent works will not encroach into the foreshore of the River Suir. The sheet piles will project above the existing ground level by between 0.7m and 2.1m in order to attain the design (top-of-wall) level of +4.3 mOD.

1.3.4 Drainage

The Flood Defence System stated above will mitigate against combination fluvial/tidal flooding. will raise the level of the quay wall and will cut off the existing flow path of over the edge surface water drainage and the existing groundwater flows.

Therefore, additional drainage pipework such as filter drains will be provided and will run linearly behind the proposed flood protection measures to accommodate the surface water and the cut-off groundwater flows.

As part of the proposed development, no significant increase in impermeable areas or changes to the overall catchment is proposed. The upgrade of the drainage networks may facilitate faster run-off of surface water from the site, however the outfall peak flows will not be increased significantly post construction.

In the vicinity of Plunkett Station from Ch.0.0 to Ch.350, a new drainage network will be provided to collect flows from the trackside drainage and also from the low point at Plunkett Station at +2.15m OD. This will reduce the risk of pluvial flooding at this location.

1.3.4.1 Outfalls to River Suir

The proposed outfalls to the River Suir at Ch.550 and Ch.900 will consist of an outfall pipe fitted flush with the proposed sheet pile wall and fitted with a flap valve or other non-return valve. Outfall levels will be above the existing mud flat levels.

At new surface water outfall locations which collect surface water run-off from the railway area, the surface water run-off shall pass through a Class 1 by-pass separator prior to discharge to the River Suir.

1.3.4.2 Outfall Structures to River Suir

A proposed new outfall structure to the River Suir will be provided at approx. Ch.390 to discharge surface water run-off from the Plunkett Station area. This new surface water outfall structure will extend between 4m and 6m into the River Suir.

At the new surface water outfall location (Ch.390) which collects surface water run-off from the railway area, the surface water run-off shall pass through a Class 1 by-pass separator prior to discharge to the River Suir.

There are 2 no. existing outfall pipes which extend past the existing quay wall into the riverbed i.e., a 750mm diameter pipe at approx. Ch.470, and a 600mm diameter pipe at approx. Ch.490. As part of the proposed works, the existing sections of these pipes which are in the riverbed will be removed and replaced in order to facilitate the construction of the proposed sheet pile wall. The new section of pipe will penetrate the new sheet pile wall and extend into the riverbed.

All three outfall structures will be provided with a headwall structure at the outfall and a flap valve or similar non-return valve at the outlet. The sections of pipe located in the river bank will be provided with a piled foundation which will be further assessed at detailed design based on localised geotechnical information. At each outfall, a pre-cast concrete wing wall will be placed in the riverbank and a stone mattress will be placed in the riverbed to prevent erosion. The stone mattress will require minor excavation works to a depth of approximately 500mm into the riverbed and will occupy an area of approximately 1.5m by 3m.The proposed new outfall structures to the River Suir will consist of a pre-cast concrete wing wall placed along the riverbank and a stone mattress which will be placed in the riverbed to prevent erosion. The existing outfall structures to be upgraded consist of a 600mm and an 900mm diameter pipe within the riverbank. The proposed new outfall will consist of a 750mm diameter pipe within the riverbank. At each outfall, a stone mattress will be provided which will require minor excavation works to a depth of approximately 500mm into the riverbed and will occupy an area of approximately 1.5m by 3m.

1.3.4.3 Surface Water Pumping Station

The 2 No. Surface Water Pumping Station Catchment area consists of surface water flows from trackside drainage.

The proposed underground surface water pumping stations at approx. Ch.380 and Ch.550, which in the event of high tide where gravity flows are not possible, will pump the flow to the River Suir via rising mains out-falling through the sheet pile wall.

The pumping station will be designed to cater for:

- Design Flood level of 4.0mOD;
- Surface water network flows for the 1 in 30 year return period, critical storm duration.

The design of the pumping stations shall be co-ordinated with IÉ to meet their requirements in relation to maintenance and access, while located close to an operational railway line.

The location of the proposed measures are presented on drawings in Appendix B.

2. FLOOD RISK

2.1 Introduction

This report has been prepared in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' herein referred to as 'The Guidelines' as published by the Office of Public Works (OPW) and Department of Environment, Heritage and Local Government (DoHLG) in 2009.

2.2 Identification of Flood Risk

Flood risk is a combination of the likelihood of a flood event occurring and the potential consequences arising from that flood event and is then normally expressed in terms of the following relationship:

Flood risk = Likelihood of flooding x Consequences of flooding.

To fully assess flood risk an understanding of where the water comes from (i.e. the source), how and where it flows (i.e. the pathways) and the people and assets affected by it (i.e. the receptors) is required. Figure 2.1 below shows a source-pathway-receptor model reproduced from 'The Guidelines' (DEHLG-OPW, 2009).

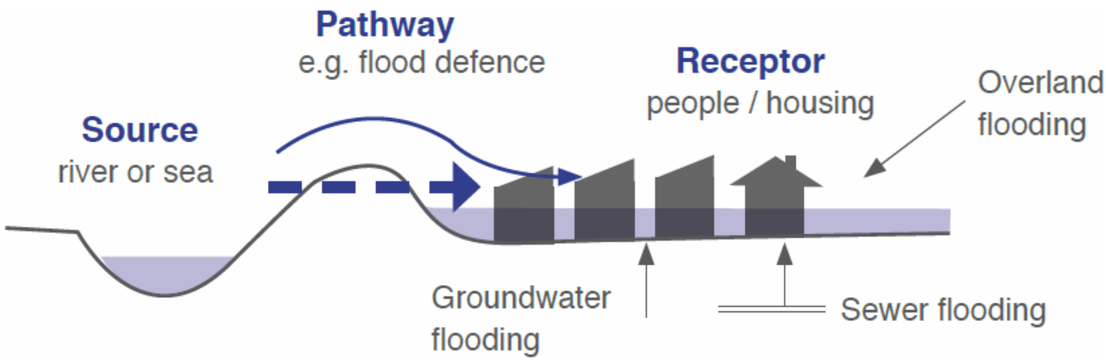


Figure 2.1 Sources, Pathways and Receptors of Flooding

The principal sources of flooding generally are rainfall or higher than normal sea levels. The principal pathways are rivers, drains, sewers, overland flow and river and coastal floodplains. The receptors can include people, their property and the environment. All three elements as well as the vulnerability and exposure of receptors must be examined to determine the potential consequences.

The Guidelines set out a staged approach to the assessment of flood risk with each stage carried out only as needed. The stages are listed below:

Stage I Flood Risk Identification – to identify whether there may be any flooding or surface water management issues.

Stage II Initial Flood Risk Assessment – to confirm sources of flooding that may affect an area or proposed development, to appraise the adequacy of existing information and to scope the extent of the risk of flooding which may involve preparing indicative flood zone maps.

Stage III Detailed Flood Risk Assessment – to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development or land to be zoned, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures.

2.3 Likelihood of Flooding

The Guidelines define the likelihood of flooding as the percentage probability of a flood of a given magnitude or severity occurring or being exceeded in any given year. It is generally expressed as a return period or annual exceedance probability (AEP). A 1% AEP flood indicates a flood event that will be equalled or exceeded on average once every hundred years and has a return period of 1 in 100 years. Annual Exceedance probability is the inverse of return period as shown Table 2.1 below.

Table 2.1: Correlation Between Return Period and AEP

Return Period (years)	Annual Exceedance Probability (%)
1	100
10	10
50	2
100	1
200	0.5
1000	0.1

2.4 Definition of Flood Zones

Flood zones are geographical areas within which the likelihood of flooding is in a particular range. These are split into three categories in The Guidelines:

Flood Zone A

Flood Zone A where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal/tidal flooding).

Flood Zone B

Flood Zone B where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 or 0.5% or 1 in 200 for coastal/tidal flooding).

Flood Zone C

Flood Zone C where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal/tidal flooding. Flood Zone C covers all plan areas which are not in zones A or B.

It is important to note that when determining flood zones the presence of flood protection structures should be ignored. This is because areas protected by flood defences still carry a residual risk from overtopping or breach of defences and the fact that there is no guarantee that the defences will be maintained in perpetuity.

2.5 Sequential Approach & Justification Test

The Guidelines outline the sequential approach that is to be applied to all levels of the planning process. This approach should also be used in the design and layout of a development and the broad philosophy is shown in Figure 2.2 below. In general, development in areas with a high risk of flooding should be avoided as per the sequential approach. However, this is not always possible as many town and city centres are within flood zones and are targeted for development.

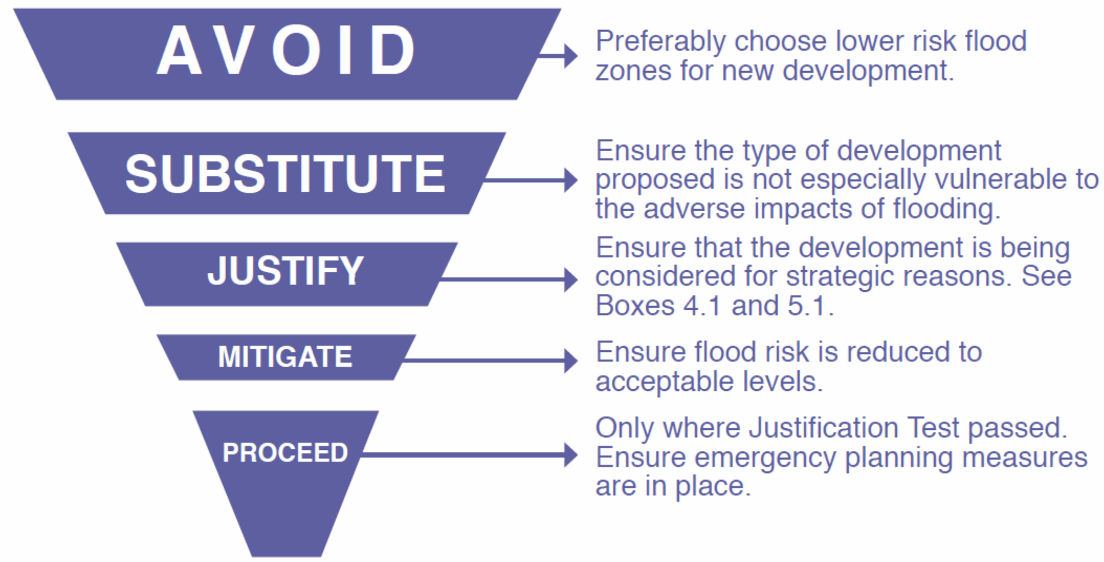


Figure 2.2 Sequential Approach (Source: The Planning System and Flood Risk Management)

The Justification Test has been designed to rigorously assess the appropriateness, or otherwise, of developments that are being considered in areas of moderate or high flood risk. The test comprises the following two processes.

The first is the Plan-making Justification Test and is used at the plan preparation and adoption stage where it is intended to zone or otherwise designate land which is at moderate or high risk of flooding.

The second is the Development Management Justification Test and is used at the planning application stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land.

Table 2.2 Matrix of Vulnerability Versus Flood Zone to Illustrate Appropriate Development that is Required to Meet the Justification Test (Source: The Planning System and Flood Risk Management)

	Flood Zone A	**Flood Zone B**	**Flood Zone C**
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

The proposed development is considered as a water compatible development as per the OPW Guidelines and as such is appropriate in all flood zones.

3. STAGE 1: FLOOD RISK IDENTIFICATION

3.1 General

This Stage 1 Flood Risk Identification includes a review of the existing information and the identification of any flooding or surface water management issues in the study area that may warrant further investigation.

3.2 Information Sources Consulted

The following information sources were consulted as part of the Stage 1 Flood Risk Identification:

Table 3.1 Information Sources Consulted

Source	Data Gathered
OPW Preliminary Flood Risk Assessment (PFRA) maps	Fluvial, Pluvial, Coastal and Groundwater flooding examined. Sourced at cfram.ie and myplan.ie
Catchment Flood Risk Assessment and Management Study (CFRAM)	Suir Fluvial & Tidal Flood Extent Mapping. Sourced at www.floodinfo.ie
Irish Coastal Protection Strategy Study	OPW Coastal flood Maps Sourced at www.floodinfo.ie
OPW National Flood Hazard Mapping	Recorded flood events. Sourced at www.floodmaps.ie
Ground Investigations	IGSL Ltd. undertook geotechnical investigations during 2019-2020.
Geological Survey of Ireland (GSI) Maps	GSI Teagasc subsoils map consulted to identify alluvial sediments
Historical Maps	OSI 25" mapping assessed. Sourced at http://map.geohive.ie/mapviewer.html
Irish Rail Technical Note	Technical Note prepared by Irish Rail staff following flood event on the 20th October 2020
News Reports	News reports published in newspapers or digital news websites.

3.3 Primary Sources of Baseline Data

(i) Preliminary Flood Risk Assessment

The PFRA is a national screening exercise, based on available and readily-derivable information, to identify areas where there may be a significant risk associated with flooding (referred to as Areas for Further Assessment, or AFA's). As part of the PFRA study, maps of the country were produced showing the indicative fluvial, coastal, pluvial and groundwater flood extents.

The PFRA map at theFlood Defences' West location indicates that the site is located within fluvial flood 1% AEP extents and within coastal flood 0.5% AEP extents. The PFRA mapping does not indicate any pluvial or groundwater flooding within or in the vicinity of the site.

The PFRA Maps for the area are reproduced in Appendix C/1-C/4.

(ii) Catchment Flood Risk Assessment and Management Study

The plan area is covered within the Suir CFRAM study areas. The CFRAM programme led by the OPW, provides a detailed assessment of flooding in areas identified as AFA's during the PFRA study. Catchment wide Flood Risk Management Plans were also developed as part of the programme.

The published Final CFRAM (02/08/2016) mapping indicates that the Flood Defences West Site has the potential to flood in the 1% Fluvial AEP flood event. The CFRAM mapping does not indicate any pluvial or groundwater flooding within or in the vicinity of the site.

The published CFRAM flood maps are reproduced in Appendix C/5.

(iii) Irish Coastal Protection Strategy Study

The Irish Coastal Protection Strategy Study (ICPSS) Phase 3, undertaken by the OPW, covers coastal flooding throughout Ireland. The aims of the ICPSS were to establish extreme coastal flood extents, produce coastal flood extent and flood depth maps and assess and quantify the hazard and potential risk associated with coastal erosion.

The ICPSS flood maps indicate that sections of the Flood Defences West Site are within the 0.5% AEP coastal flood extent.

The published ICPSS flood maps are reproduced in Appendix C/6.

(iv) OPW National Flood Hazard Mapping

The OPW National Flood Hazard Mapping Web Site (www.floodmaps.ie) was examined to identify any recorded flood events within the vicinity of the site. No Flood Event has been recorded at the Flood Defences West Site.

The OPW Flood Hazard Mapping is reproduced in Appendix C/7.

(v) Ground Investigations

Ground Investigations were undertaken by IGSL Ltd. during 2019-2020. The boreholes in the vicinity of Plunkett Station have indicated that groundwater levels in several boreholes respond rapidly to tidal levels, particularly boreholes that are closest to the riverbank and closest to the Rice Bridge northern roundabout.

(vi) Secondary Sources of Baseline data

The following sources were also examined to identify areas that may be liable to flooding:

Table 3.2 Secondary Sources of Baseline Data

Source	Data Gathered
GSI Maps	GSI Teagasc subsoils map shows the Flood Defences West Site is mainly underlain by made ground. In the most westerly section of the site there is evidence of Alluvium. No evidence of Karst features has been identified within the vicinity of the site. Refer to Appendix C/8 for GSI maps.
Historical Maps	No areas of the site have been identified as liable to flooding. Refer to Appendix C/9 for Historical Maps.
Irish Rail Technical Note	Irish Rail staff documented recent flooding on the 20/10/2020. This is summarised as follows: 1. Flooding occurred on Tuesday 20th October 2020 at Plunkett Station requiring the station to be closed. There had been 20.6mm of rainfall in the previous 24hrs and a high tide of 2.78mOD on the day of the flooding. Unusual local wind conditions emanating from the south-east on the days preceding the flood event potentially contributed to an elevated sea state. Irish Rail site staff indicate that the sea wall was over topped immediately west of Plunket station in the vicinity of a premises known as "The Paving Yard". 2. Flooding of the northern and southern rail line at Plunket station. Standing water is seen for the full length between the two road bridges over the rail line. Irish Rail staff estimate that the "Ground Level at Rail Line approx. 2.1m OD. Flood water level approx. 2.7mOD. Platform Level approx. 3.2m OD". Flood waters appear deeper along the northern line adjacent the cliff face. Water levels appear to be approximately at top of rail level on the southern line. It should be noted that following the 2013 landslide event at Plunkett Station upgrade works on the southern line were undertaken which increased track and ballast level by approximately 300mm. Records of previous flood events such as the 2012 incident indicate similar flooding at the station though at much greater depth (to platform level). 3. Flooding inside the existing sea wall immediately west of Plunket station. Water can been seen both ponding on the inside of the sea wall and draining from the flooded lands through drainage outfalls and cracks in the existing sea wall. The ponding water seems to extend no further along the sea wall than the western end of platform 5.
News Reports	An article published on www.theirishindependant.ie on the 11th March 2008 entitled "Escaping in the eye of the storm" describes that rail services at the existing Plunkett train station were affected sue to flooding resulting in bus transfers to be put in place. An article published on www.thejournal.ie on the 17th October 2012 entitled "Waterford train station is flooded… very flooded" describes how Plunkett train station was flooded following a period of heavy rain. An article published on www.theirishindependant.ie on the 5th February 2014 highlights rail services being suspended in and out of Plunkett station due to flooding at the platform. Refer to Appendix C/10-C/13 for News Reports.

3.4 Conclusion of Stage 1 SFRA

In accordance with Stage 1 of the approach outlined in the Guidelines, the possible sources of flooding associated with this development have been identified. These are summarised in Table 3.3 (taken from Appendix A of the Guidelines).

Table 3.3 Possible Sources of Flooding Associated with the Flood Defences West Site

<table>
<tr><th>Source</th><th>Pathway</th><th>Receptor</th><th>Likelihood</th><th>Consequence</th><th>Risk</th></tr>
<tr><td>Tidal</td><td>Overland flow, out of bank</td><td>Proposed Flood Defences West site</td><td>High</td><td rowspan="4">Low
(Development is classified as water compatible development as per the Guidelines)</td><td>Low</td></tr>
<tr><td>Fluvial</td><td>Overland flow, out of bank</td><td>Proposed Flood Defences West site</td><td>High</td><td>Low</td></tr>
<tr><td>Surface Water / Pluvial</td><td>Overland flow, drains</td><td>Proposed Flood Defences West site</td><td>Medium</td><td>Low</td></tr>
<tr><td>Ground Water</td><td>Rising levels</td><td>Proposed Flood Defences West site</td><td>High due to tidal /fluvial interaction</td><td>Low</td></tr>
</table>

The information provided in this section identifies that the proposed development is within an area that is liable to flooding from coastal, fluvial and groundwater sources; therefore, a Stage 2 SFRA is required to be undertaken.

4. STAGE 2 – INITIAL FLOOD RISK ASSESSMENT

4.1 General

A Stage 2 SFRA (initial flood risk assessment) was undertaken to:

- Confirm the sources of flooding that may affect the subject site;
- Appraise the adequacy of existing information as identified by the Stage 1 FRA.

4.2 Sources of Flooding

Flooding from Fluvial & Sea Level Rises / Coastal Flooding

The proposed Flood Defences West site is in close proximity to the River Suir which discharges into the Atlantic Ocean at Waterford Harbour. The character of the site is influenced by its proximity to the tidal waterbody, as such, the most prevalent flood risk to the site is from extreme tidal inundation events or tidal events in combination with extreme fluvial events. Most of the site is indicated to be within flood zones A in OPW Suir CFRAM Study, OPW Preliminary flooding assessment and the Irish Coastal Protection Strategy study. The proposed development site is considered to require a stage 3 detailed flood risk assessment with respect to flooding derived from Fluvial and Tidal Flooding.

Surface Water Flooding

Surface water flooding occurs when the local drainage system cannot convey stormwater flows from extreme rainfall events. The rainwater does not drain away through the normal drainage pathways or infiltrate into the ground but instead ponds on or flows over the ground instead. Surface water flooding is unpredictable as it depends on a number of factors including ground levels, rainfall and the local drainage network. The drainage network for the proposed development on the site will incorporate best practice in drainage design for the purpose for managing surface water in terms of both flow and quality. There is no indication of previous surface water flooding on the Flood Defences West site. The proposed site is not considered to require a detailed flood risk assessment with respect to flooding derived from surface water flooding.

Groundwater Flooding

Ground water flooding is a result of upwelling in occurrences where the water table or confined aquifers rises above the ground surface. This tends to occur after long periods of sustained rainfall and/or very high tides. High volumes of rainfall and subsequent infiltration to ground will result in a rising of the water table. Groundwater flooding tends to occur in low-lying areas, where with additional groundwater flowing towards these areas, the water table can rise to the surface causing groundwater flooding. The sources consulted such as the CFRAM mapping and GSI records show no indication that the Flood Defences West site is subject to Groundwater derived flooding. However, ground investigations indicate high permeability in the subsoils. This in combination with extreme tidal flood events may lead to groundwater flooding within the subject site. The proposed development site area is considered to require a detailed flood risk assessment with respect to groundwater flooding.

Pluvial Flood Risk

Pluvial flooding results from heavy rainfall that exceeds ground infiltration capacity or more commonly in Ireland where the ground is already saturated from previous rainfall events. This causes ponding and flooding at localised depressions. Pluvial flooding is commonly a result of changes to the natural flow regime such as the implementation of hard surfacing and improper drainage design. Sources such as the CFRAM mapping and PFRA mapping show no indication that the Flood Defences West site is subject to pluvial derived flooding. Pluvial flooding will be considered in the design of drainage systems as part of planned developments.

4.3 Conclusion of Stage 2 SFRA

The information provided in this section identifies that there is high level of coastal/fluvial and groundwater flood risk arising on the Flood Defences West site. This will be assessed further in Stage 3 Flood Risk Assessment.

5. STAGE 3 DETAILED FLOOD RISK ASSESSMENT

5.1 Introduction

Stages 1 and 2 of the flood risk assessment for the proposed Flood Defences West Development have indicated that the subject site and adjacent lands are liable to flood in medium and high probability exceedance events from tidal/fluvial and groundwater sources. The hydraulic assessment of the proposed development is summarised below.

5.2 Coastal / Fluvial Flooding

A one-dimensional (1D) model has been prepared to ascertain the effects of extreme tidal and combination tidal/fluvial events. A 1D model was utilised as it was determined that the Suir Estuary is dominated by tidal flows in the longitudinal flow direction. The model was developed with surveyed topographic and channel cross-sections, OPW Cross-sections and GSI / Marine Institute Infomar Sea-bed survey of the Waterford Harbour Area, LiDAR data and a detailed hydrological assessment of the catchment.

The findings from the hydraulic model are that critical flooding and flood levels in the estuary and on the site are as a consequence of the tidal storm surge conditions. Fluvial flood flows at this location contribute very little to increasing the peak flood levels in the Suir. Flood levels are summarised in Table 5.1 below. The removal of the defended lands as a tidal inundation area will have a negligible effect on the flood depths and will not have any perceivable effects on adjacent lands. Climate change allowances as per the OPW Climate Change Sectoral Adaptation Plan (2015) are presented in Table 5.2 for the mid-range future scenario (MRFS) and the high end future scenario (HEFS).

In accordance with *OPW The Planning System and Flood Risk Management Guidelines for Planning Authorities (2009),* the OPW MRFS climate change allowance should be adopted as the minimum for all design flood levels.

Table 5.1 Flood levels derived Waterford North Quays SFRA

Return Period 1 in XX year	Existing Flood level (excl. climate change) (m OD) Note 1	MRFS Flood Level (m OD) Note 2
2	2.72	3.27
10	3.00	3.55
20	3.11	3.66
50	3.22	3.77
100	3.33	3.88
200	3.45	4.00
500	3.58	4.13
1000	3.69	4.24

Notes:

1. Flood Levels given above are taken from the hydraulic model based on a combined analysis of the tidal 1 in XX-year event / 1 in 2 year fluvial event at an upstream location at the confluence of the River Blackwater.
2. MRFS climate change allowance = (+0.55m which consists of +0.50m for climate change and +0.05m for isostatic tilt)

Table 5.2 Extract from Climate Change sectoral Adaptation Plan (2015)

Parameter	MRFS	HEFS
Extreme Rainfall Depths	+ 20%	+ 30%
Peak Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 500 mm	+ 1000 mm
Land Movement	- 0.5 mm / year[1]	- 0.5 mm / year[1]
Urbanisation	*No General Allowance – Review on Case-by-Case Basis*	*No General Allowance – Review on Case-by-Case Basis*
Forestation	- 1/6 Tp[2]	- 1/3 Tp[2] + 10% SPR[3]

The highest recorded water level at the Adelphi Quays gauging station is 3.02mOD (03/Feb/2014). This corresponds to a 1 in 10 year present day flood event.

OPW guidelines generally include for a freeboard of 0.3m for walls and 0.5m for bunds.

5.2.1 Waterford City Flood Alleviation Scheme

Waterford City has previously implemented a significant flood alleviation scheme on the south side of the River Suir. The works were constructed in three separate civil works contracts and on completion is protecting the city from flooding from the rivers for events up to the 0.5% annual exceedance probability (1 in 200 years) in tidal areas and up to the 1% annual exceedance probability (1 in 100 years) in non tidal areas. The design heights were increased from the modelled flood heights to accommodate the effects of climate change and uncertainty in flow estimation.
The flood defences are a maximum of 1.1 - 1.2m above ground levels to preserve river views. The design heights were increased from the modelled flood heights to accommodate the effects of climate change and uncertainty in flow estimation. A freeboard of 0.5m and 0.3m was implemented in tidal and non-tidal areas respectively. The design for Waterford South Quays flood defences features glass flood defences prominently. The implemented design height for the Waterford South Quays flood defence wall is 3.7mOD.

5.3 Groundwater Flooding

Along the line of the eastern periphery of the proposed flood defences in the vicinity of the Plunkett Station, the ground layers immediately below the surface typically comprise of permeable granular made ground fills which allows relatively large groundwater seepage to take place.

The following considers groundwater flooding in this area (Ch.370 to Ch.000) and potential future groundwater flooding associated with climate change and rising sea water levels.

5.3.1 Monitoring of Groundwater Levels at Plunkett Station

Boreholes were undertaken by IGSL in late 2019. Both cable percussion (CP) and rotary coring (RC) were undertaken at each borehole location shown in figure 5.1 below. Due to issues with site access, IGSL installed the required piezometer with datalogger in BH302 on 7th May 2020 to monitor ground water levels. Ground water level readings from the 7th May to 22nd December 2020 have been analysed as part of this assessment.

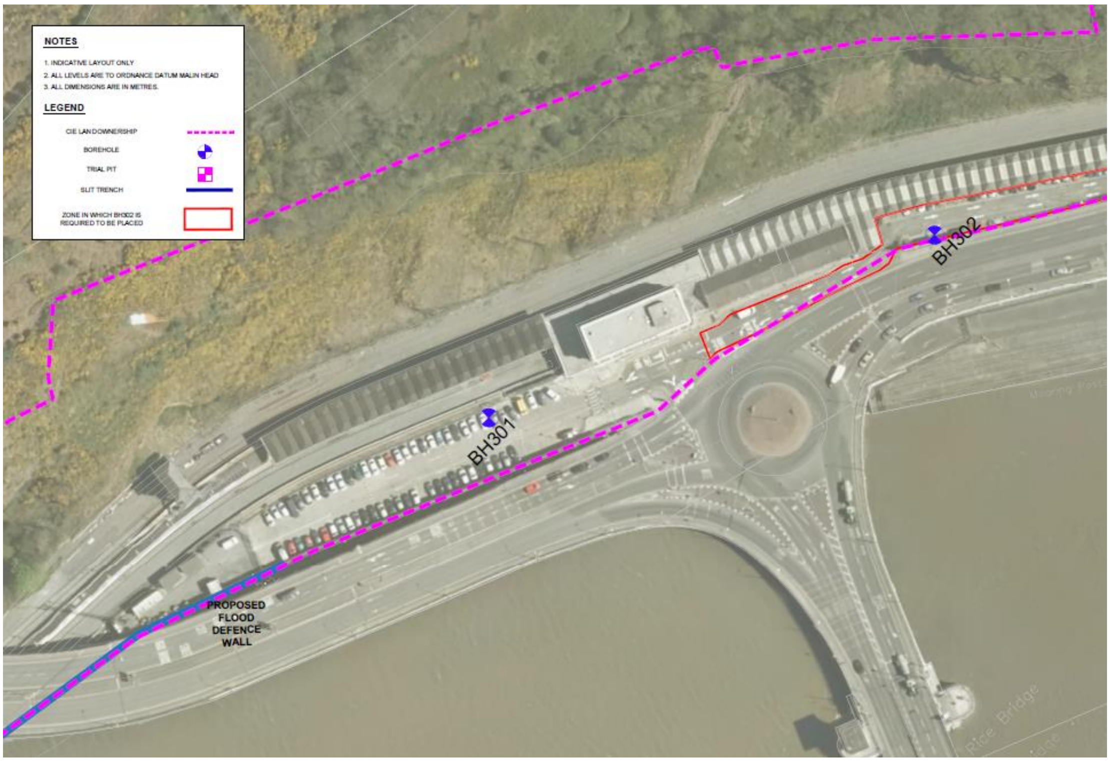


Figure 5.1 Borehole locations

The borehole records indicate bedrock very close to ground level, typically 1m to 3m below ground level (with potential local minima of 3m below ground level as suggested in some less detailed logs) with a relatively thin layer of granular overburden and made ground below existing pavement. These findings are positive from a flood protection perspective, as bedrock is typically seen as a low permeability medium, except in localised zones where it is very weathered.

The BH 302 piezometer (with datalogger) was installed with a response zone in the granular overburden material in order to track the change of groundwater levels in this material. A groundwater level observation graph was produced using the datalogger readings. This graph was superimposed onto a graph of the River Suir levels for the same period to investigate if there was a correlation between the dataset (Appendix D).

Based on the analysis of the available datasets it would appear that:

i. the tidal fluctuations in the River Suir during the normal conditions (high tide up to 2.0m OD) have a near-negligible impact on the groundwater levels in BH302, which seem stable at around +1.00m OD.

ii. Tidal maxima during high water (above 2.0m OD) induces the rise in BH302 to the level of approximately 0.9-1.0m below the tidal maxima. The maximum reading in BH302 also lags the tidal maximum for approximately 3 hours.

5.3.2 Record of Flood Event at Plunkett Station (20th October 2020)

During the flood event of 20th October 2020 when the tracks at Plunkett station were flooded by overtopping for the existing sea wall (high tide at +2.78m OD). There was significant flooding on the railway line (approx. 0.6m of standing water). The recorded groundwater level rose to +1.87m OD. BH302 is approximately 20m closer to River Suir than the railway tracks. It was observed during this flood event that there was evidence of groundwater ingress to the west of Plunkett station in the vicinity of the Road Over Bridge prior to the overtopping of the wall.

5.3.3 Risk of Groundwater Flooding

From the obtained data it would appear that there is a significant risk of ground water flooding at the following locations:

- Ch.370 to Ch.310 (i.e., large groundwater inflows through the overburden towards the rail infrastructure during flood events under present day conditions);
- Ch.310 to Ch.000 (i.e., some groundwater inflows through the overburden towards the rail infrastructure during flood events under present day conditions which is likely to increase with future climate change and rising tide levels);

5.4 Flood Defences West Proposed Standard of Protection

5.4.1 Design Flood Level

A Design Flood Level (200 year flood including Climate Change) of 4.30mOD has been calculated for the Flood Defences West based on:

- 0.5% annual exceedance probability combined tidal-fluvial event (3.45 m OD);
- An additional 0.55 m to allow for climate change and isostatic tilt; and,
- 0.30 m freeboard, including local wave wake effects.

The proposed flood defences will have a minimum top of wall level of 4.30mOD.

The combination 1000 year tide and 2 year fluvial flood level including climate change is 4.240mOD. The proposed Design Flood level of 4.30mOD is above the 1000 year flood including climate change level which is a requirement for “Highly Vulnerable developments” as per the OPW Guidelines 2009.
The proposed standard of protection will be achieved by undertaking works as described below. The location of the proposed measures (as described in Section 1 of this report) are presented on scheme drawings within Appendix B.

6. RESIDUAL FLOOD RISK

As discussed above, the Design Height for flood protection measures along the proposed Flood Defences West is 4.30mOD. Residual risk will be managed through the use flood resilient design throughout the development. The proposed development will be subject to a maintenance plan, the maintenance will be undertaken by the relevant competent authority. Due to the nature of the flooding (tidally dominated), extreme events will be forecasted multiple days in advance.

7. FLOOD RISK ASSESSMENT CONCLUSIONS

The Proposed Flood Defences West development has been assessed for existing and future sources of flood risk. The primary sources of flood risk identified for the site are from combination of tidal/fluvial events emanating from the River Suir.

A hydraulic assessment of the potential impact of the proposed development has been completed using best practice hydraulic modelling techniques. This has concluded that there will be an imperceptible effect on extreme flood levels upstream or downstream of the proposed development and will therefore not increase flood risk within the locality. The proposed flood defences shall defend to a minimum level of 4.30mOD. This will defend the Irish Rail lands in a combination 1 in 1000 year coastal + 1 in 2 year fluvial (+ climate change factor) extreme flood event.

The proposed development has been designed with regard to flood resilient construction measures and materials. The proposed development will be subject to a maintenance plan, the maintenance will be undertaken by the relevant competent authority. The proposed development will serve existing and future development within Waterford City and environs. The proposed project shall reinforce the transportation network, which will assist in achieving strategic planning objectives in the immediate vicinity and County Waterford as a whole.

The proposed development is considered to a water compatible development as per the OPW Guidelines. The proposed development is therefore appropriate for the associated flood risk as per the OPW Guidelines.

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY OF TERMS

Catchment: The area that is drained by a river or artificial drainage system.

Catchment Flood Risk Assessment and Management Studies (CFRAMS): A catchment-based study involving an assessment of the risk of flooding in a catchment and the development of a strategy for managing that risk in order to reduce adverse effects on people, property and the environment. CFRAMS precede the preparation of Flood Risk Management Plans (see entry for FRMP).

Climate change: Long-term variations in global temperature and weather patterns, which occur both naturally and as a result of human activity, primarily through greenhouse gas emissions.

Core of an urban settlement: The core area of a city, town or village which acts as a centre for a broad range of employment, retail, community, residential and transport functions.

Detailed flood risk assessment: A methodology to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of flood hazard and potential risk to an existing or proposed development, of its potential impact on flood elsewhere and of the effectiveness of any proposed measures.

Estuarial (or tidal) flooding: Flooding from an estuary, where water level may be influenced by both river flows and tidal conditions, with the latter usually being dominant.

Flooding (or inundation): Flooding is the overflowing of water onto land that is normally dry. It may be caused by overtopping or breach of banks or defences, inadequate or slow drainage of rainfall, underlying groundwater levels or blocked drains and sewers. It presents a risk only when people, human assets and ecosystems are present in the areas that flood.

Flood Relief Schemes (FRS): A scheme designed to reduce the risk of flooding at a specific location.

Flood Defence: A man-made structure (e.g. embankment, bund, sluice gate, reservoir or barrier) designed to prevent flooding of areas adjacent to the defence.

Flood Risk Assessment (FRA): FRA can be undertaken at any scale from the national down to the individual site and comprises 3 stages: Flood risk identification, initial flood risk assessment and detailed flood risk assessment.

Flood Risk Identification: A desk- based study to identify whether there may be any flooding or surface water management issues related to a plan area or proposed development site that may warrant further investigation.

Flood Hazard: The features of flooding which have harmful impacts on people, property or the environment (such as the depth of water, speed of flow, rate of onset, duration, water quality, etc.).

Floodplain: A flood plain is any low-lying area of land next to a river or stream, which is susceptible to partial or complete inundation by water during a flood event.

Flood Risk: An expression of the combination of the flood probability, or likelihood and the magnitude of the potential consequences of the flood event.

Flood Storage: The temporary storage of excess run-off, or river flow in ponds, basins, reservoirs or on the flood plain.

Flood Zones: A geographic area for which the probability of flooding from rivers, estuaries or the sea is within a particular range.

Fluvial flooding: Flooding from a river or other watercourse.

Groundwater flooding: Flooding caused by groundwater escaping from the ground when the water table rises to or above ground level.

Initial flood risk assessment: A qualitative or semi-quantitative study to confirm sources of flooding that may affect a plan area or proposed development site, to appraise the adequacy of existing information, to provide a qualitative appraisal of the risk of flooding to development, including the scope of possible mitigation measures, and the potential impact of development on flooding elsewhere, and to determine the need for further detailed assessment.

Freeboard: Factor of safety applied for water surfaces. Defines the distance between normal water level and the top of a structure, such as a dam, that impounds or restrains water.

Justification Test: An assessment of whether a development proposal within an area at risk of flooding meets specific criteria for proper planning and sustainable development and demonstrates that it will not be subject to unacceptable risk nor increase flood risk elsewhere. The justification test should be applied only where development is within flood risk areas that would be defined as inappropriate under the screening test of the sequential risk-based approach adopted by this guidance.

Likelihood (probability) of flooding: A general concept relating to the chance of an event occurring. Likelihood is generally expressed as a probability or a frequency of a flood of a given magnitude or severity occurring or being exceeded in any given year. It is based on the average frequency estimated, measured or extrapolated from records over a large number of years and is usually expressed as the chance of a particular flood level being exceeded in any one year. For example, a 1-in-100 or 1% flood is that which would, on average, be expected to occur once in 100 years, though it could happen at any time.

Ordnance Datum (or OD) Malin: is a vertical datum used by an ordnance survey as the basis for deriving altitudes on maps. A spot height may be expressed as AOD for “above ordnance datum”. Usually mean sea level (MSL) is used for the datum. In the Republic of Ireland, OD for the Ordnance Survey of Ireland is Malin Ordnance Datum: the MSL at Portmoor Pier, Malin Head, County Donegal, between 1960 and 1969. Prior to 1970, Poolbeg Ordnance Datum was used: the low water of spring tide at Poolbeg lighthouse, Dublin, on 8 April 1837. Poolbeg OD was about 2.7 metres lower than Malin OD.

Management Train/Treatment Train: the sequence of drainage components that collect, convey, store and treat runoff as it drains through the site.

Mitigation: The term is used to describe an action that helps to lessen the impacts of a process or development on the receiving environment. It is used most often in association with measures that would seek to reduce negative impacts of a process or development.

Pathways: These provide the connection between a particular source (e.g. high river or tide level) and the receptor that may be harmed (e.g. property). In flood risk management, pathways are often ‘blocked’ by barriers, such as flood defence structures, or otherwise modified to reduce the incidence of flooding.

Pluvial flooding: Usually associated with convective summer thunderstorms or high intensity rainfall cells within longer duration events, pluvial flooding is a result of rainfall-generated overland flows which arise before run-off enters any watercourse or sewer. The intensity of rainfall can be such that the run-off totally overwhelms surface water and underground drainage systems.

Regional Planning Guidelines (RPG): These provide the regional context and priorities for applying national planning strategy to each NUTS III region and encourage greater co-ordination of planning policies at the city/county level. RPGs are an important part of the flood policy hierarchy as they can assist in co-ordinating flood risk management policies at the regional level.

Resilience: Sometimes known as "wet-proofing", resilience relates to how a building is constructed in such a way that, although flood water may enter the building, its impact is minimised, structural integrity is maintained, and repair, drying and cleaning and subsequent reoccupation are facilitated.

Receptors: Things that may be harmed by flooding (e.g. people, houses, buildings or the environment).

Residual risk: The risk which remains after all risk avoidance, substitution and mitigation measures have been implemented, on the basis that such measures can only reduce risk, not eliminate it.

Sequential Approach: The sequential approach is a risk-based method to guide development away from areas that have been identified through a flood risk assessment as being at risk from flooding. Sequential approaches are already established and working effectively in the plan-making and development management processes.

Sustainable Drainage System (SuDS): Drainage systems that are considered to be environmentally beneficial, causing minimal or no long-term detrimental impact.

Site-specific Flood Risk Assessment: An examination of the risks from all sources of flooding of the risks to and potentially arising from development on a specific site, including an examination of the effectiveness and impacts of any control or mitigation measures to be incorporated in that development.

Source: Refers to a source of hazard (e.g. the sea, heavy rainfall).

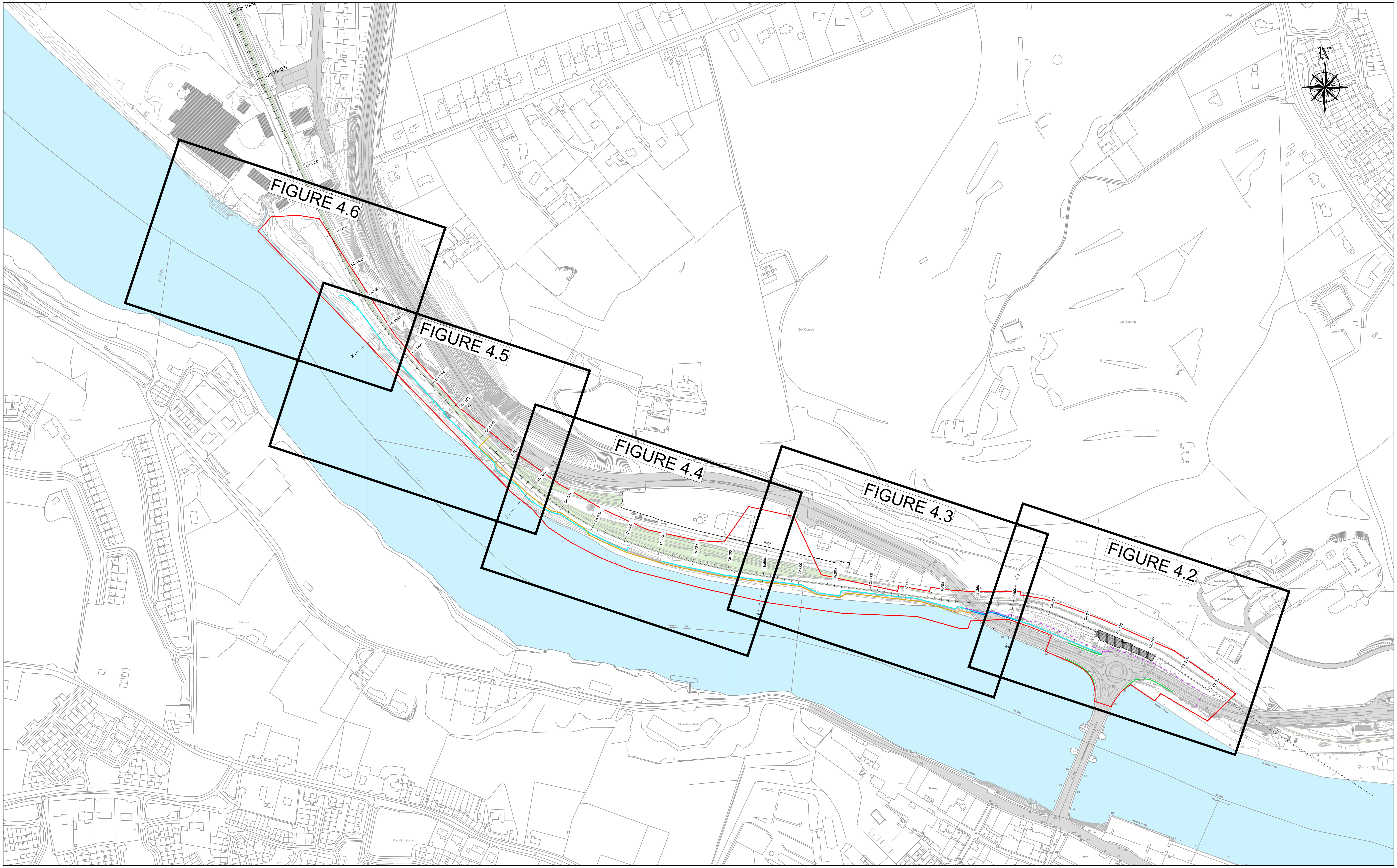
Strategic Flood Risk Assessment: The assessment of flood risk on a wide geographical area against which to assess development proposed in an area (Region, County, Town).

Vulnerability: The resilience of a particular group of people or types of property or habitats, ecosystems or species to flood risk, and their ability to respond to a hazardous condition and the damage or degree of impact they are likely to suffer in the event of a flood. For example, elderly people may be more likely to suffer injury, and be less able to evacuate, in the event of a rapid flood than younger people.

Source: *The definitions above are sourced from the DoEHLG Guidelines for Planning Authorities on 'The Planning System and Flood Risk Management, 2009' and Ciria 753 "the SuDS Manual".*

APPENDIX B

SCHEME DRAWINGS



Project Ireland 2040
Building Ireland's Future

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Waterford City & County Council

NTA
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Iarnród Éireann
Irish Rail

ROD
ROUGHAN & O'DONOVAN
Consulting Engineers
Civil - Structural - Transportation - Environmental

Arena House, Arena Road, Sandyford, Dublin 18, Ireland
t +353 (0) 1 294 0800
f +353 (0) 1 294 0820
www.rod.ie

Project Title
WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT FLOOD DEFENCES WEST

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

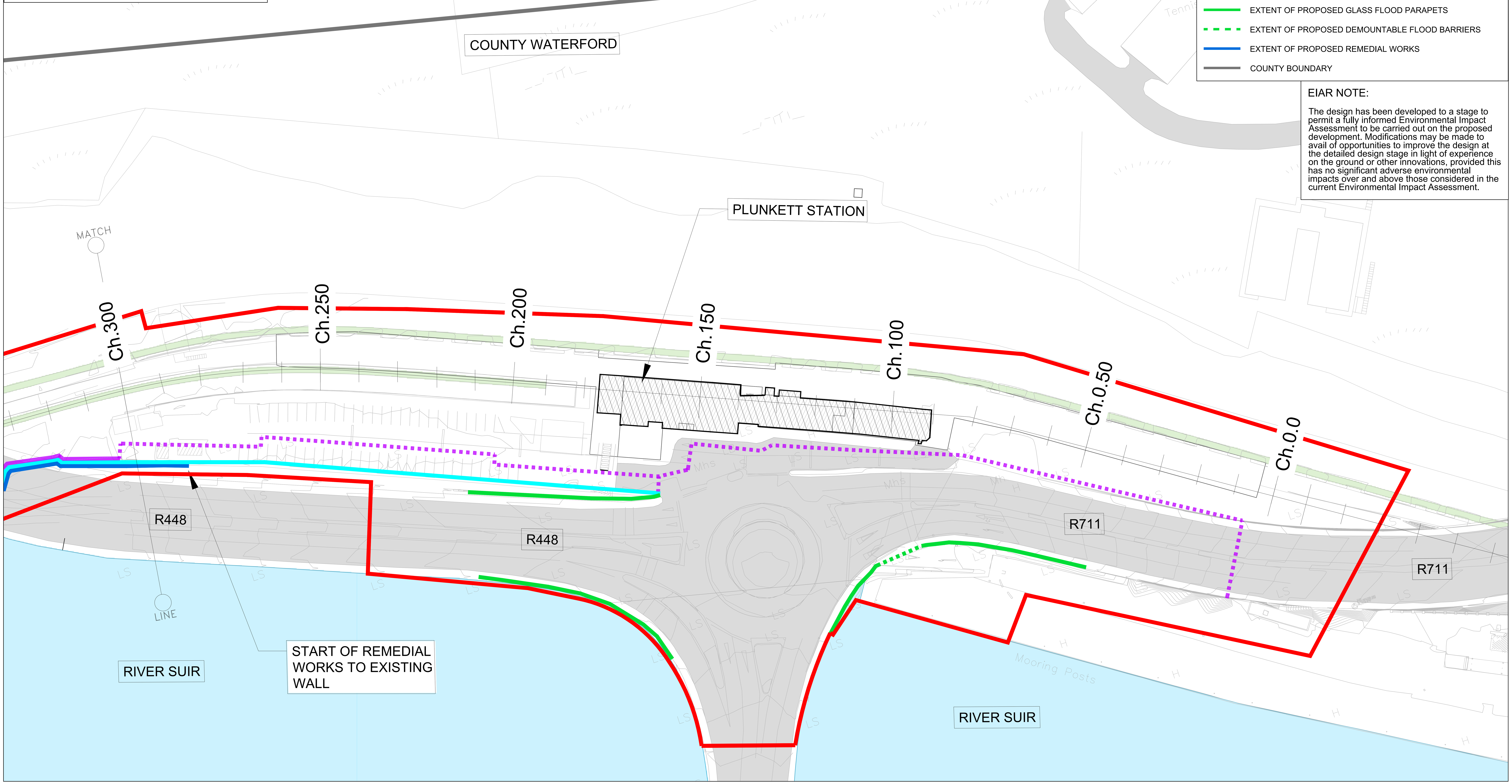
Drawing Title:
Proposed Extents of Structural Works Sheet - Key Plan

Designed:	YB	File:		Status:	E.I.A.R.
Drawn:	IM	Job No:	18.141		
Checked:	BC	Scale:	1:2500 (@ A3)	Drawing No: FIG 4.1	Rev: -
Approved:	TD	Date:	OCTOBER 2021		

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

NOTES:

1. REFER TO FIGURES 4.7 TO 4.10 FOR NOTES ON CROSS SECTION DETAILS.
2. THE WESTERN END OF FLOOD DEFENCES AT CH.1090 IS SET AT A NATURAL HIGH POINT OF THE TERRAIN AND THE RAIL TRACK.
3. A C.20M UNDERGROUND ISOLATION STRUCTURE WILL BE CONSTRUCTED AT CH.1090. TEMPORARY OVERGROUND FLOOD BARRIERS WILL BE PROVIDED ALONG THE STRUCTURE SHOULD THESE BE REQUIRED TO BE IMPLEMENTED DURING A FLOOD EVENT.



LEGEND

- EXTENT OF EXISTING RAILWAY LINES
- EXISTING QUAY WALL
- EXTENT OF PROPOSED SHEET PILE FLOOD DEFENCE WALL
- PROPOSED SHALLOW IMPERMEABLE UNDERGROUND TRENCH
- POTENTIAL SHALLOW IMPERMEABLE UNDERGROUND TRENCH
- SITE BOUNDARY
- EXTENT OF PROPOSED GLASS FLOOD PARAPETS
- EXTENT OF PROPOSED DEMOUNTABLE FLOOD BARRIERS
- EXTENT OF PROPOSED REMEDIAL WORKS
- COUNTY BOUNDARY

EIAR NOTE:

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Consulting Engineers
Civil - Structural - Transportation - Environmental
Arena House, Arena Road, Sandyford, Dublin 18, Ireland
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Project Title
WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT FLOOD DEFENCES WEST

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Drawing Title:
Proposed Extents of Structural Work
Sheet 1 of 5

Designed: YB	File:	Status: E.I.A.R.	
Drawn: IM	Job No: 18.141		
Checked: BC	Scale: 1:500 (@ A3)	Drawing No: FIG 4.2	Rev: -
Approved: TD	Date: OCTOBER 2021		

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

NOTES:

1. REFER TO FIGURES 4.7 TO 4.10 FOR NOTES ON CROSS SECTION DETAILS.
2. THE WESTERN END OF FLOOD DEFENCES AT CH.1090 IS SET AT A NATURAL HIGH POINT OF THE TERRAIN AND THE RAIL TRACK.
3. A C.20M UNDERGROUND ISOLATION STRUCTURE WILL BE CONSTRUCTED AT CH.1090. TEMPORARY OVERGROUND FLOOD BARRIERS WILL BE PROVIDED ALONG THE STRUCTURE SHOULD THESE BE REQUIRED TO BE IMPLEMENTED DURING A FLOOD EVENT.

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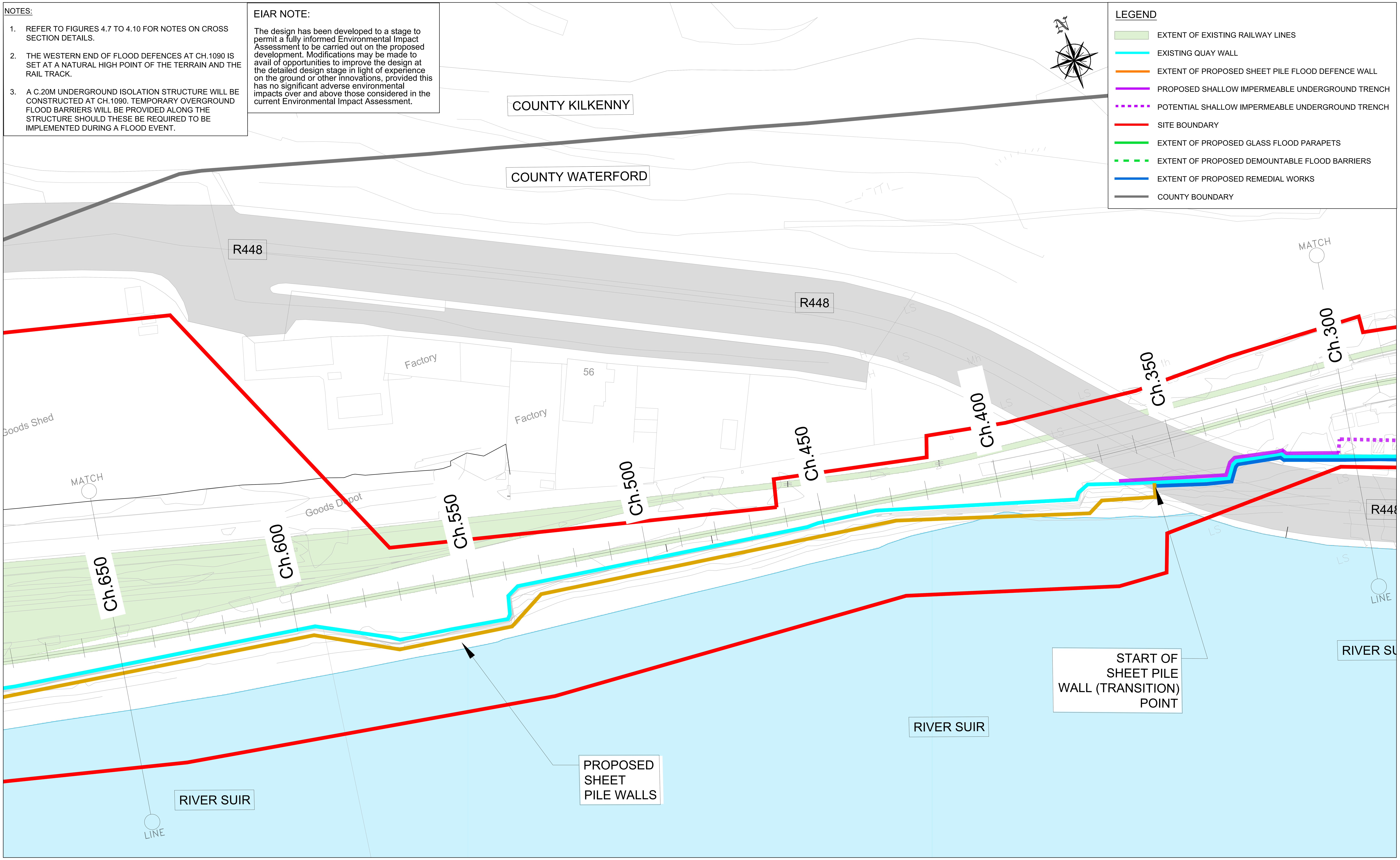

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Project Title: WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT FLOOD DEFENCES WEST

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Drawing Title: Proposed Extents of Structural Works Sheet 2 of 5

Designed:	YB	File:		Status:	E.I.A.R.
Drawn:	IM	Job No:	18.141		
Checked:	BC	Scale:	1:500 (@ A3)	Drawing No: FIG 4.3	Rev: -
Approved:	TD	Date:	OCTOBER 2021		

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NOTES:

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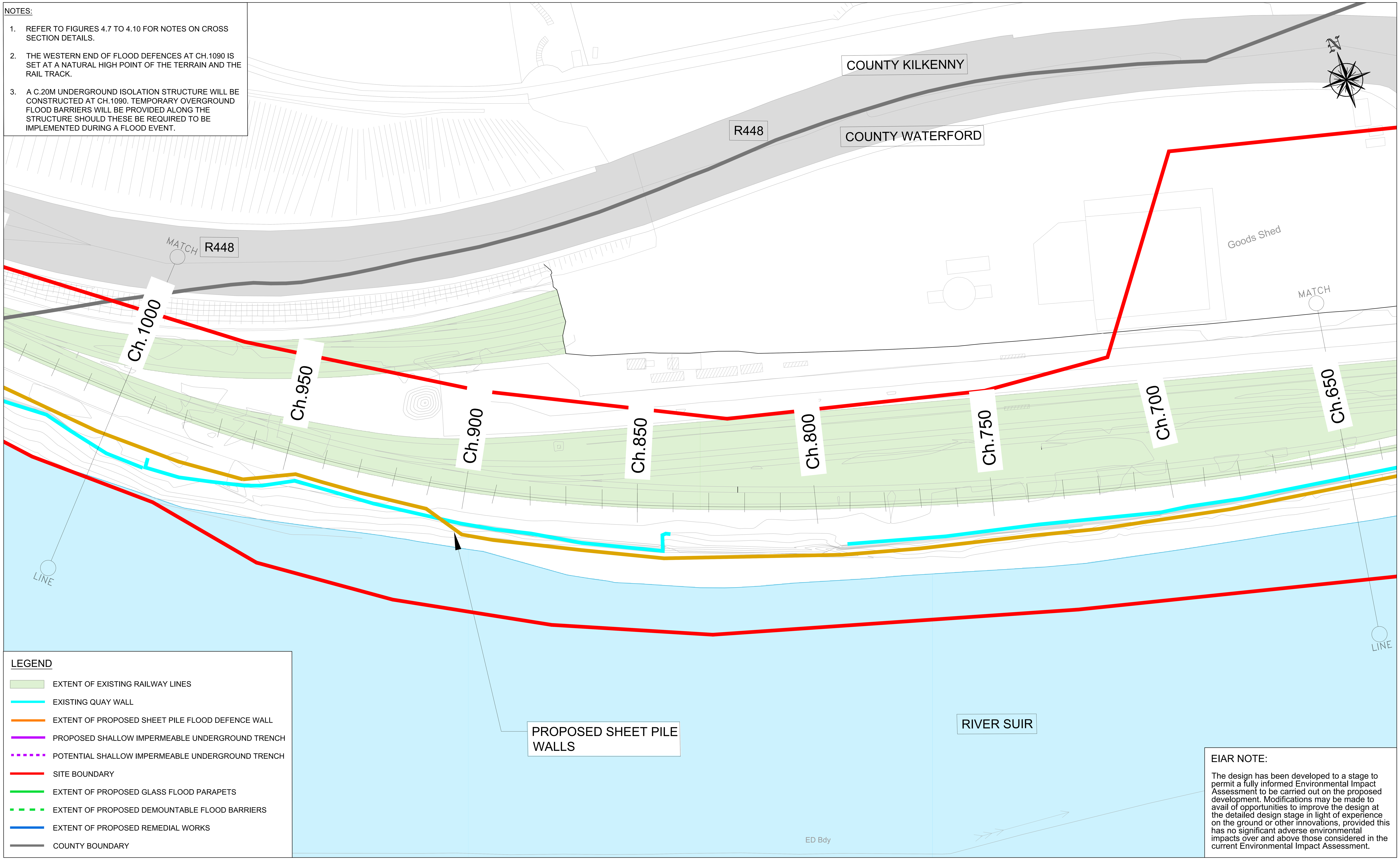

LEGEND

- EXTENT OF EXISTING RAILWAY LINES
- EXISTING QUAY WALL
- EXTENT OF PROPOSED SHEET PILE FLOOD DEFENCE WALL
- PROPOSED SHALLOW IMPERMEABLE UNDERGROUND TRENCH
- POTENTIAL SHALLOW IMPERMEABLE UNDERGROUND TRENCH
- SITE BOUNDARY
- EXTENT OF PROPOSED GLASS FLOOD PARAPETS
- EXTENT OF PROPOSED DEMOUNTABLE FLOOD BARRIERS
- EXTENT OF PROPOSED REMEDIAL WORKS
- COUNTY BOUNDARY

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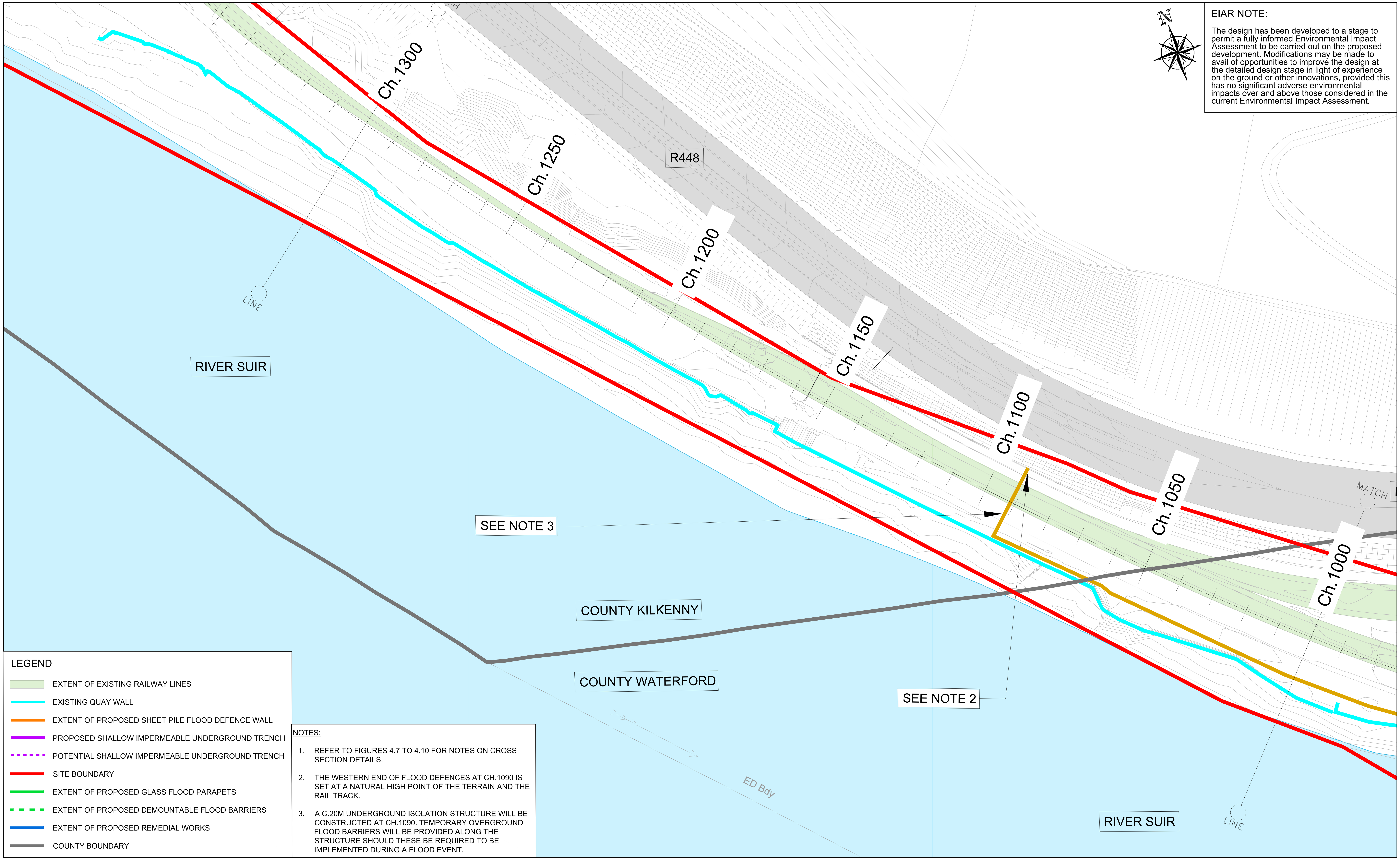
Project Title: WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT FLOOD DEFENCES WEST

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Drawing Title: Proposed Extents of Structural Works Sheet 3 of 5

Designed:	YB	File:		Status:	E.I.A.R.
Drawn:	IM	Job No:	18.141		
Checked:	BC	Scale:	1:500 (@ A3)	Drawing No:	FIG 4.4
Approved:	TD	Date:	OCTOBER 2021	Rev:	-

DO NOT SCALE USE FIGURED DIMENSIONS ONLY



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LEGEND

- EXTENT OF EXISTING RAILWAY LINES
- EXISTING QUAY WALL
- EXTENT OF PROPOSED SHEET PILE FLOOD DEFENCE WALL
- PROPOSED SHALLOW IMPERMEABLE UNDERGROUND TRENCH
- POTENTIAL SHALLOW IMPERMEABLE UNDERGROUND TRENCH
- SITE BOUNDARY
- EXTENT OF PROPOSED GLASS FLOOD PARAPETS
- EXTENT OF PROPOSED DEMOUNTABLE FLOOD BARRIERS
- EXTENT OF PROPOSED REMEDIAL WORKS
- COUNTY BOUNDARY

NOTES:

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ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Drawing Title: Proposed Extents of Structural Works Sheet 4 of 5

Designed:	YB	File:		Status:	E.I.A.R.
Drawn:	IM	Job No:	18.141		
Checked:	BC	Scale:	1:500 (@ A3)	Drawing No:	FIG 4.5
Approved:	TD	Date:	OCTOBER 2021	Rev:	-

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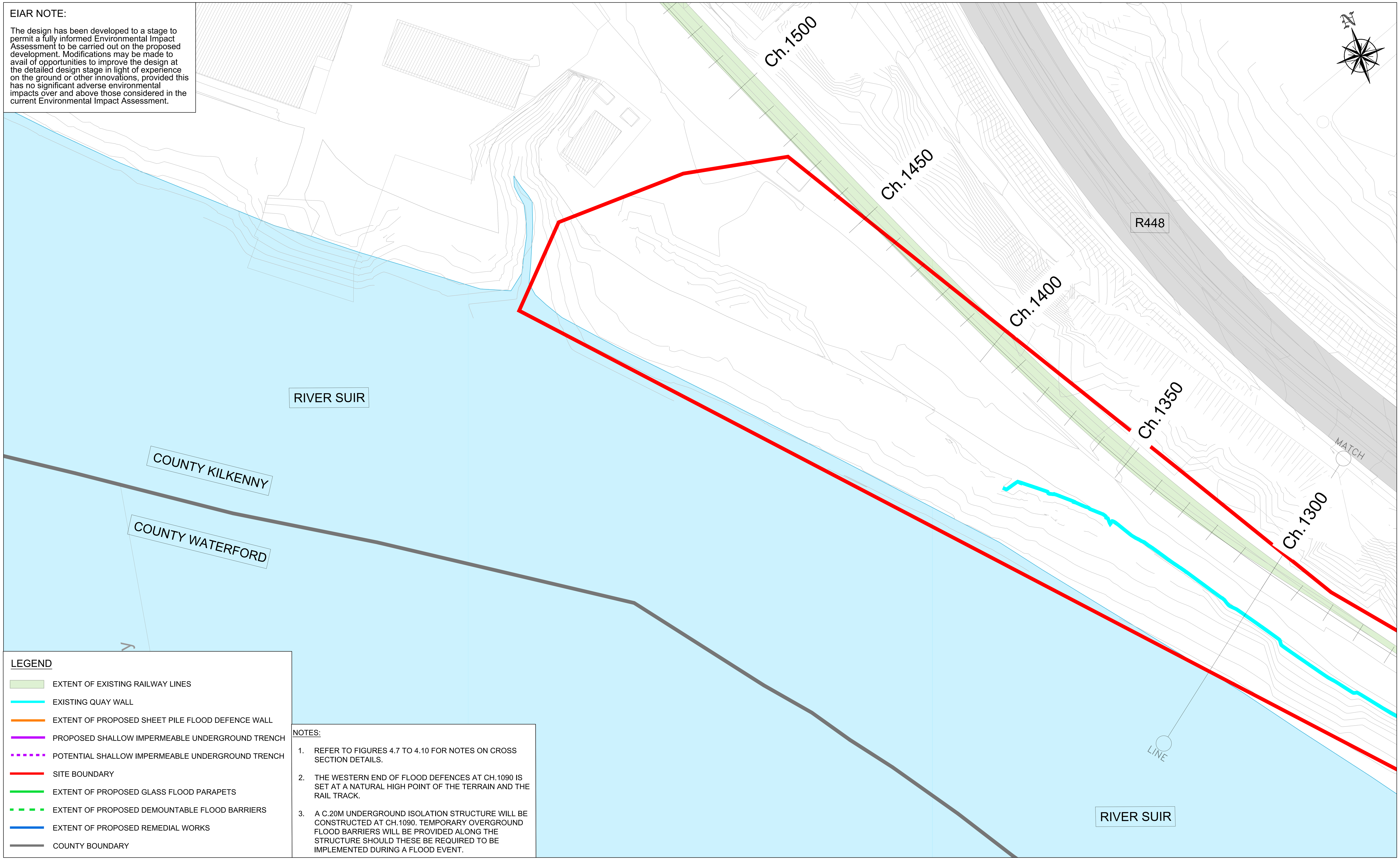

LEGEND

- EXTENT OF EXISTING RAILWAY LINES
- EXISTING QUAY WALL
- EXTENT OF PROPOSED SHEET PILE FLOOD DEFENCE WALL
- PROPOSED SHALLOW IMPERMEABLE UNDERGROUND TRENCH
- POTENTIAL SHALLOW IMPERMEABLE UNDERGROUND TRENCH
- SITE BOUNDARY
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NOTES:

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Project Title: **WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT FLOOD DEFENCES WEST**

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Drawing Title: Proposed Extents of Structural Works Sheet 5 of 5

Designed:	YB	File:		Status:	E.I.A.R.
Drawn:	IM	Job No:	18.141		
Checked:	BC	Scale:	1:500 (@ A3)	Drawing No: FIG 4.6	Rev: -
Approved:	TD	Date:	OCTOBER 2021		

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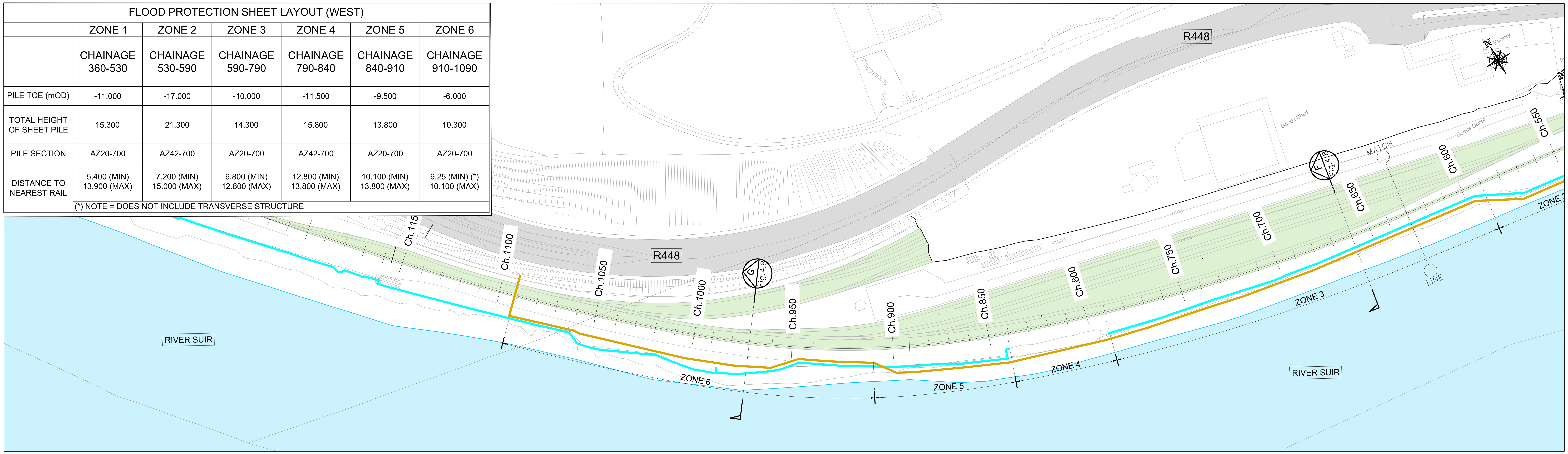
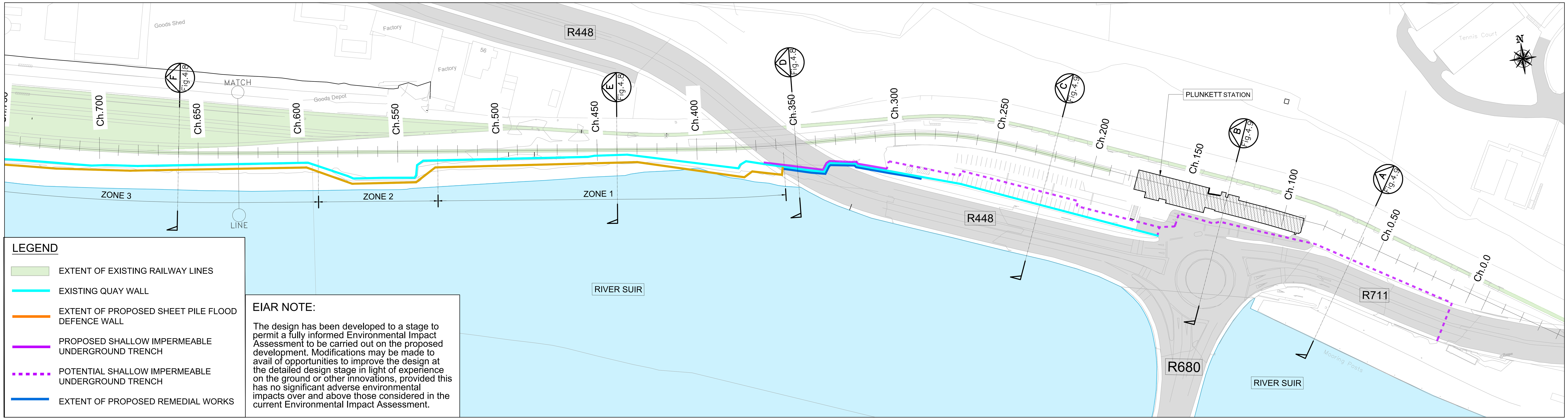
FLOOD PROTECTION SHEET LAYOUT (WEST)

	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6
	CHAINAGE 360-530	CHAINAGE 530-590	CHAINAGE 590-790	CHAINAGE 790-840	CHAINAGE 840-910	CHAINAGE 910-1090
PILE TOE (mOD)	-11.000	-17.000	-10.000	-11.500	-9.500	-6.000
TOTAL HEIGHT OF SHEET PILE	15.300	21.300	14.300	15.800	13.800	10.300
PILE SECTION	AZ20-700	AZ42-700	AZ20-700	AZ42-700	AZ20-700	AZ20-700
DISTANCE TO NEAREST RAIL	5.400 (MIN) 13.900 (MAX)	7.200 (MIN) 15.000 (MAX)	6.800 (MIN) 12.800 (MAX)	12.800 (MIN) 13.800 (MAX)	10.100 (MIN) 13.800 (MAX)	9.25 (MIN) (*) 10.100 (MAX)

(*) NOTE = DOES NOT INCLUDE TRANSVERSE STRUCTURE





LEGEND

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- EXISTING QUAY WALL
- EXTENT OF PROPOSED SHEET PILE FLOOD DEFENCE WALL
- PROPOSED SHALLOW IMPERMEABLE UNDERGROUND TRENCH
- POTENTIAL SHALLOW IMPERMEABLE UNDERGROUND TRENCH
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Project Title: WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT FLOOD DEFENCES WEST

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

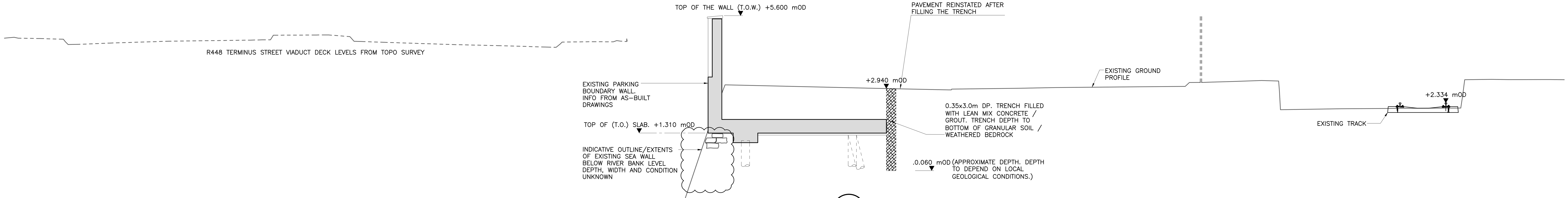
Drawing Title: Indicative Cross Sections of Structural Works - Key Plan

Designed:	YB	File:		Status:	E.I.A.R.
Drawn:	IM	Job No:	18.141		
Checked:	BC	Scale:	1:2000 (@ A3)	Drawing No: FIG 4.7	Rev: -
Approved:	TD	Date:	OCTOBER 2021		

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

NOTES:

1. HAND DIGGING TO BE EMPLOYED AROUND UTILITIES TO ADEQUATELY PROTECT SERVICES AND UTILITES.
2. TRENCH TO BE CONSTRUCTED IN SHORT SECTIONS TO MINIMISE THE TIME TRENCH IS LEFT OPEN.

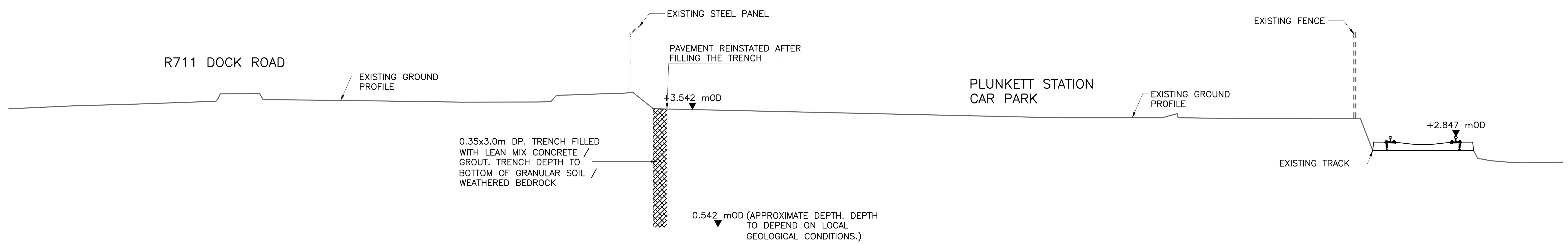


SECTION C
A1 SCALE 1:75
A3 SCALE 1:150

CROSS SECTION TAKEN AT CH:220 FACING WESTWARDS

SECTION B
A1 SCALE 1:75
A3 SCALE 1:150

CROSS SECTION TAKEN AT CH:130 FACING WESTWARDS



SECTION A
A1 SCALE 1:75
A3 SCALE 1:150

CROSS SECTION TAKEN AT CH:060 FACING WESTWARDS

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Project Title	WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT FLOOD DEFENCES WEST
	ENVIRONMENTAL IMPACT ASSESSMENT REPORT
Drawing Title:	Indicative Cross Sections of Structural Works - Sheet 1 of 2
Designed:	YB
Drawn:	IM
Checked:	BC
Approved:	TD
File:	
Job No:	18.141
Scale:	AS SHOWN
Date:	OCTOBER 2021
Status:	E.I.A.R.
Drawing No:	FIG 4.8
Rev:	-

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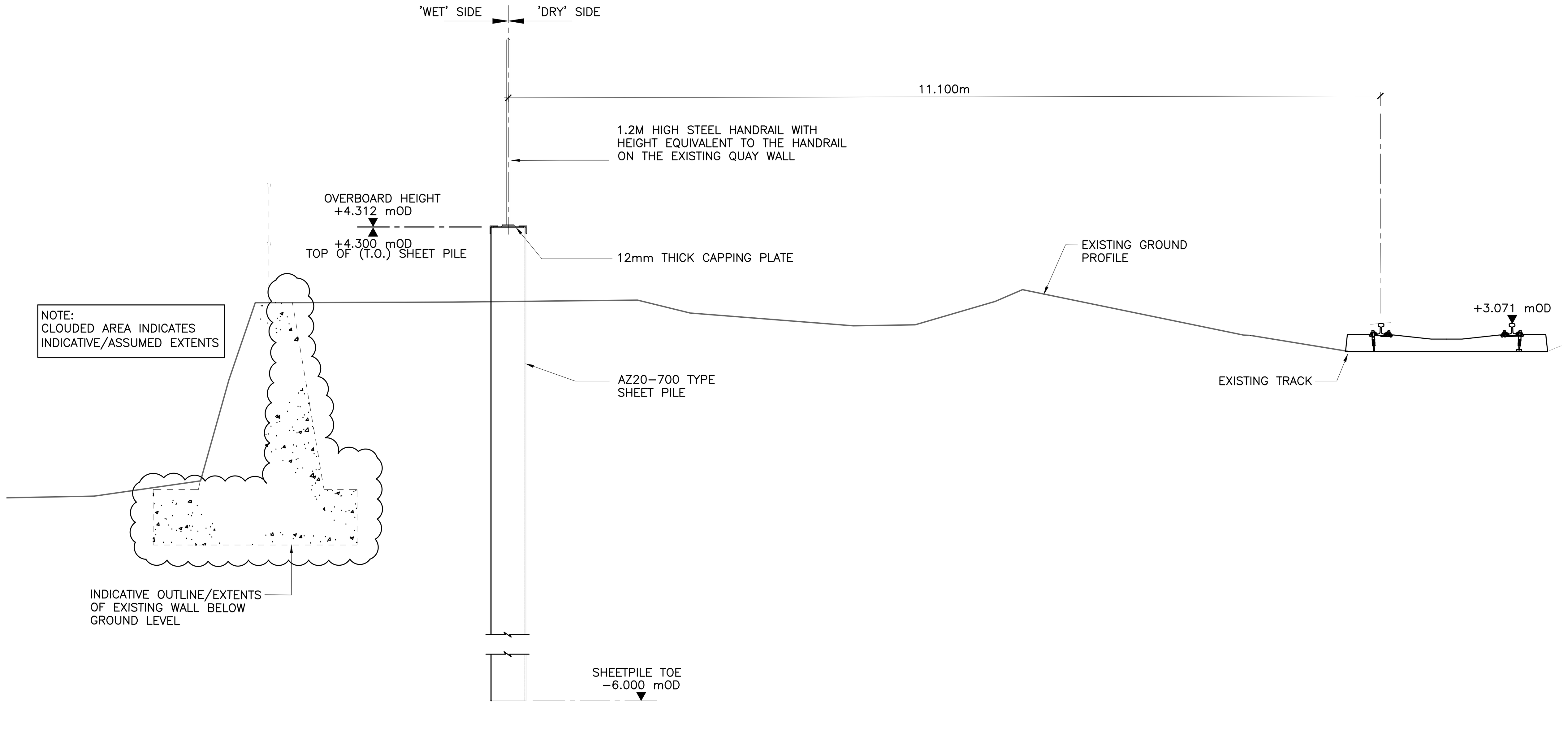
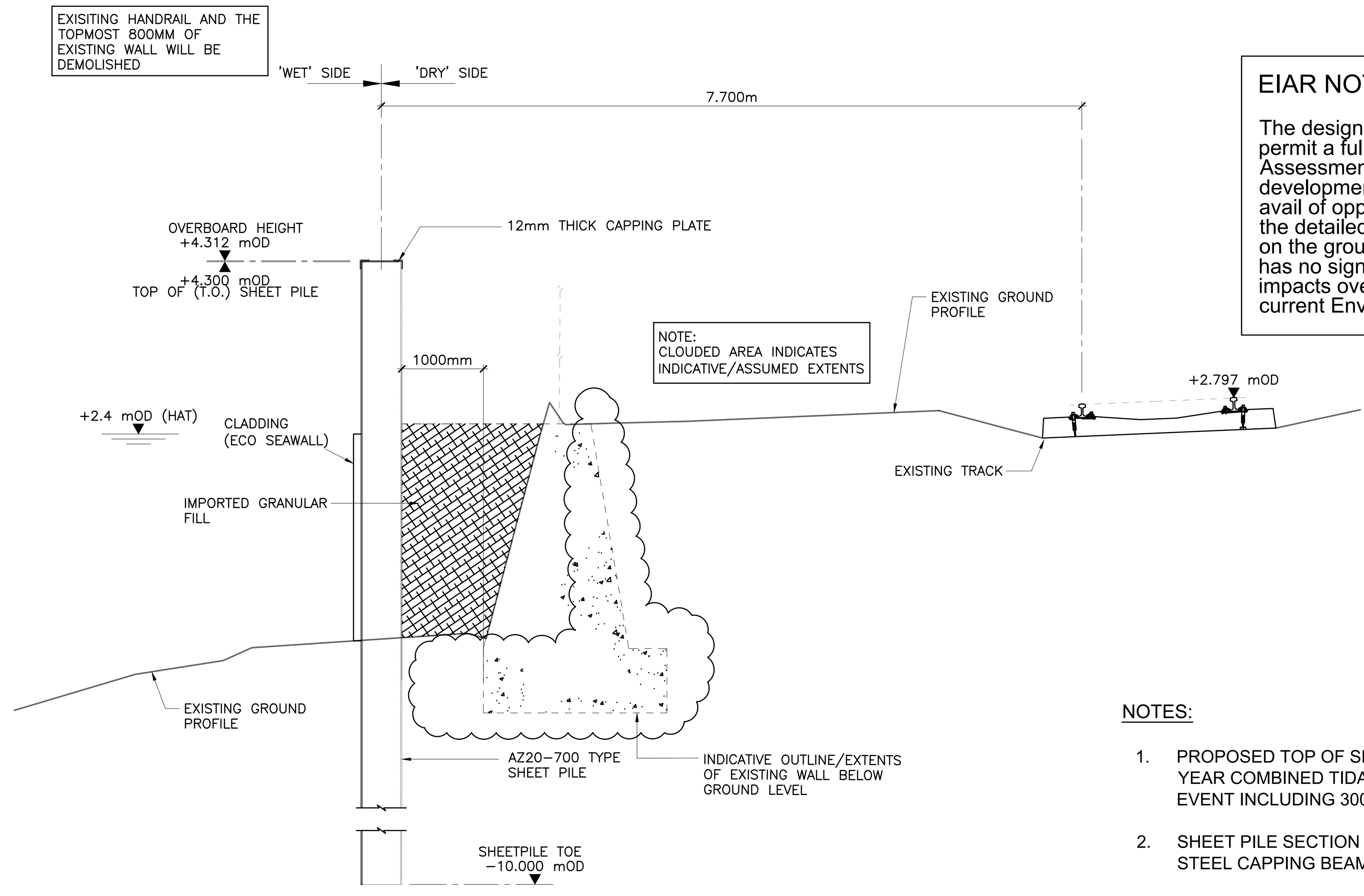


SECTION G
A1 SCALE 1:50
A3 SCALE 1:100

SECTION TAKEN AT CH:970 FACING WESTWARDS



SECTION F
A1 SCALE 1:50
A3 SCALE 1:100

SECTION TAKEN AT CH:660 FACING WESTWARDS

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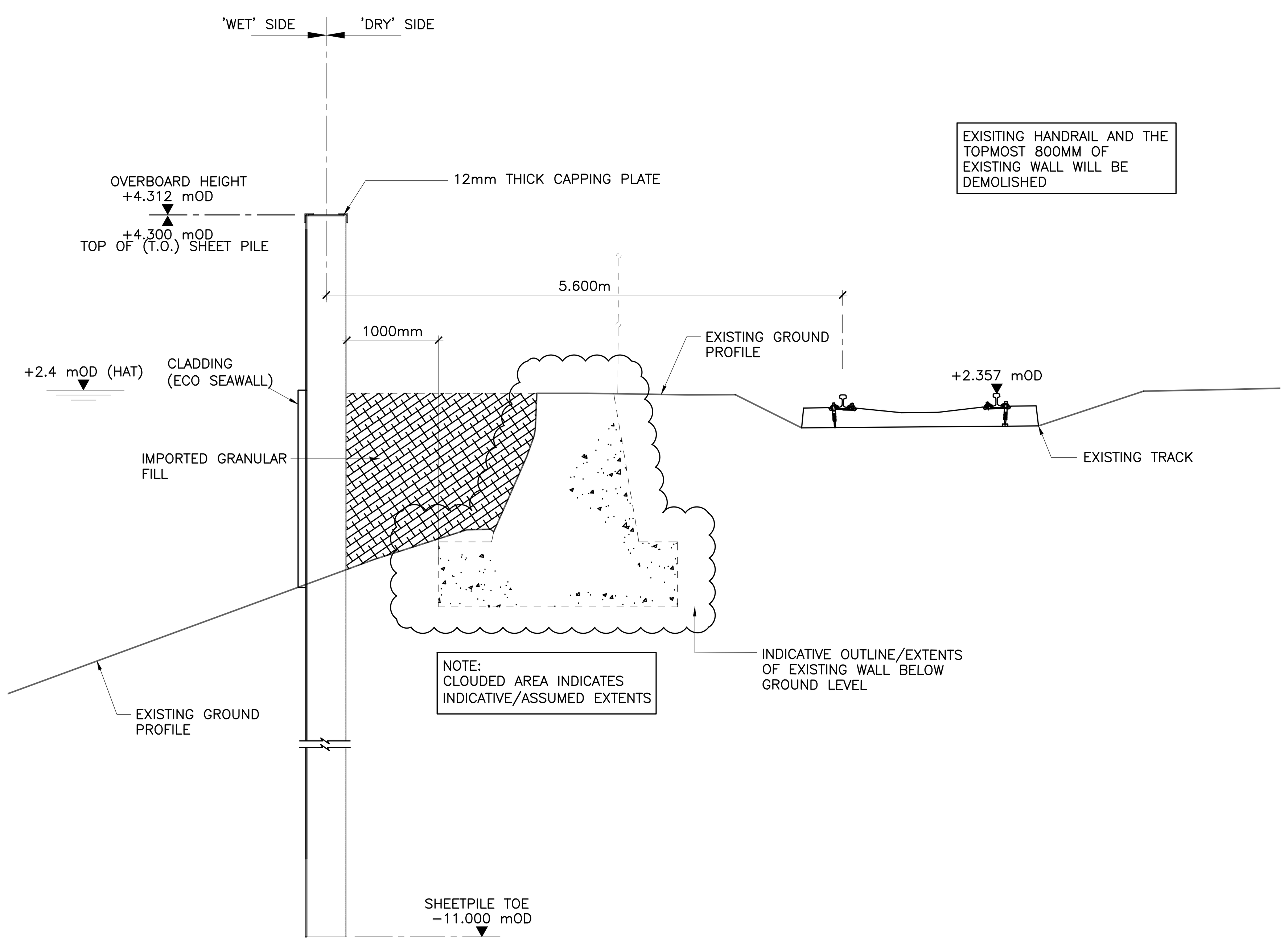
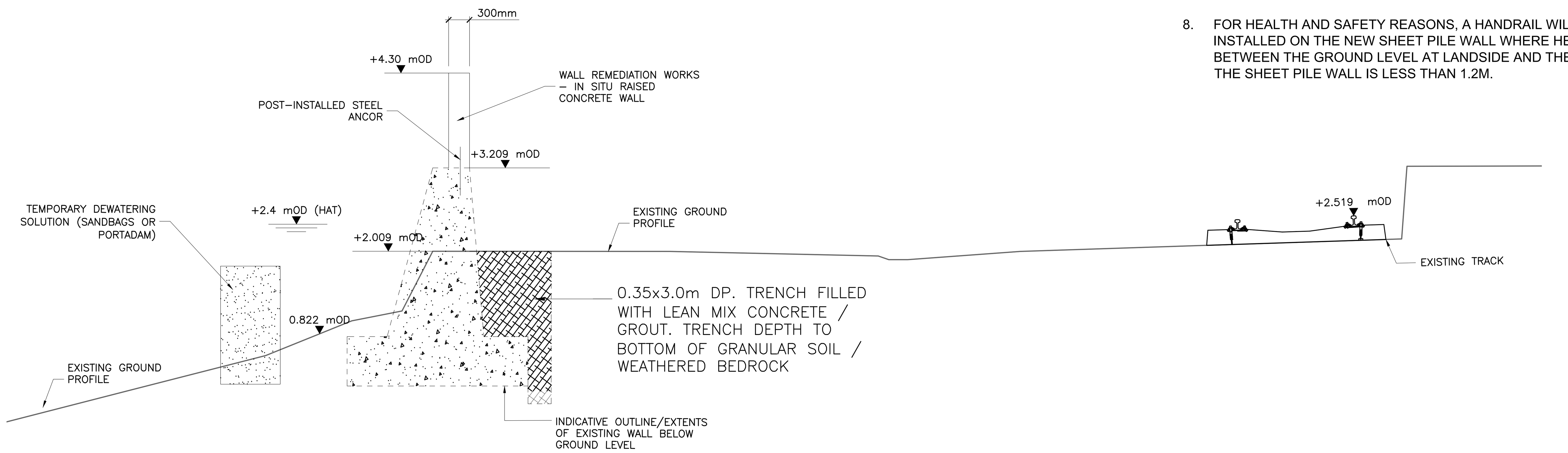
NOTES:

1. PROPOSED TOP OF SHEET PILE (+4.300MOD) TO PROVIDE 1:200 YEAR COMBINED TIDAL/ FLUVIAL PROTECTION DURING FLOOD EVENT INCLUDING 300MM FREEBOARD ALLOWANCE.
2. SHEET PILE SECTION DEPTH OF 450mm ASSUMED. PRESSED STEEL CAPPING BEAM PROPOSED.
3. A MINIMUM WIDTH 1000mm SHALL BE PROVIDED, WHERE FEASIBLE, BETWEEN THE FRONT AND BACK OF EXISTING QUAY WALL AND THE NEAREST FACE OF THE PROPOSED SHEET PILE TO MINIMIZE RISK OF CLASHES WITH THE EXISTING WALL.
4. THE PROPOSED SHEET PILE WALL WILL NOT BE DESIGNED TO RESIST NOTIONAL IMPACT FORCES ARISING FROM A DERAILMENT.
5. RIVERSIDE SHEET PILE WALL INSTALLATION WILL BE UNDERTAKEN FROM BARGE. BARGE IS EXPECTED TO BE SET-UP A MINIMUM OF 6M FROM THE FRONT OF FACE OF EXISTING MASONRY QUAY WALL.
6. PRE-CAST CONCRETE CLADDING ("ECO-SEAWALL") WILL BE INSTALLED TO THE INTERTIDAL ZONE OF THE RIVERSIDE SHEET PILE WALL TO ENHANCE MARINE BIODIVERSITY.
7. NO DRAINAGE WORKS ARE SHOWN ON THESE CROSS SECTIONS. REFER TO FIG. 4.11. TO 4.20 FOR DRAINAGE WORKS FIGURES.
8. FOR HEALTH AND SAFETY REASONS, A HANDRAIL WILL BE INSTALLED ON THE NEW SHEET PILE WALL WHERE HEIGHT BETWEEN THE GROUND LEVEL AT LANDSIDE AND THE TOP OF THE SHEET PILE WALL IS LESS THAN 1.2M.



SECTION E
A1 SCALE 1:50
A3 SCALE 1:100

SECTION TAKEN AT CH:440 FACING WESTWARDS



SECTION D
A1 SCALE 1:50
A3 SCALE 1:100

SECTION TAKEN AT CH:350 FACING WESTWARDS

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Project Title: WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT FLOOD DEFENCES WEST

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Drawing Title: Indicative Cross Sections of Structural Works - Sheet 2 of 2

Designed:	YB	File:		Status:	E.I.A.R.
Drawn:	IM	Job No:	18.141		
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Approved:	TD	Date:	OCTOBER 2021		

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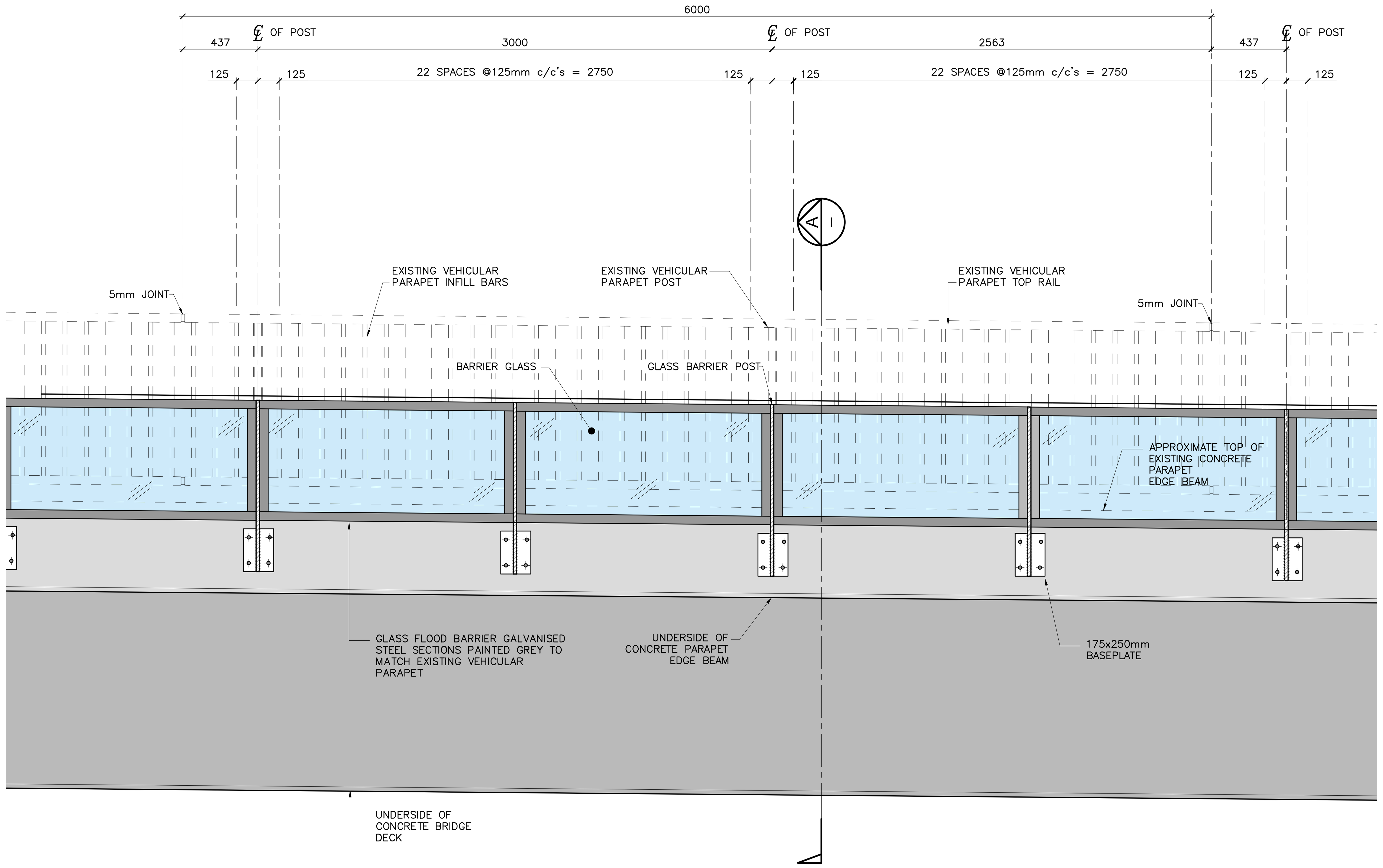
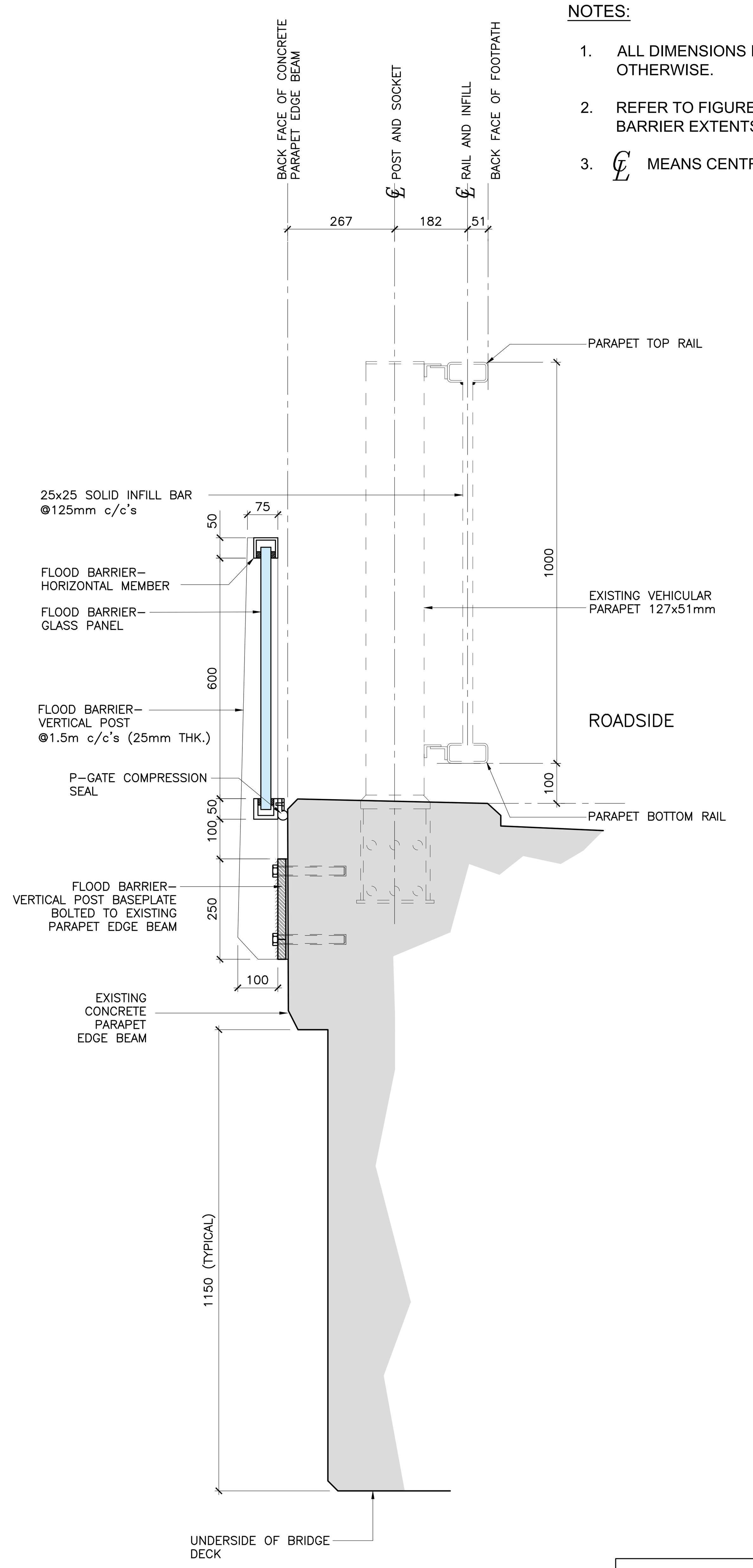


ELEVATION–TYPICAL GLASS FLOOD BARRIER ARRANGEMENT

A1 SCALE 1:20
A3 SCALE 1:40



SECTION A

A1 SCALE 1:10
A3 SCALE 1:20

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. REFER TO FIGURES 4.1 & 4.2 FOR PROPOSED GLASS FLOOD BARRIER EXTENTS.
3. ℄ MEANS CENTRE LINE

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Project Title: WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT FLOOD DEFENCES WEST

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Drawing Title: Indicative Elevation & Section of Glass Flood Barriers

Designed:	CS	File:		Status:	E.I.A.R.
Drawn:	AR	Job No:	18.141		
Checked:	BC	Scale:	AS SHOWN	Drawing No:	FIG 4.10
Approved:	TD	Date:	OCTOBER 2021	Rev:	

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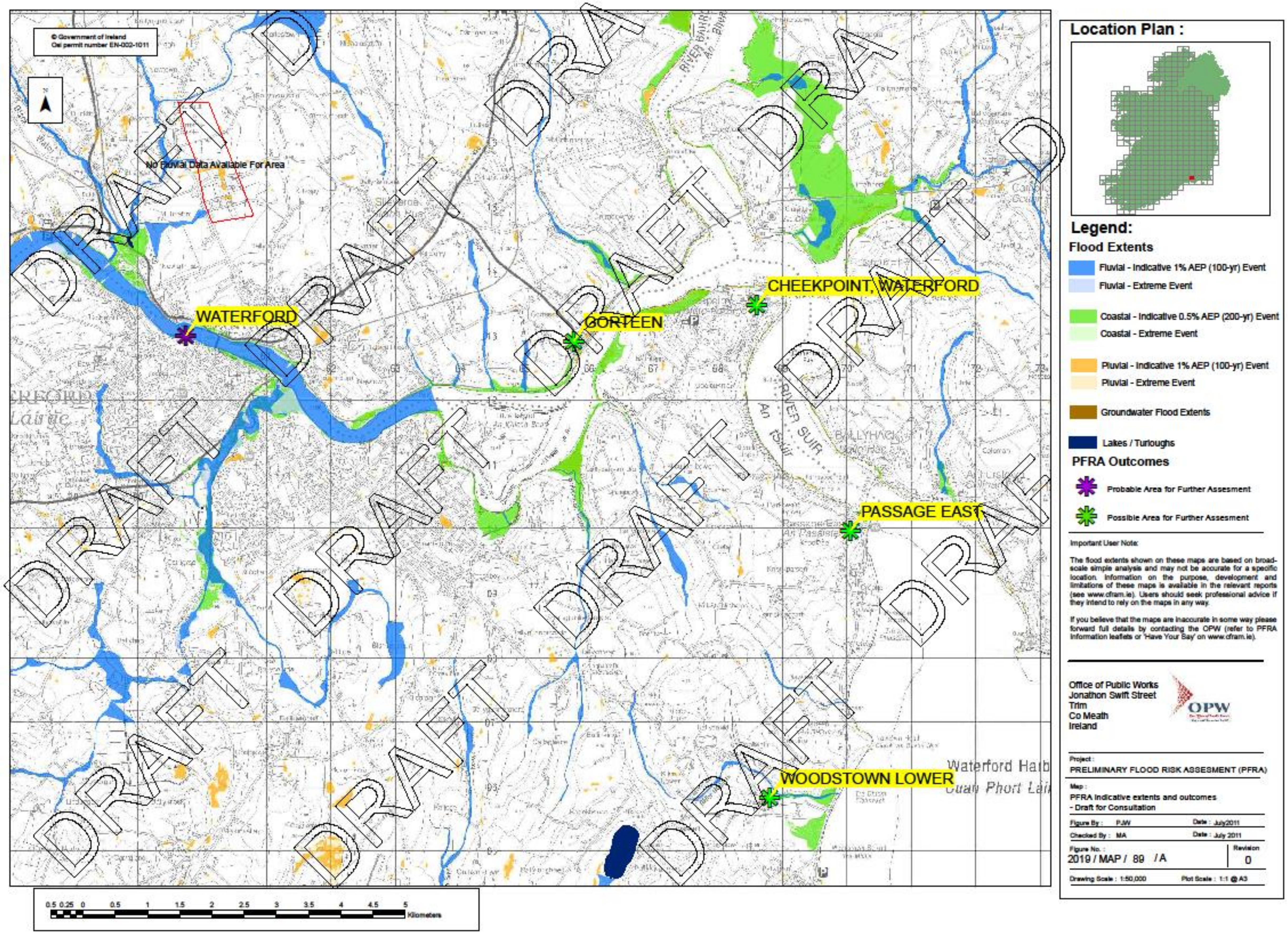
APPENDIX C

INDICATIVE FLOOD SOURCES

Preliminary Flood Risk Assessment



Myplan Web Map

January 28, 2019

- Coastal - Indicative 0.5% AEP (200-yr) Event
- Coastal - Extreme Event

1:25,000

0 0.2 0.4 0.8 mi

0 0.325 0.65 1.3 km

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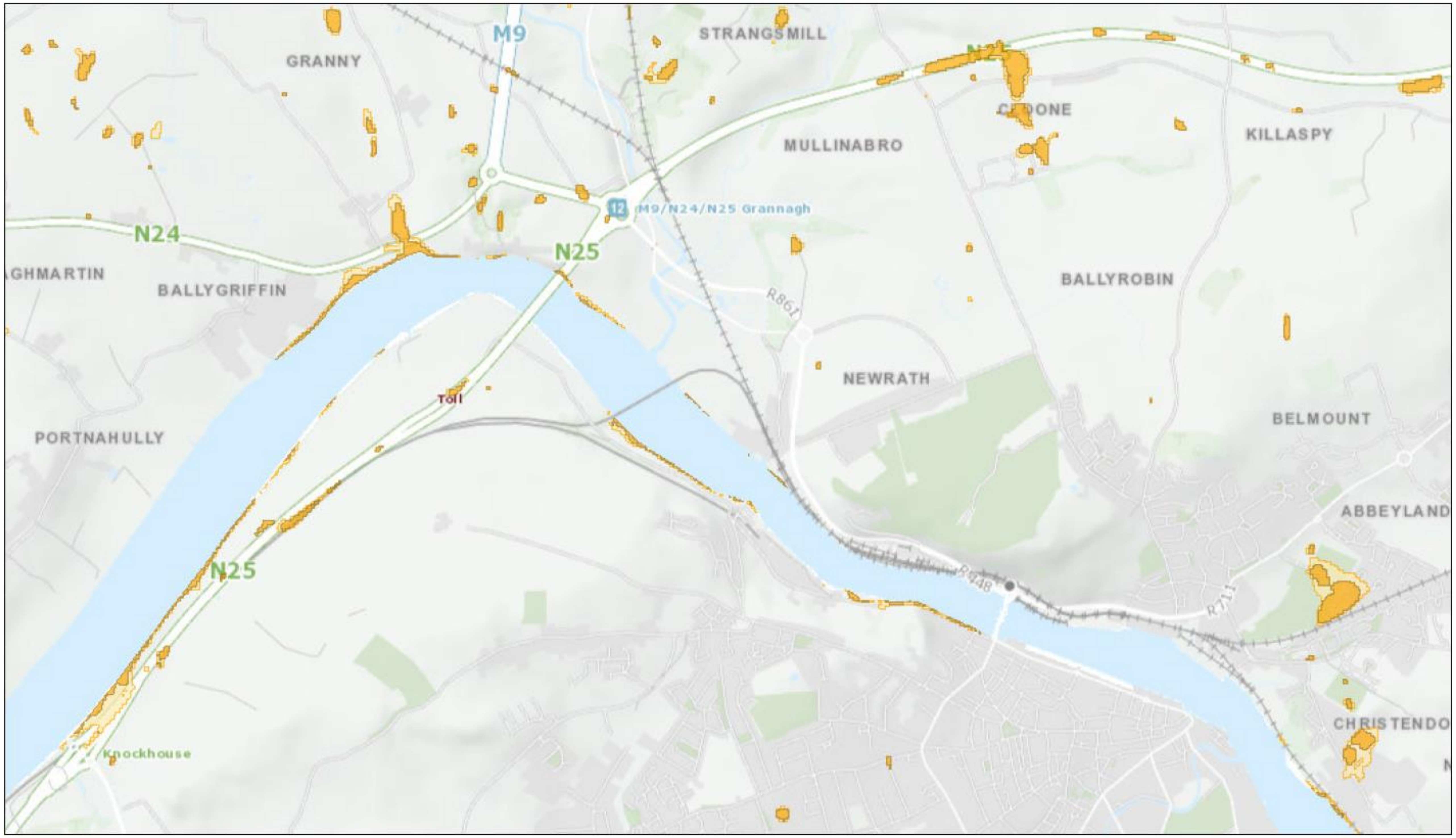
Myplan
DHPCLG

Myplan Web Map Fluvial

Myplan Web Map Pluvial



January 28, 2019

Pluvial - Indicative 1% AEP (100-yr) Event

Pluvial - Extreme Event

1:25,000

0 0.2 0.4 0.8 mi

0 0.325 0.65 1.3 km

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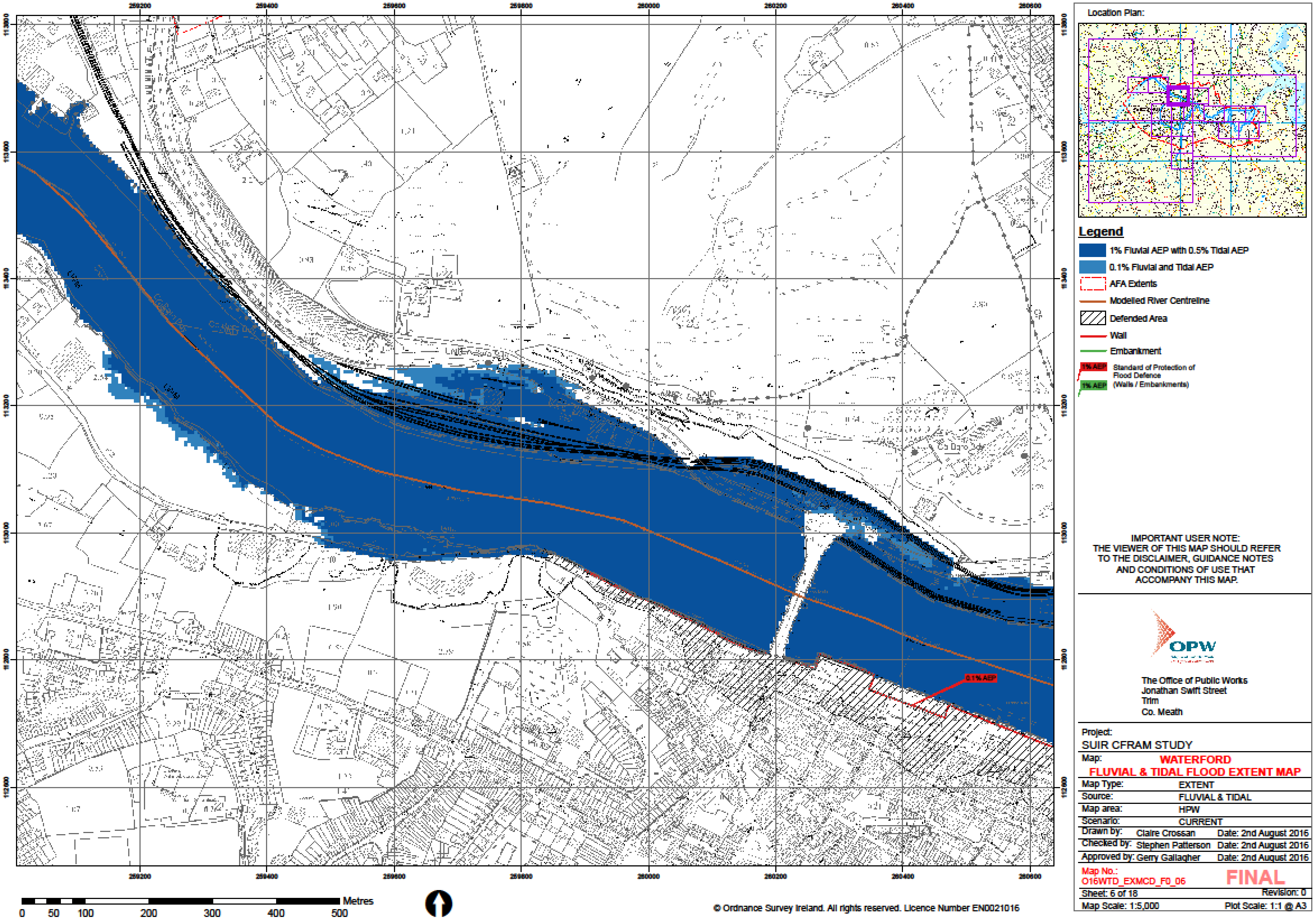
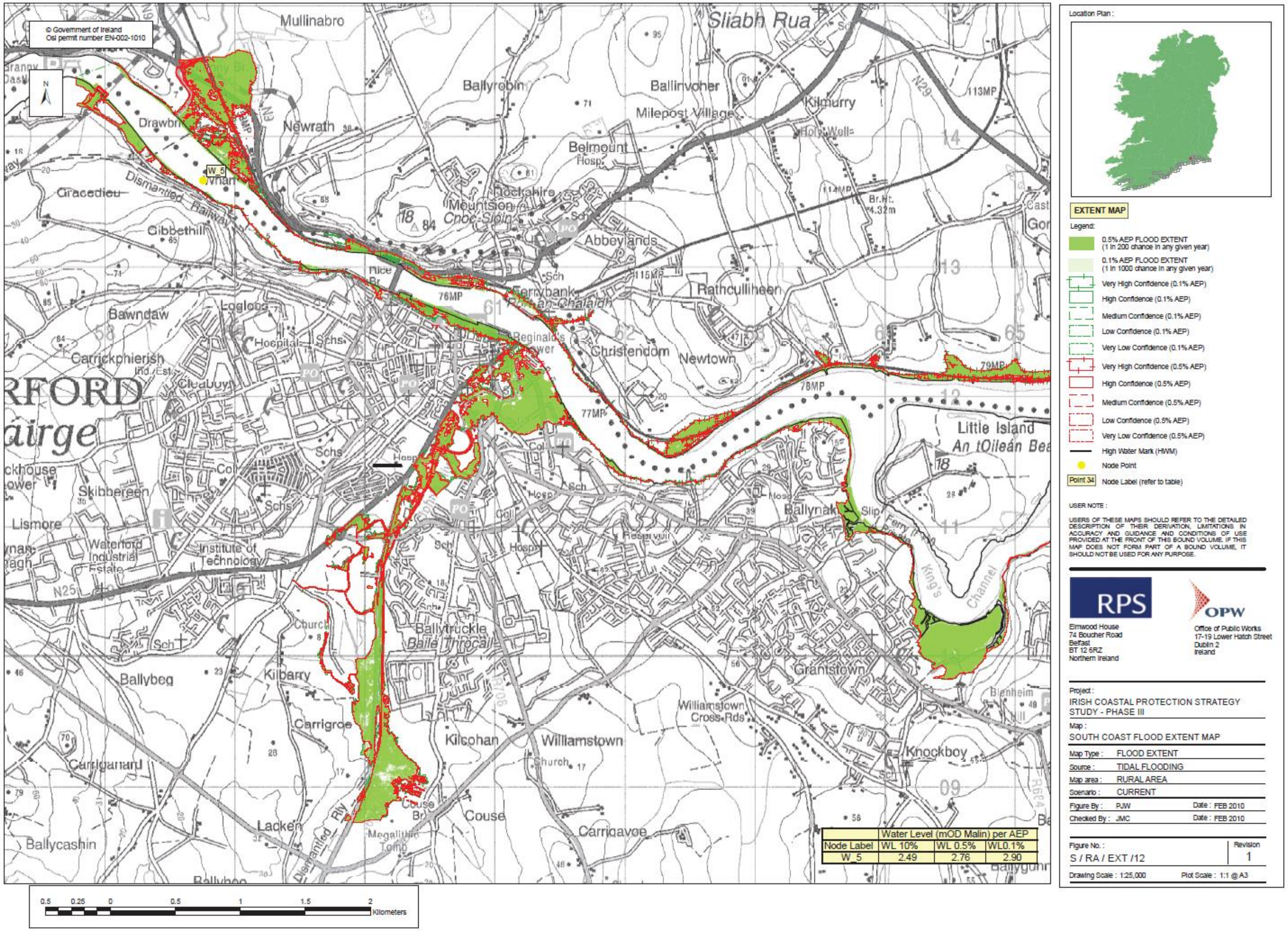
Myplan
DHPCLG

Catchment Flood Risk Assessment and Management Study



Irish Coastal Protection Strategy Study



	Water Level (mOD Malin) per AEP		
Node Label	WL 10%	WL 0.5%	WL0.1%
W_5	2.49	2.76	2.90

OPW Flood Hazard Mapping

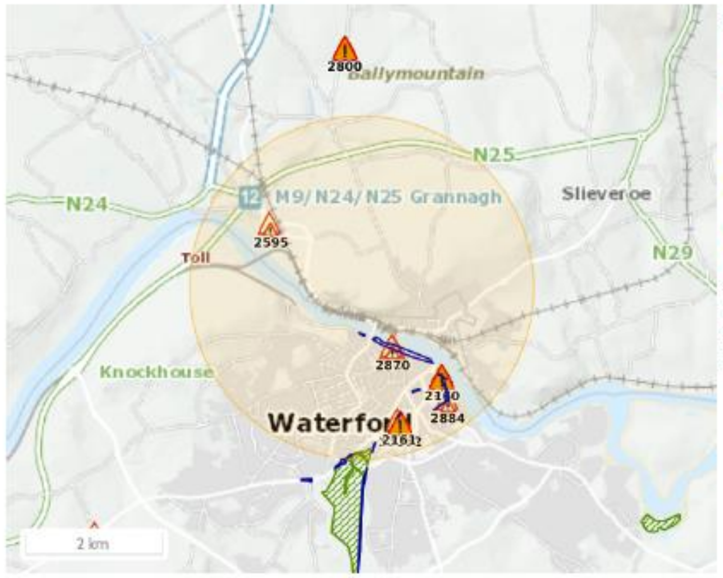
Past Flood Event Local Area Summary Report

OPW

Report Produced: 17/2/2021 11:14

This Past Flood Event Summary Report summarises all past flood events within 2.5 kilometres of the map centre.

This report has been downloaded from www.floodinfo.ie (the "Website"). The users should take account of the restrictions and limitations relating to the content and use of the Website that are explained in the Terms and Conditions. It is a condition of use of the Website that you agree to be bound by the disclaimer and other terms and conditions set out on the Website and to the privacy policy on the Website.



Map Legend

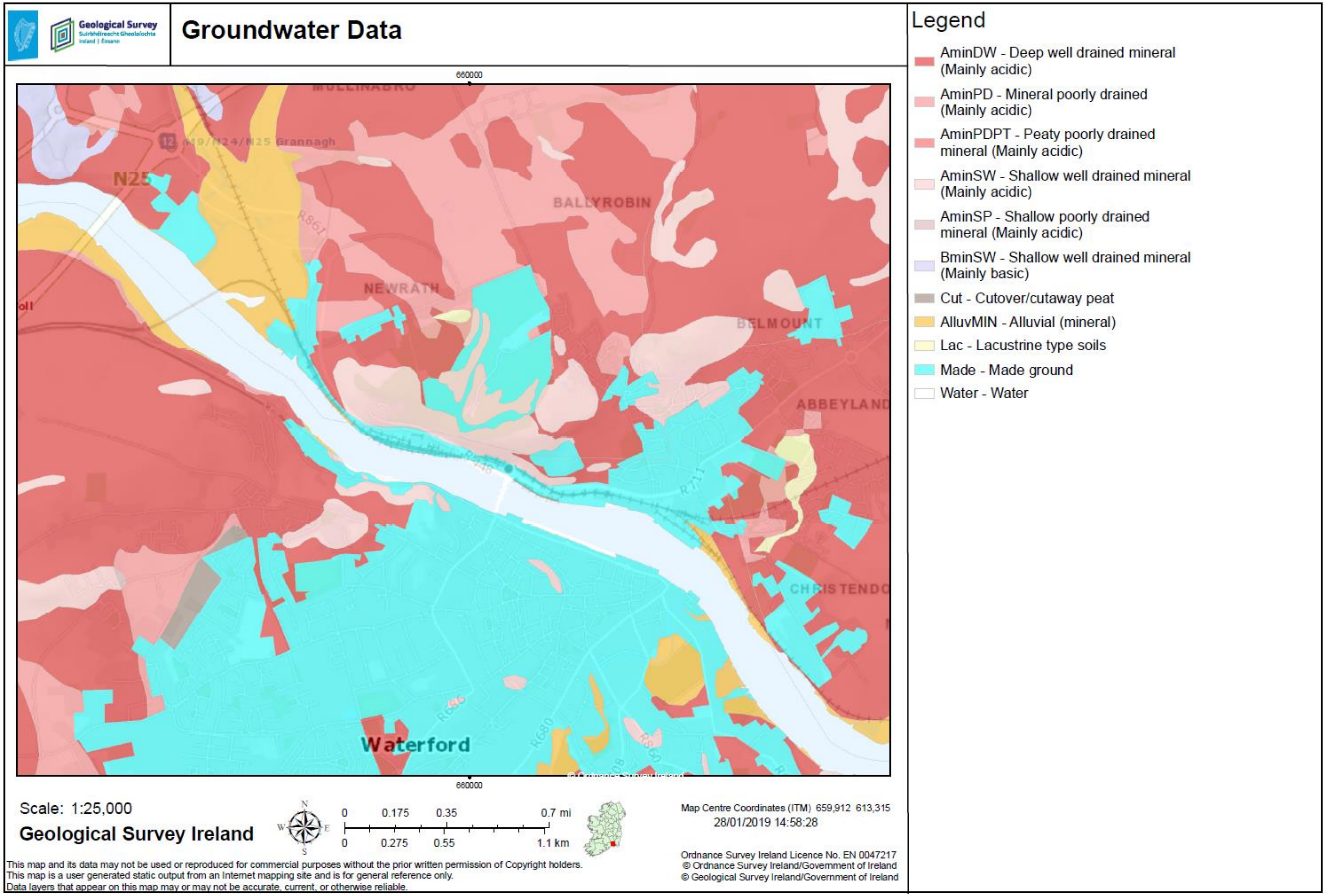
- Single Flood Event
- Recurring Flood Event
- Past Flood Event Extents
- Drainage Districts Benefited Lands*
- Land Commission Benefited Lands*
- Arterial Drainage Schemes Benefited Lands*

* Important: These maps do not indicate flood hazard or flood extent. Their purpose and scope is explained on Floodinfo.ie

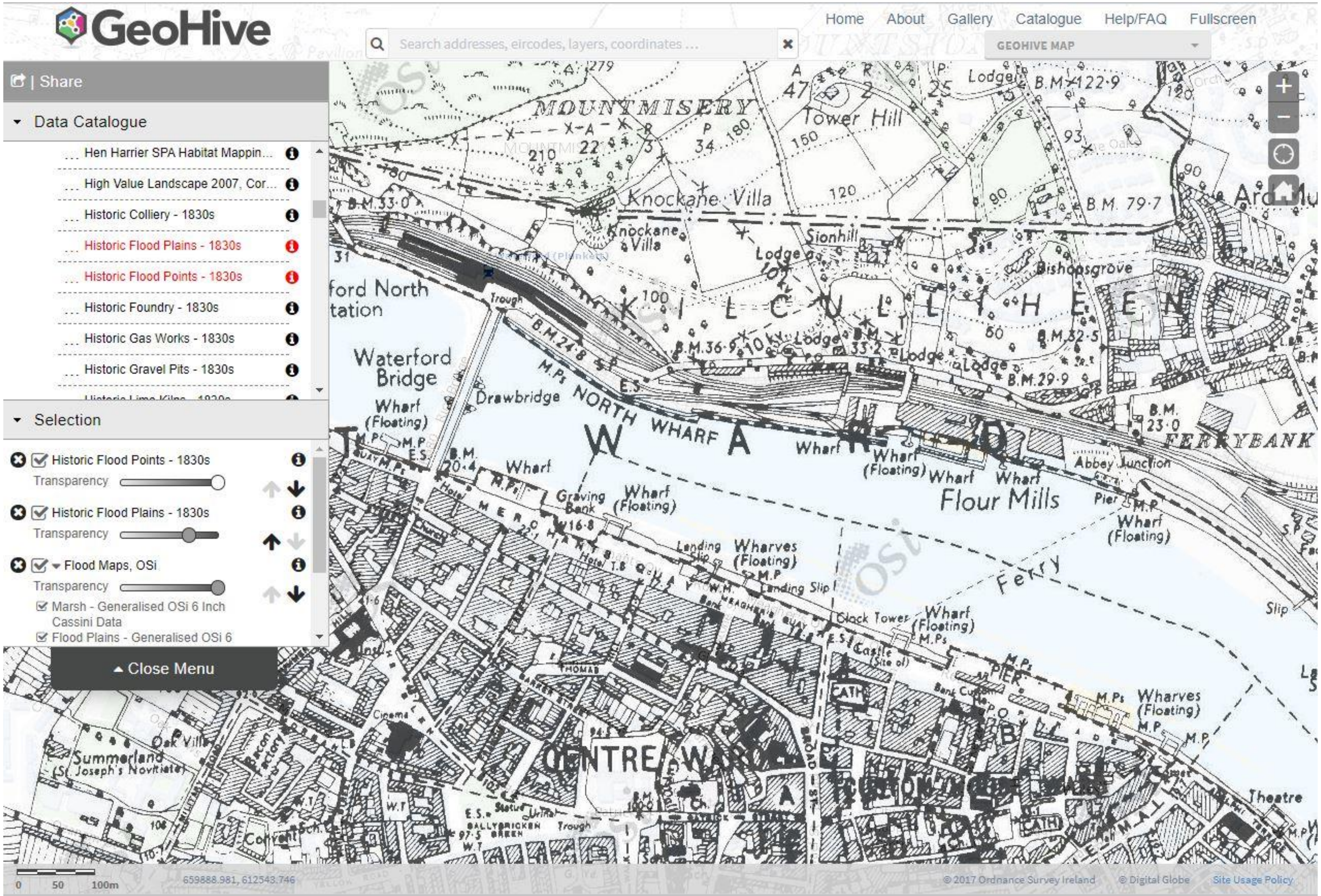
14 Results

	Name (Flood_ID)	Start Date	Event Location
1.	Scotch Quay Area Waterford Recurring (ID-2160)	n/a	Approximate Point
	Additional Information: Reports (11) Press Archive (0)		
2.	Poleberry Bath St Waterford Recurring (ID-2161)	n/a	Approximate Point
	Additional Information: Reports (6) Press Archive (0)		
3.	Scotch Quay Newtown Park Road Oct 2004 (ID-2876)	27/10/2004	Area
	Additional Information: Reports (5) Press Archive (0)		
4.	Flooding at Poleberry, Co. Waterford (ID-12162)	03/02/2014	Exact Point
	Additional Information: Reports (1) Press Archive (0)		
5.	Suir Newrath at Redbridge recurring. (ID-2595)	n/a	Exact Point
	Additional Information: Reports (4) Press Archive (0)		
6.	Suir Waterford City Quay Feb 1994 (ID-2870)	28/02/1994	Approximate Point
	Additional Information: Reports (5) Press Archive (0)		
7.	Suir Waterford City Quay recurring (ID-2880)	n/a	Approximate Point
	Additional Information: Reports (12) Press Archive (73)		
8.	Suir Newtown Road/Park Road recurring (ID-2884)	n/a	Approximate Point
	Additional Information: Reports (4) Press Archive (5)		
9.	Suir Scotch Quay William St area Feb 1994 (ID-2885)	28/02/1994	Approximate Point
	Additional Information: Reports (6) Press Archive (2)		
10.	St John's River Poleberry Oct 2004 (ID-2875)	27/10/2004	Area
	Additional Information: Reports (5) Press Archive (0)		
11.	Suir Waterford City Quay Oct 2004 (ID-2873)	27/10/2004	Area
	Additional Information: Reports (5) Press Archive (0)		
12.	St John's River Tramore Road Oct 2004 (ID-2874)	27/10/2004	Area
	Additional Information: Reports (5) Press Archive (0)		
13.	Kingsmeadow Roundabout Waterford Oct 2004 (ID-2878)	27/10/2004	Area
	Additional Information: Reports (5) Press Archive (0)		
14.	St John's River Waterside Oct 2004 (ID-2877)	27/10/2004	Area
	Additional Information: Reports (5) Press Archive (0)		

Geological Survey of Ireland: Teagasc Subsoil Mapping



Historical Maps: 6” Cassini



News Reports

thejournal.ie

Waterford train station is flooded... very flooded

Last night's heavy rain led to this happening to the station.

BY AOIFE BARRY | WEDNESDAY 17 OCT 2012, 10:32 AM | HTTP://JRNL.IE/638505

LAST NIGHT'S HEAVY rain **led to flooding** around parts of Ireland – and Waterford train station got hit particularly badly.

This image, which was **tweeted by Irish Rail**, shows the full extent of the flooding caused by the downpour.

Bus transfers are in place from Waterford to Kilkenny while Irish Rail works to get the station back up and running.

Read: Heavy overnight rain leads to flooding, delays>

ABOUT THE AUTHOR
Aoife Barry | **@sweetoblivion26** | **aoife@thejournal.ie**

Residents face health alert as flood nightmare strikes again

8

A man with two children make their way through flood water in Cork city.

Ralph Riegel Twitter Email

February 5 2014 2:30 AM

-
- Email

A MAJOR health alert was issued over the dangers posed by bacteria-laden flood waters as Cork suffered its fourth flooding nightmare in just four weeks.

The River Lee broke its banks for a second time in 24 hours and the fourth time since early January due to high tides, torrential rain and a one-metre high storm surge.

But Limerick residents and traders breathed a sigh of relief as the city escaped a second round of flooding from the River Shannon.

Both Limerick County and City councils confirmed no further flooding with high tides over the next 36 hours predicted to be up to two metres lower than on Saturday when the worst floods in living memory hit the city.

Saturday's flooding hit 200 acres of the city, impacting 300 houses and over 3,000 people.

However, while Limerick residents began the clean-up, homeowners in Athlone were being given sandbags as water levels on the River Shannon threaten low-lying properties.

Cork Flooding time lapse

Privacy settings

00:00 00:35 480p

Athlone Town Council activated its flood emergency plan on Monday due to the rising water levels with 2,000 sandbags ready for distribution. A further 2,000 have been in place since January when flooding also threatened the town.

In Cork, pressure has mounted on the Office of Public Works (OPW) to fast-track a long-delayed flood defence plan for Ireland's lowest lying city.

While parts of the city centre were left under flood waters last night, the damage was limited due to a major emergency plan by Cork City Council, Cork Fire Brigade and trader groups.

Stores on Oliver Plunkett Street, Patrick Street and other vulnerable areas had moved stock out of the reach of flood waters after a 24-hour advance warning.

Both Cork Chamber of Commerce and Cork Business Association warned that the clean-up costs will still be disastrous for some retailers.

Parts of the city centre were effectively evacuated as a precautionary measure given the scale of the feared storm surge.

Cork School of Music and Cork College of Commerce were both ordered to close by 7pm because of their location in a high-risk flood zone.

A number of businesses also closed early to allow flood gates and sand-bags to be installed.

Gardai and traffic wardens warned motorists not to leave vehicles parked in flood zones including Union Quay, Morrisson's Quay, Fr Mathew Quay, Oliver Plunkett Street, Lavitt's Quay, Proby's Quay and Sharman-Crawford Street.

City Manager Tim Lucey had appealed to all householders and traders to be on their premises from 6pm to aid in the flood protection campaign.

"We have done everything we possibly can. We are dealing with quite an extensive area and we needed property owners to be on their premises to check flood defences," he said.

But while Cork city took the brunt of the flooding, deluges also hit county towns including Mallow, Fermoy, Youghal, Bandon, Cobh, Clonakilty, Carrigaline and Bantry. Access to Cobh on Great Island was again restricted because of flooding near Belvelly Bridge.

Privacy settings

Train passengers using the services into and out of Waterford city were transferred on buses yesterday after Plunkett Station was closed at 9.30am because of flooding at the platforms. And train services between Limerick and Ennis were suspended because the rail line is flooded in two places.

SEWERS

Concern over the risks posed by the flooding prompted the HSE to issue a health warning for flooded areas including Cork, Limerick and Waterford.

In some areas, the flood waters have resulted in sewers and septic tanks overflowing with the sludge flowing into homes, streets and gardens.

The HSE urged parents not to allow children to play in flood waters given the potentially high bacteria levels present.

People were also urged to wash their hands carefully if they come in contact with floods and not to expose any cuts or grazes to such water.

Anyone who feels unwell after they have come in contact with flood waters is urged to seek urgent medical advice.

Irish Independent

Follow @Independent_ie

Escaping in eye of the storm

Fiach Kelly
March 11 2008 12:00 AM

"The eye of the storm was so large that it killed off most of the winds," Met Eireann's Pat Clarke told the Irish Independent. He added that there were some tidal swells caused by low pressure and winds.

"Pressure was so low and allied to that, there were onshore winds that caused swelling of one third to two thirds. The spring tides were already high to start off with."

Flooding yesterday affected Waterford city, where the River Suir burst its banks and flooded Scotch Quay and Williams Street. Flooding also affected the Waterford-Wexford road in New Ross.

Waterford rail services were also hit by flooding on the line at Plunkett Station and bus transfers were used to complete passengers' journeys until the service was restored just before two o'clock.

APPENDIX D

GROUNDWATER ANALYSIS

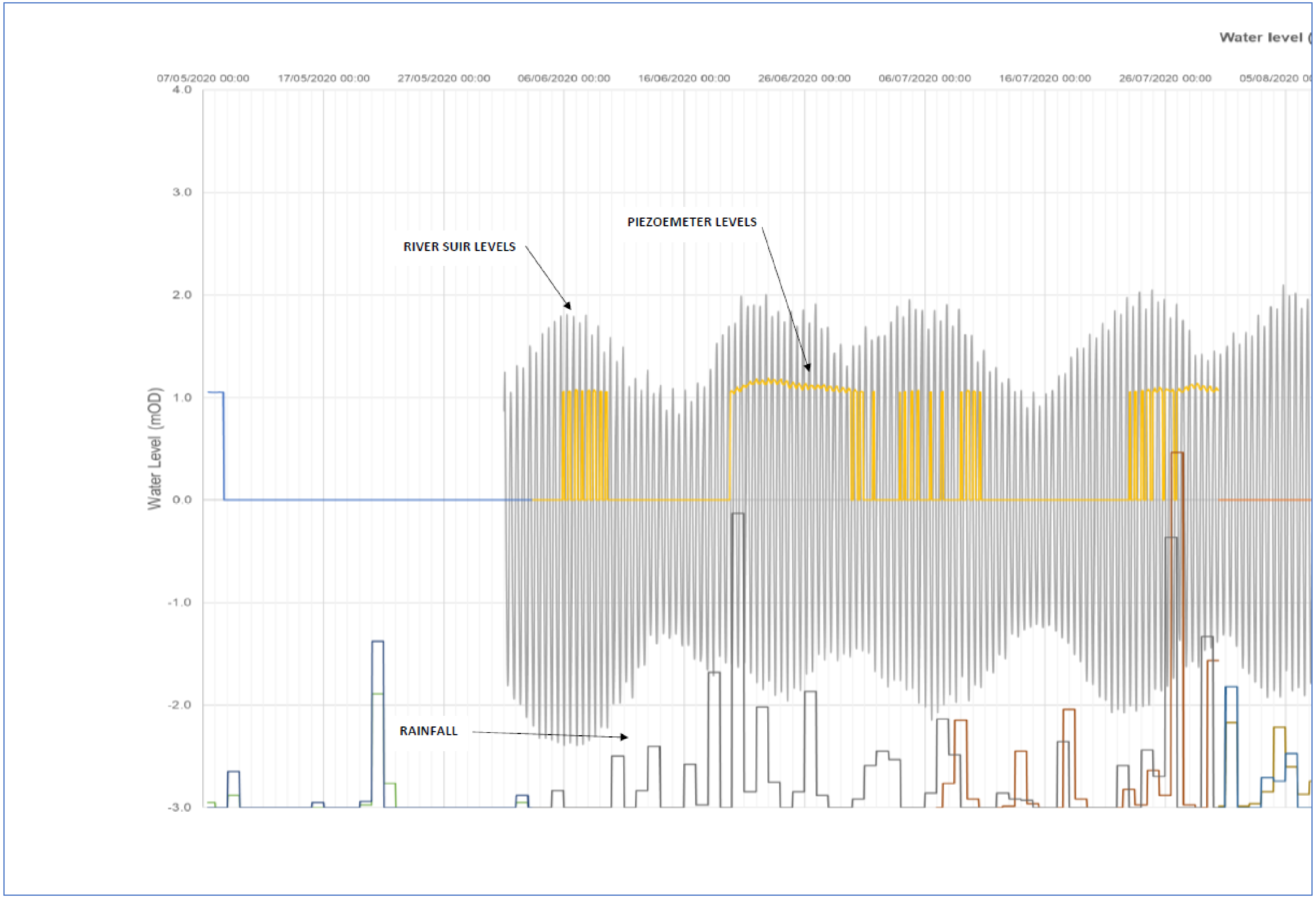


Figure 3 **(Part 1) Groundwater levels in BH302.** *Note that where dry conditions (no groundwater in response zone) were encountered, the reading defaults to +0.0mOD. Note: When the piezometer groundwater levels fall below 0.0 mOD the readings are set to 0 (indicating that ground water levels drop below the 0.0m level- this is notable during periods of neap\ moderate tides)*

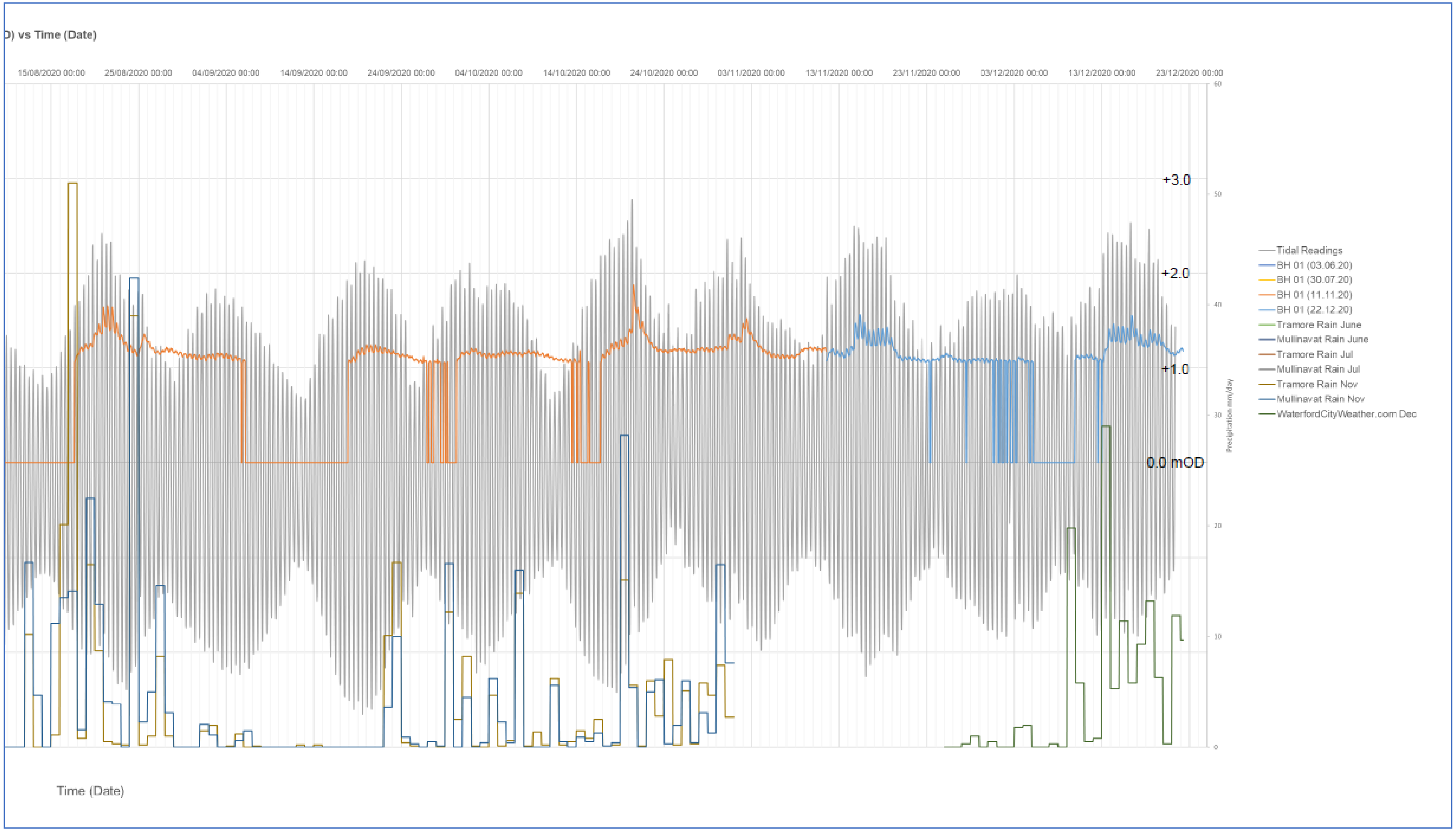


Figure 3 **(Part 2) Groundwater levels in BH302**. *Note that where dry conditions (no groundwater in response zone) were encountered, the reading defaults to +0.0mOD.*

Appendix 10.2
Hydraulic Modelling of the Flood Defences West Scheme River Suir Flood Wall

ROD ROUGHAN & O'DONOVAN
Comhairle Cathrach & Contae Phort Láirge Waterford City & County Council
Údarás Náisiúnta Iompair National Transport Authority
Iarnród Éireann Irish Rail
Rialtas na hÉireann Government of Ireland
Tionscadal Éireann Project Ireland 2040

Report No. HEL212204 v1.2

Hydraulic Modelling of the Flood Defences West Scheme River Suir Flood Wall

Prepared for

Roughan O'Donovan Consulting Engineers

April 2021

FINAL

Hydro Environmental Ltd
No. 4 Caiseal Riada,
Clarinbridge,
Co. Galway.
Tel / Fax: 091 796734
email: info@HydroE.ie

Hydraulic Modelling of the Flood Defences West Scheme River Suir Flood Wall

Job No.:	212204
Report No.:	HEL212204 v1.2
Prepared by:	Anthony Cawley BE, MEngSc, CEng MIEI
Date:	30th April 2021
Issue	**Final**

DISCLAIMER

This hydraulic modelling report has been prepared for Roughan O'Donovan Consulting Engineers as input to the Flood Defences West Scheme Project. Hydro Environmental Ltd. accept no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned.

Contents

1. INTRODUCTION

1.1 Background

Hydro Environmental Ltd., was commissioned by Roughan O'Donovan Consulting Engineers to carry out hydrodynamic modelling study of a proposed Flood Defence Wall a long a 730m Section of the north bank of the River Suir northwest of the Waterford Plunkett Rail Station. This hydrodynamic model study supports the Hydrology chapter of the Environmental Impact Assessment Report (EIAR) and the Natura Impact Statement (NIS). The purpose of this study is to predict the potential local change in flow velocities within the Suir Estuary and to assess the impact of the proposed flood wall on bed morphology as a result of changes to the hydrodynamic regime.

1.2 Description of Proposed development

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City. The development extends for approximately 1km to the west and 100m to the east of the Waterford (Plunkett) Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor located to the north of the proposed development.

The proposed flood defence measures are for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval, eliminating the risk of flooding to the Transport Hub.

A design flood level of +4.0m OD (metres above Ordnance Datum Malin) is proposed for this development. The design flood level has been based on a flood with an annual exceedance probability of 0.5% and allowances for climate change and isostatic tilt as noted below.

The design (top-of-wall) level for the proposed flood protection measures is +4.30m OD (metres above Ordnance Datum Malin). The following allowances are integrated into the proposed height of the flood defence walls:

- 0.5% annual exceedance probability combined tidal-fluvial event (+3.45 m OD)
- An additional 0.55m to allow for climate change and isostatic tilt; and,
- 0.30m freeboard to the wall, including local wave wake effects.

The proposed flood protection measures will consist of:

- Construction of c.365m of impermeable shallow underground trench (0.35m wide and up to 3m deep) within Iarnród Éireann's Plunkett Station car park.

- Total of c.185m of overground flood defence measures consisting of:
  - c.170m of glass flood barriers (each parapet is approx. 1.5m in length and 0.7m in height) fitted on the river side of the road edge vehicular parapets on R680 Rice Bridge roundabout and along the 3 roundabout arms; R448 Terminus St., R711 Dock Rd., and R680 Rice Bridge.
  - c.15m of demountable flood barriers on the R680 Rice Bridge (leading to the North Quays Strategic Development Zone);
- Remedial works to c.75m section of existing quay wall in front of the Plunkett Station car parking area by raising its height to between 0.6m and 1.2m to conform with the top-of-wall flood protection measures of +4.30m OD.
- Construction of c.730m of sheet pile flood defence wall with the top-of-the wall level at +4.30mOD consisting of:
  - c.540m of sheet pile wall within the foreshore from the riverside, 1m from the front face of the existing quay wall. The space between the sheet pile wall and the front face of the existing quay wall will be filled with clean imported granular fill. The intertidal zone of the sheet pile wall within the foreshore will be fitted with pre-cast concrete cladding material (“eco-seawall”).
  - c.190m of sheet pile wall will be installed on Iarnród Eireann land, 1m behind the existing quay wall. Construction of c.20m underground isolation structure comprising of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers to the structure should these be required to be implemented during a flood event.
  - Demolition of up to 3m of existing quay wall at transition point between the landside and riverside sheet pile wall.
- Drainage works will consist of:
  - Remedial works to the existing drainage outfalls to the River Suir by extending them to reach an outlet within the new sheet pile wall and/or be retrofitted to pass through the new sheet pile wall, and installation of non-return valves.
  - Construction of new trackside drainage and groundwater drains to include 2 no. pumping stations and surface water outfalls to the River Suir.
  - Demolition of c. 540m of existing quay wall south of the railway corridor to approximately 800mm below the existing ground level.
  - Demolition of the existing quay wall to approximately 800mm below the existing ground level. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level to facilitate the construction of a surface water pumping station.
- And all ancillary works.

The location of the proposed 730m length of sheet piled food defence wall upgrade located along the Suir channel bank within the North Quays area is presented here in Figure 1-1.

Figure 1-1 Location and Extent of the proposed Flood Defence Wall at the North Quays area

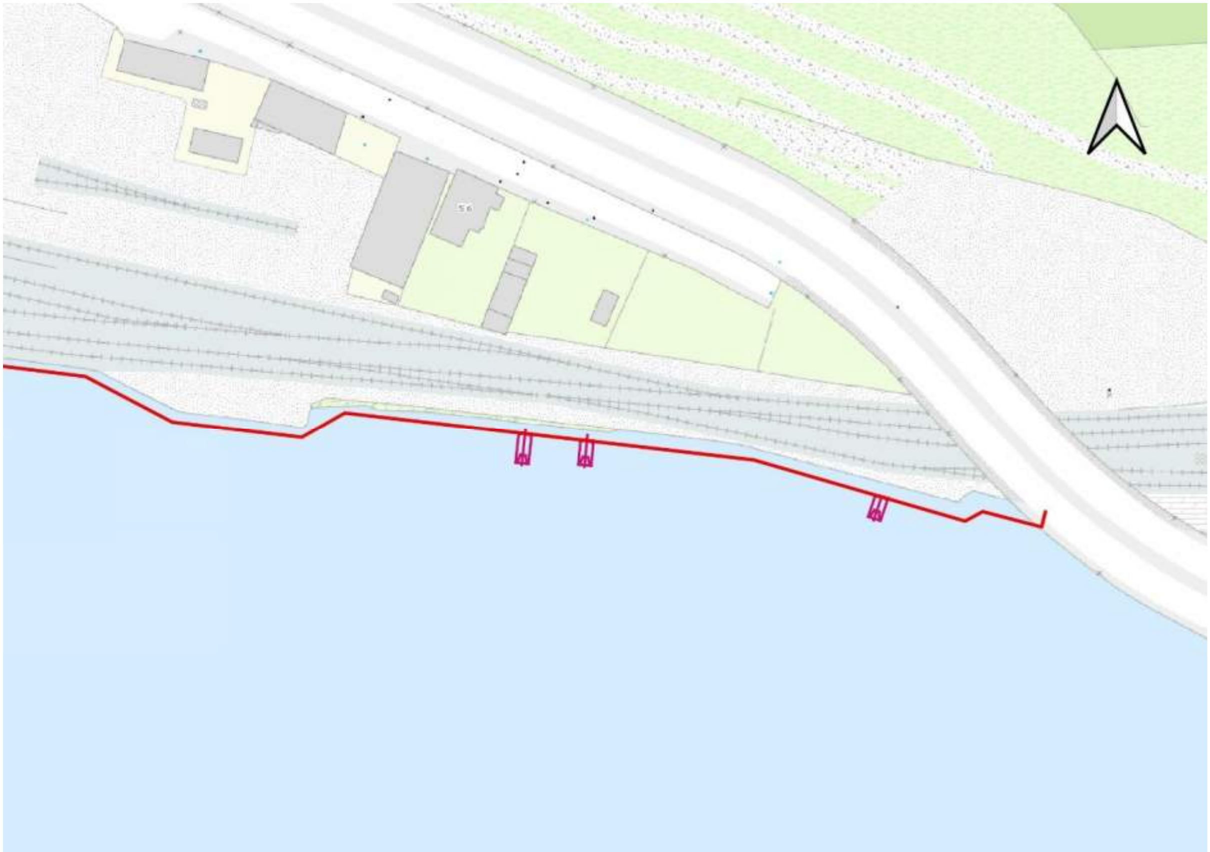


Figure 1-2 Location of storm drainage outfalls associated with the proposed Flood Defence Wall at the North Quays area

1.3 Existing Flood Defences on the North Quays

The existing flood protection measures along this section of north quays area consist of a quay wall along the banks of the River Suir. These existing flood protection measures are no longer effective in protecting the infrastructure on the North Quays from flood events. The existing quay wall is a masonry structure over most of its length built in the late 19th century and has been subject to numerous upgrades / repairs since including sections of mass concrete. Sections of this existing Quay Wall structure are damaged with structural cracks and damage to both foundations and wall and loss of masonry from the wall.

There has been a series of recent tidal flood events in the vicinity of Plunkett Station over the past two decades in which the estuary overtopped of sections of the existing flood wall at Ch 370, Ch 540, Ch 590 and between Ch. 900 and Ch.1050. The OPW CFRAM Flood inundation mapping of this area shows the lands behind the proposed floodwall to be inundated at both 200 (0.5% AEP) and 1000year (0.1% AEP) return period coastal flood events.

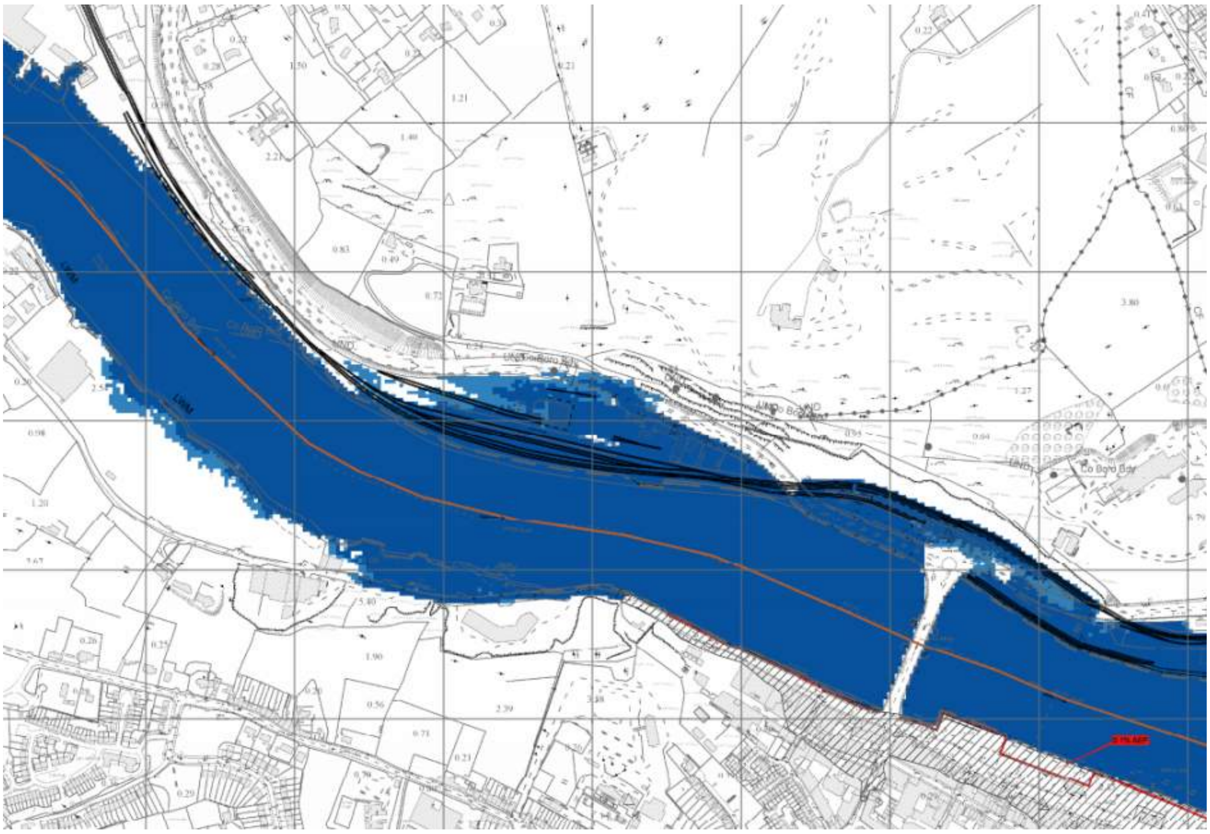


Figure 1-3 Extract from OPW River Suir CFRAM Map of 200year and 1000year coastal flooding

1.3 Sediment Sampling of channel bed

Aquafact Ltd. was commissioned to take a series of bed surface grab sediment samples for sediment distribution analysis across the width of the estuary channel and banks. They were unable to obtain any grab samples towards the middle of the River channel as no loose sediment was present with the bed sediment likely to be a compacted cohesive sandy Silt. The location where grab samples were obtained are shown in Figure 1-4 and the sediment distribution results are presented in Table 1.1.

The results show that where fresh unconsolidated sediment was captured it generally represented a silt and fine sand with little or no coarser sediments. It is likely given the generally high fines content that the sediment acts as a cohesive sediment that is consolidated over time and provides good resistance to erosion. With only the freshly laid silts mobile in the tidal flows.

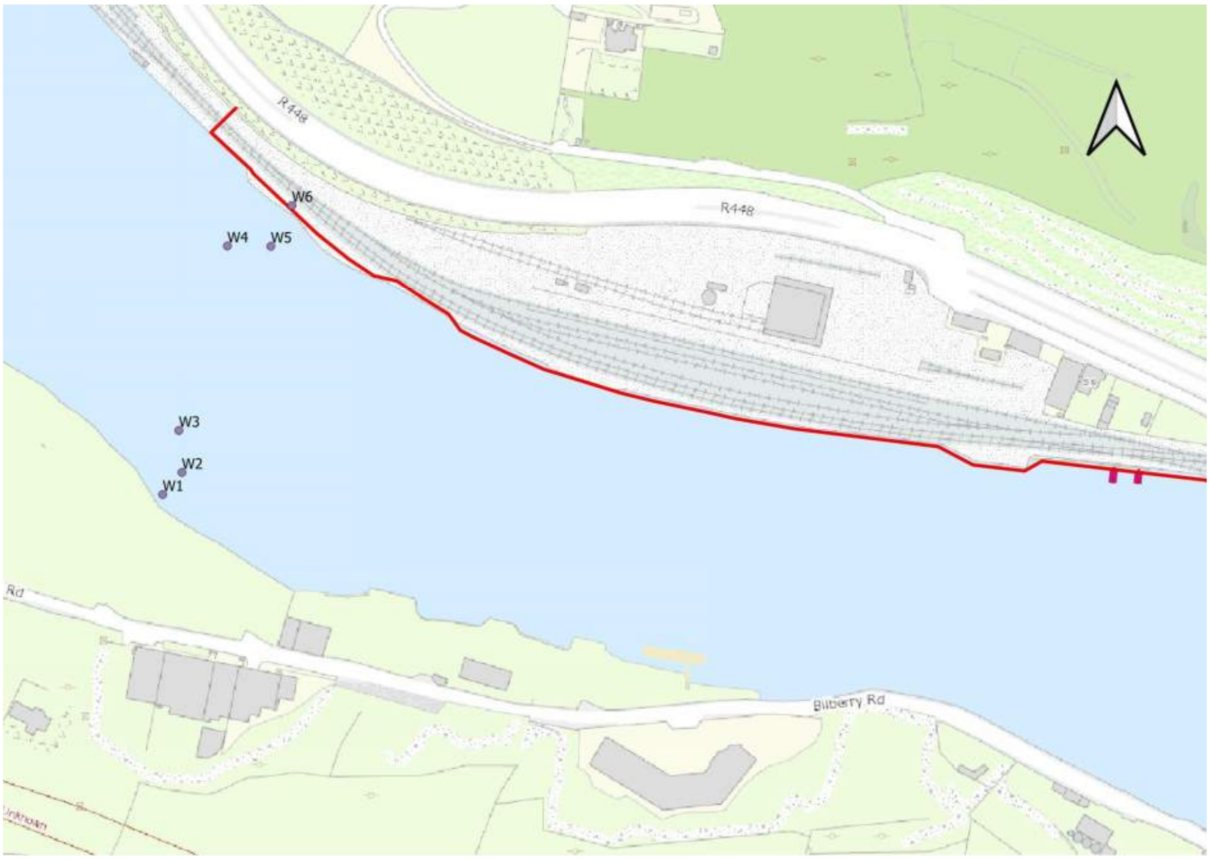


Figure 1-4 Bed Sediment sampling Locations

Table 1.1 Results from Sediment Sampling

Fraction Size (mm)	Description	W1 (%)	W2 (%)	W3 (%)	W4 (%)	W5 (%)	W6 (%)
< 0.063	Silt/clay	42.3	6.5	38.4	38.9	33.3	34.5
0.063 - 0.125	silt / v. fine Sand	30.6	40.9	32.6	36.5	34.6	38.2
0.125 - 0.250	fine Sand	7.9	27.7	9.5	8.9	14.4	8.7
0.250 - 0.500	medium sand	7.7	8.5	8	6.7	6.5	7.7
0.500 - 1.000	Coarse Sand	6.8	8.9	7.2	5.6	5.9	6.9
1.000 - 2.000	Very Coarse Sand	3.9	5.7	3.4	2.9	4	3.6
2.000 - 4.000	fine gravel	0.8	1.3	0.7	0.3	0.8	0.3
> 4.000	medium gravel	0.2	0.6	0.1	0.2	0.5	0.1

2. HYDRAULIC MODEL DESCRIPTION

2.1 General

In order to assess accurately the potential impact of the proposed 740m length of sheet piled flood wall on the hydrodynamics of the River Suir adjacent to the development a high resolution 2-D hydrodynamic model of the local reach was developed. Two-dimensional modelling was chosen in preference to 1-d modelling so as to evaluate spatially the tidal circulation and flood inundation of the estuary banks. To efficiently drive the high resolution 2-D model a 1D node-link river estuary model was developed, which extended from southern open sea upstream to the tidal extents on the Suir, Nore and Barrow Rivers, as presented in Figure 3. This enabled the large tidal flows generated within each of the estuaries to be computed under varying tides and fluvial inflow conditions and the relevant output from this model in terms of flow and water level hydrographs was specified as boundary conditions to drive the local 2-D model.

2.2 HEC-RAS 1-D model

A 1D river model using HEC-RAS hydraulic software system developed by the U.S. Army Corps of Engineers was used to model Waterford Harbour and its full estuarine reaches of the Suir, Barrow and Nore Rivers. HEC-RAS is the industry standard used internationally for hydraulic modelling of river and estuarine systems. HEC-RAS implements a 1-dimensional model of longitudinal channel flow (depth and width averaged) and solves for water elevation and average cross-sectional velocity under unsteady flows solving the full St. Venant equations that include the momentum and mass equations. HEC-RAS 1-D is ideal for modelling narrow elongated estuaries where the dominant flow is longitudinal with little variation in the energy slope in the transverse direction.

The unsteady model allows for tidal varying flow and elevation boundary conditions to be specified at the downstream Open Sea boundary and inflow hydrographs at the upstream fluvial boundaries. It also facilitates internal inflows at various nodes to allow for inclusion of lateral tributary inflows. The HEC-RAS model requires cross section survey data of bed and overbank levels versus Station distance from left overbank to right overbank and facilitates different channel roughness's and various structure types including bridges, culverts spillways and weirs.

2.3 TELEMAC Hydraulic Software System

The TELEMAC system is the software of choice for modelling the complicated hydrodynamics of the Suir Estuary at the bridge crossing, particularly given the very high computation refinement required to model the individual slender piles for the proposed bridge structure and the collision fender system. TELEMAC is a software system designed to study environmental processes in free surface transient flows. It is therefore applicable to seas and coastal domains, estuaries, rivers and lakes. Its main fields of application are in hydrodynamics, water quality, sedimentology and water waves.

TELEMAC is an integrated, user friendly software system for free surface waters. TELEMAC was originally developed by Laboratoire National d'Hydraulique of the French Electricity Board (EDF-LNHE), Paris. It is now under the directorship of a consortium of organisations including EDF-LNHE, HR Wallingford, SOGREAH, BAW and CETMEF. It is regarded as one of the leading software packages for free surface water hydraulic applications and with more than 1000 Telemac Installations Worldwide.

The TELEMAC system is a powerful integrated modelling tool for use in the field of free-surface flows. Having been used in the context of very many studies throughout the world (several thousand to date), it has become one of the major standards in its field. The various simulation modules use high-capacity algorithms based on the finite-element method. Space is discretised in the form of an unstructured grid of triangular elements, which means that it can be refined particularly in areas of special interest. This avoids the need for systematic use of embedded models, as is the case with the finite-difference method. Telemac-2D is a two-dimensional computational code describing the horizontal velocities, water depth and free surface over space and time. In addition it solves the transport of several tracers which can be grouped into two categories, active and passive, with salinity and temperature being the active tracers which alter density and thus the hydrodynamics.

The TELEMAC System is a set of finite element programs designed to solve free water surface problems. A series of modules are available for solution of hydrodynamics, transport and dispersion of pollutants, sediment transport and wave dynamics. These are:

- TELEMAC-2D: 2-dimensional depth averaged hydrodynamics and transport and dispersion of tracers
- TELEMAC-3D: 3-dimensional hydrodynamics, transport and dispersion and sediment movement

- TOMAWAC: A third generation spectral wave model representing the generation of waves due to winds or offshore climates and propagation into shallow waters.

- ARTEMIS: A harbor wave model that solves the mild slope equation in elliptical form and includes the processes of refraction by bed shoaling, wave breaking, diffraction and reflection of waves due to structures.

- SISYPHE: Sediment transport module solving bed and suspended load of cohesive and non-cohesive sediments and can be coupled with TELEMAC-2D, -3D and TOMAWAC for the hydrodynamic transport and bed shear stress calculations

Each TELEMAC Module uses a completely flexible unstructured mesh of triangular elements allowing it to efficiently model complex geometry problems such as harbours and estuaries.

2.4 Data Sources

A range of survey information was utilised in constructing the 1D and 2D models which are described below:

- OPW CFRAM river cross-section survey of the Suir, Nore and Barrow river channels
- Apex cross-sections River Survey of the Suir at Waterford
- Infomar Sea bed Survey of Waterford Harbour
- Admiralty Chart of Waterford Harbour
- Apex Topographical Survey of the SDZ site and adjacent lands
- 2m Lidar Survey of Waterford City
- High resolution bathymetric Survey of the river reach by Murphy Surveys in 2021.
- Bed sediment sampling by Aquafact at the bridge crossing
- ADCP (Acoustic Doppler Current Profiler) current metering over a 24day period at 1m vertical Bin depths by Aquafact.

2.5 1-D Model Development

River channel and overbanks were defined for approximately 115km of river reach along the main river/estuarine channels of the Suir, Nore and Barrow. The complete estuarine reaches which extend many kilometres upstream along the Suir, Barrow and Nore were included in the model so that the simulations accurately accounted for the large tidal exchange volume that generate significant ebbing and flooding flows at

Waterford Harbour. The model domain is presented in Figure 2-1 and the HEC-RAS model schematic in Figure 2-2.

The model domain extends from the open sea off Dunmore to 1km upstream of Carrick-On-Suir on the Suir, to 3km north of St. Mullin's Village on the River Barrow and to Inistoige on the Nore. A total of 249 river sections were included from the various surveys. Survey information was not available for a 19km upstream middle section of the Suir Estuary from Woodstown, Waterford to Piltown, southeast of Carrick-on-Suir. This unavailable (un-surveyed) reach was represented by simple liner interpolation between the nearest available upstream and downstream surveyed section so as to account for the tidal exchange volume.

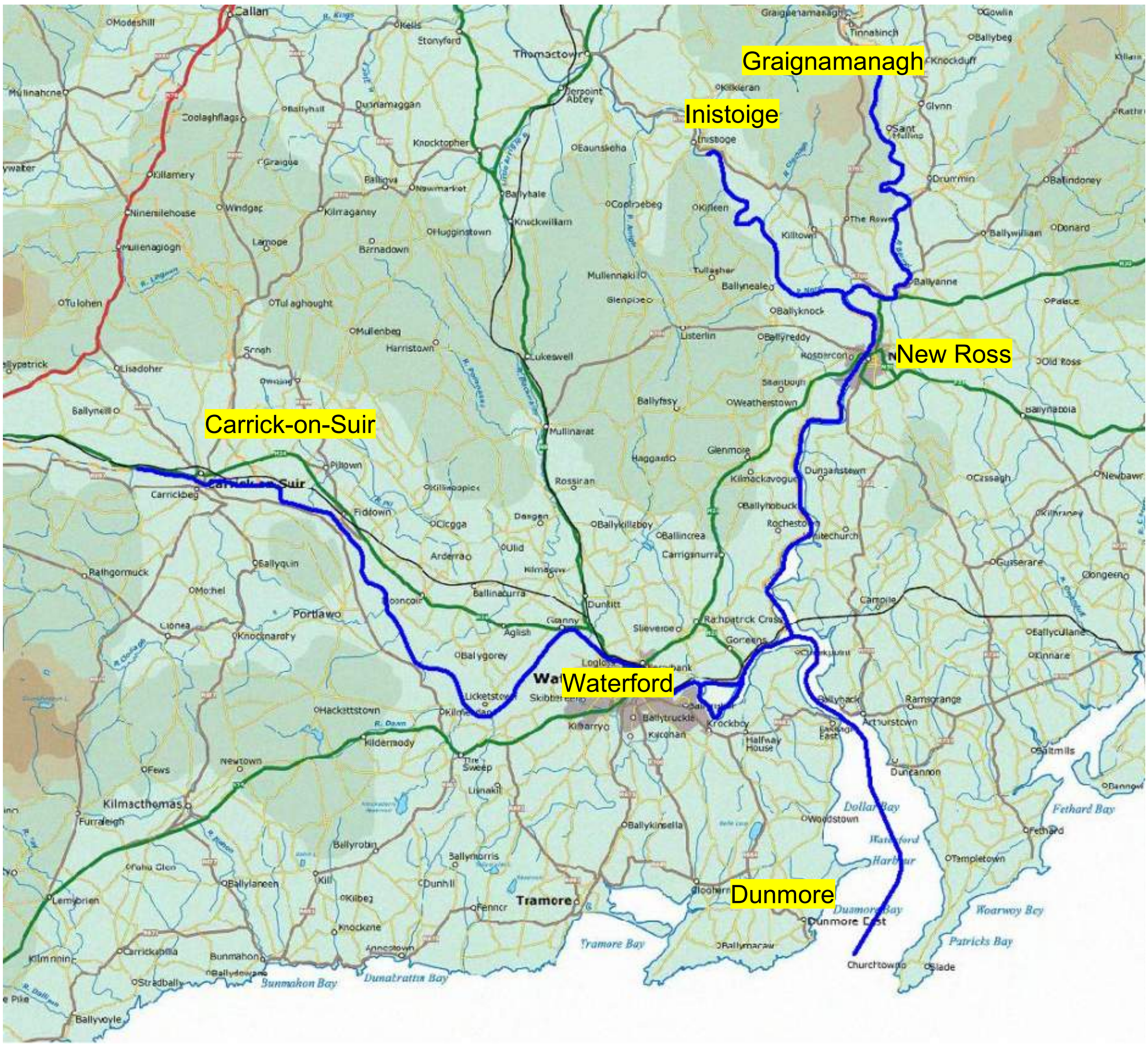


Figure 2-1 Extent of one-dimensional tidal model for the Waterford Flood Defences Project

A Manning's roughness coefficient (n) of 0.028 was used for the various estuarine reaches and a lower roughness coefficient of 0.024 for the wider and deeper Waterford Harbour reach. These roughness coefficients are considered to be appropriate for the wide deep estuarine reaches through Waterford. The HEC-RAS 1-D model set-up included the loop configuration around King's island in Waterford Harbour.

Figure 2-2 ***HEC-RAS Model Schematic***

2.6 2-D Model Development

The 2-D model domain area is presented in Figure 2-3 which represents the local estuarine reach at Waterford City, some 4km in length and 90ha in area. The existing model has a variable mesh set with a general mesh spacing of 10m remote from the flood wall reach section and a more refined mesh within the flood wall reach section of 5m and local refinement in the vicinity of the flood wall of 2m. The total number of computational nodes in the finite element model is 20,652 and 40,168 triangular finite elements. Tidal Flat wetting and drying option was included in the model to facilitate out of channel flow and the wetting and drying of the channel banks with the rising and falling of the tide. Computationally this can lead to some numerical oscillation in water surface elevation and computed flows in the vicinity of the drying element. The Mesh structure in the vicinity of the proposed flood wall is presented in Figure 2-7.

Figure 2-3 2-D Model Reach of Suir Estuary at Waterford City

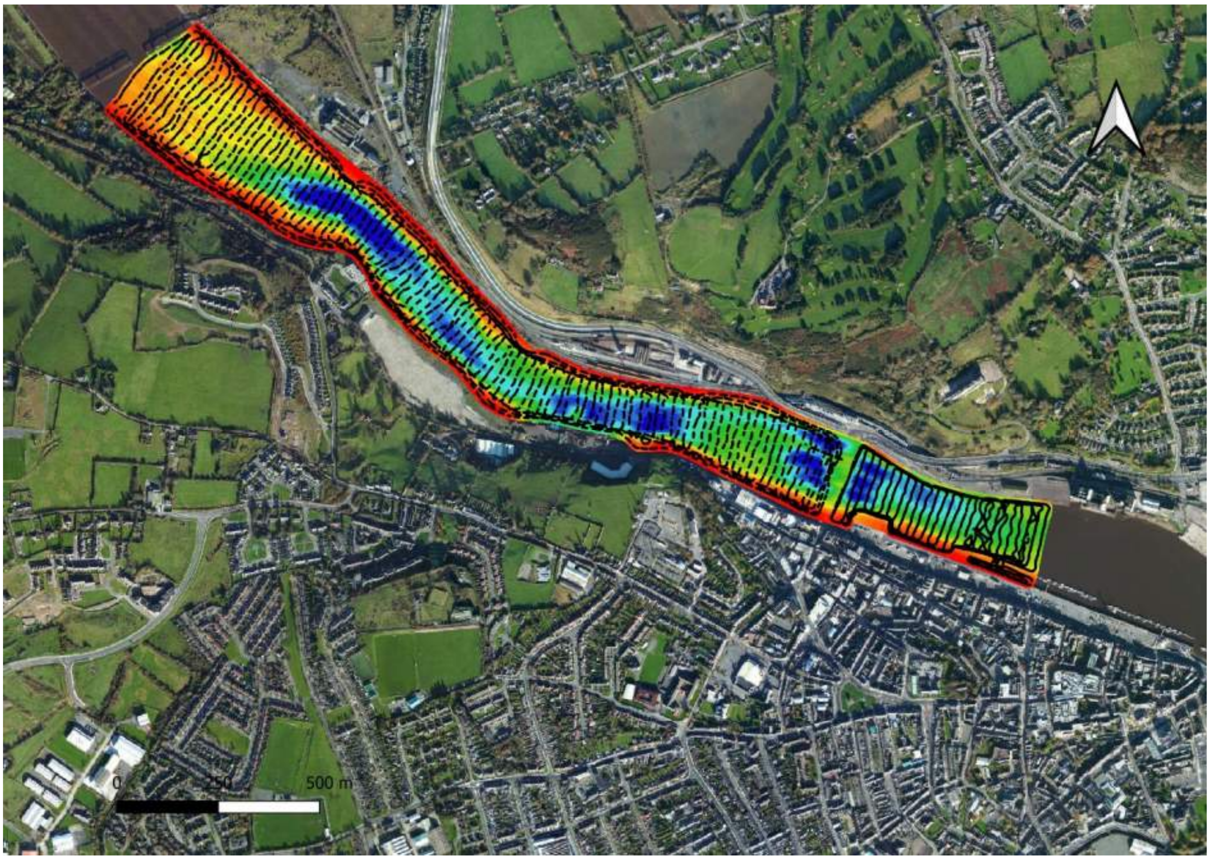


Figure 2-4 2-D Recent 2021 Murphy Survey's bathymetric coverage

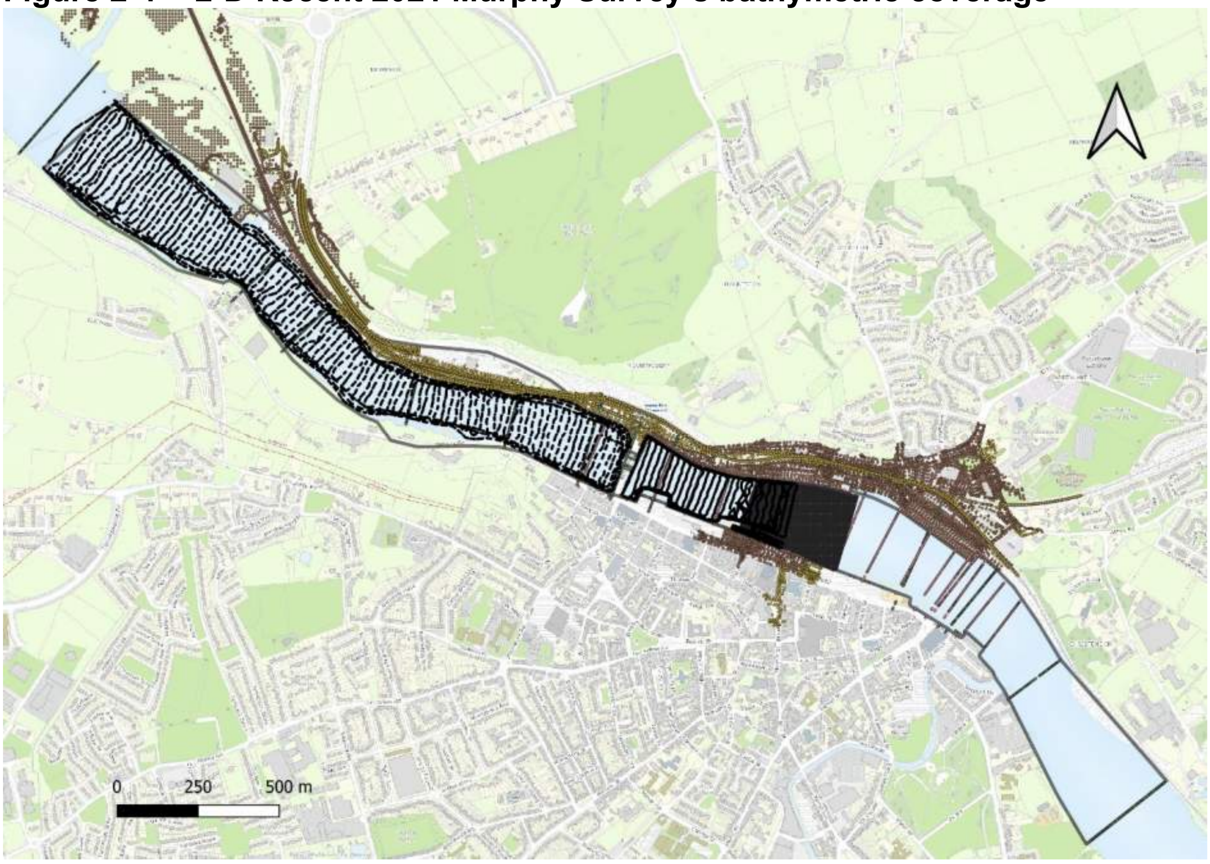


Figure 2-5 combined Bathymetric and topographic surveys including OPW CFRAM cross-section survey data (lidar data not included in figure)

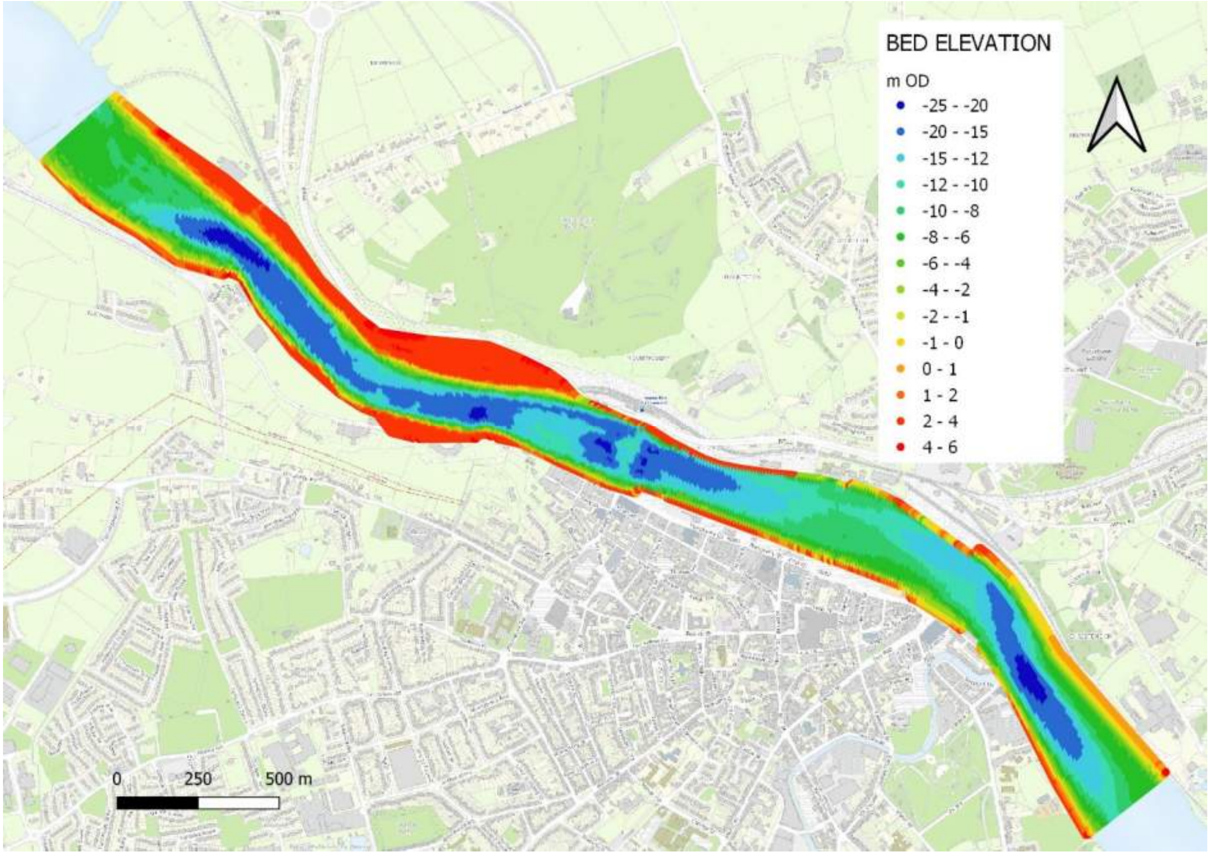


Figure 2-6 Modelled Bathymetry

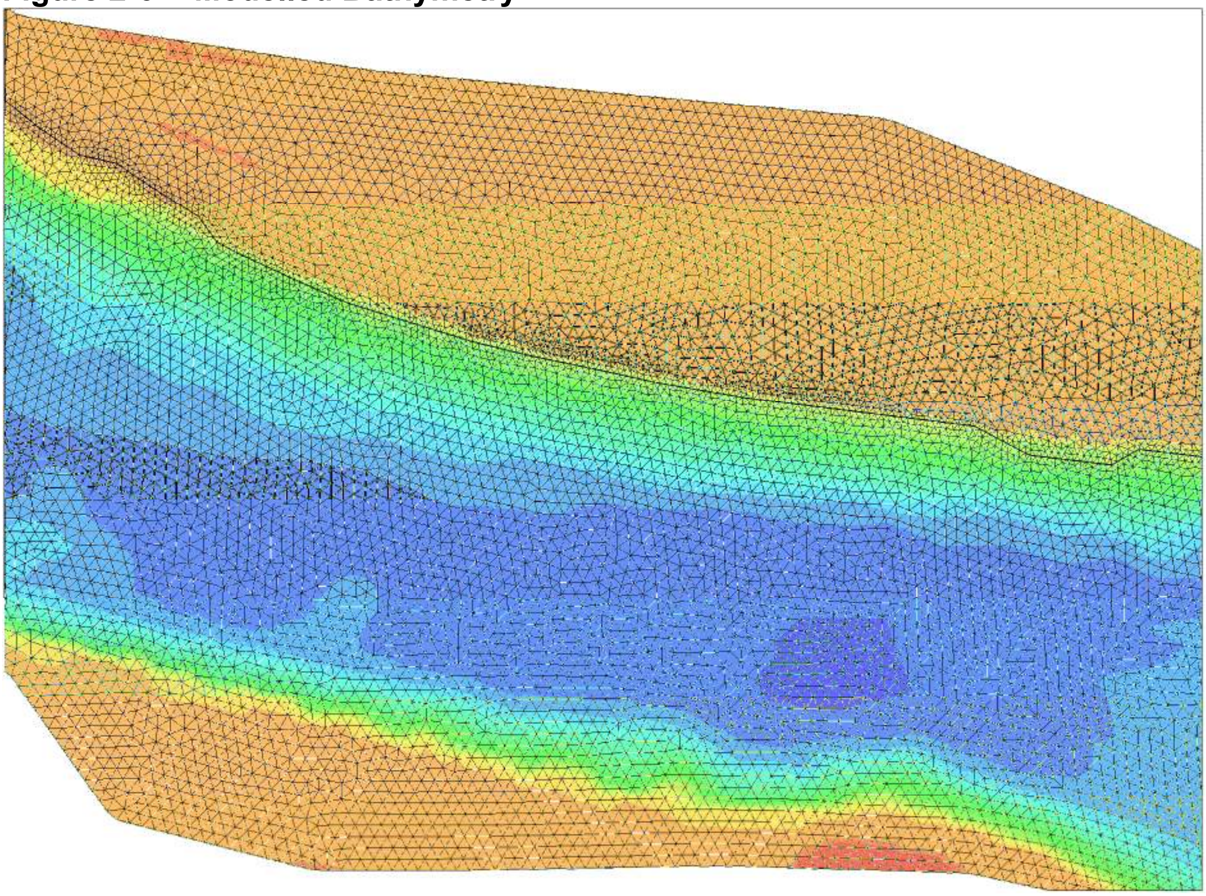


Figure 2-7 Finite Element Mesh for existing case in vicinity of the proposed Flood Wall alignment

2.7 Model Calibration

The hydrodynamic model was calibrated against the tidal velocity and elevation measurements obtained from a previous survey that was carried out in support of the hydrodynamic modelling for the Sustainable Transport Bridge planning application. This hydrographic survey was performed by Aquafact (2018) using an Acoustic Doppler Current meter for the period 25th June 2018 to 19th July 2018. The ADCP was deployed for 24 days near the proposed pedestrian bridge crossing section, located 42m out from the North Quay at National Grid Reference 260782, 112796 (refer to Figure 2-8).

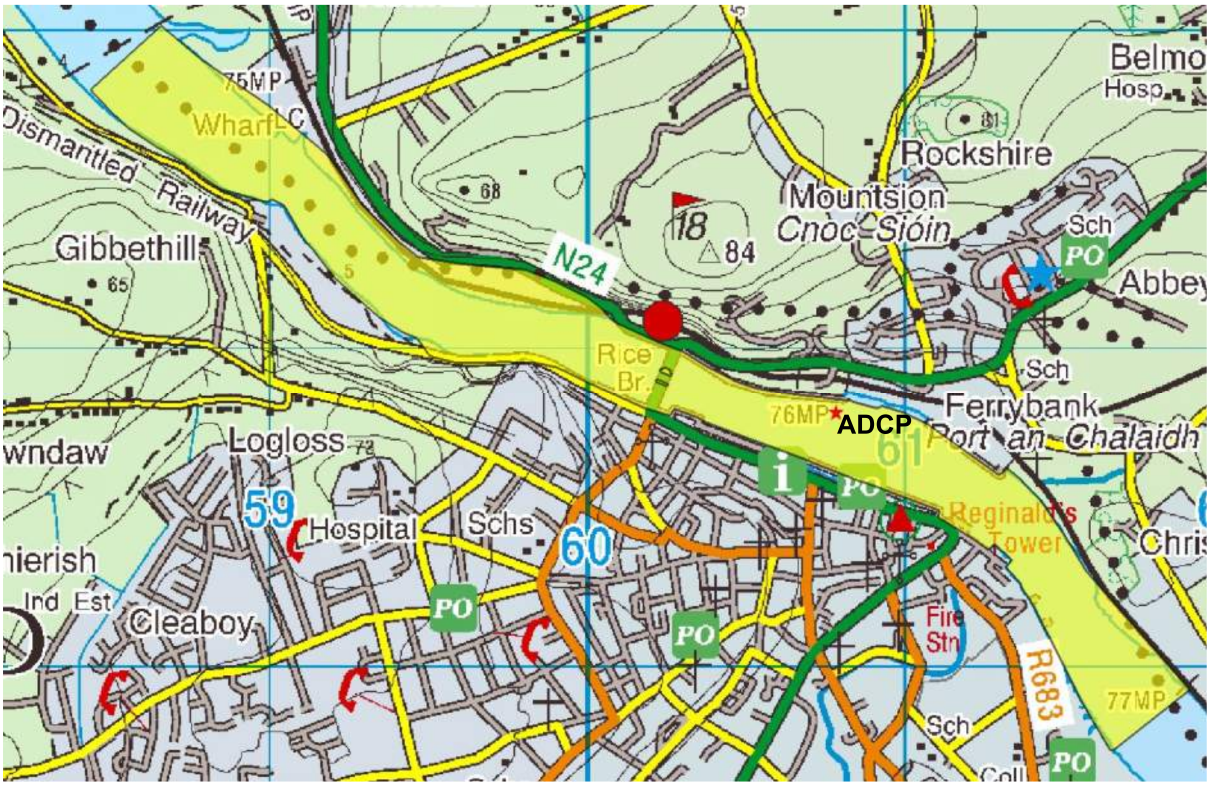


Figure 2-8 ***Location of ADCP current meter for model calibration.***

The tide elevation recorded at Dunmore East tidal gauge was input to the 1D HEC-RAS model and the model was run for the 24day simulation period so as to produce flow and elevation hydrographs at the upstream and downstream locations.

The hydrodynamic model was run for a start date of 25/06/2018 14:00 to the 19/07/2018 12:00 for a computational time step of 1second and simulation results were output every 10 minutes for the complete model domain and stored in a binary results database. Time series of tide elevation and depth averaged velocities were generated for the measurement point from this results database. A final calibrated

Manning's roughness of 0.028 was used with a full k-ε turbulence model to simulate eddy viscosity / turbulence and accurately produce the observed hydrodynamics.

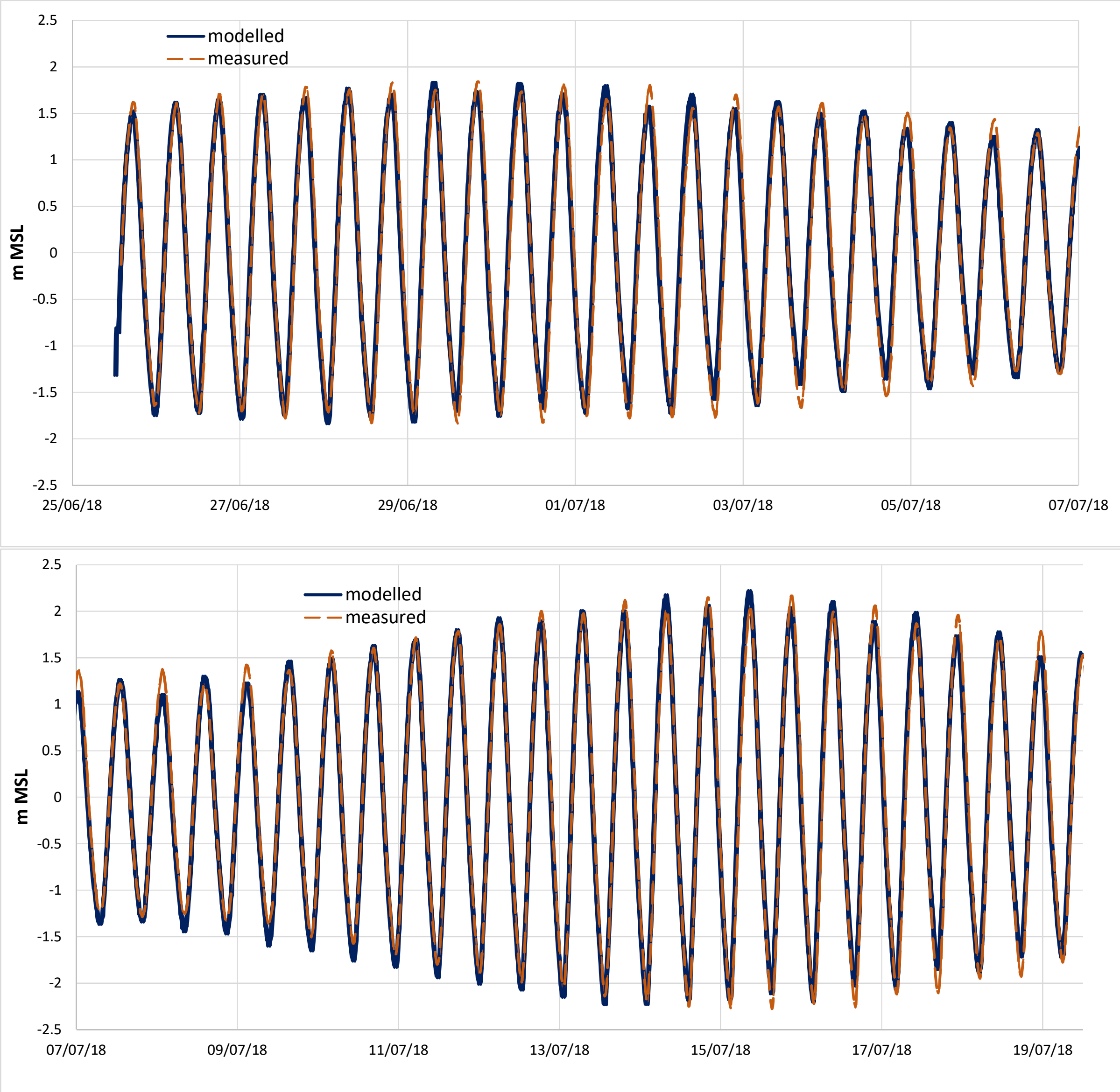


Figure 2-9 Measured and Predicted Tidal Elevation 25 June 2018 to 19 Jul 2018

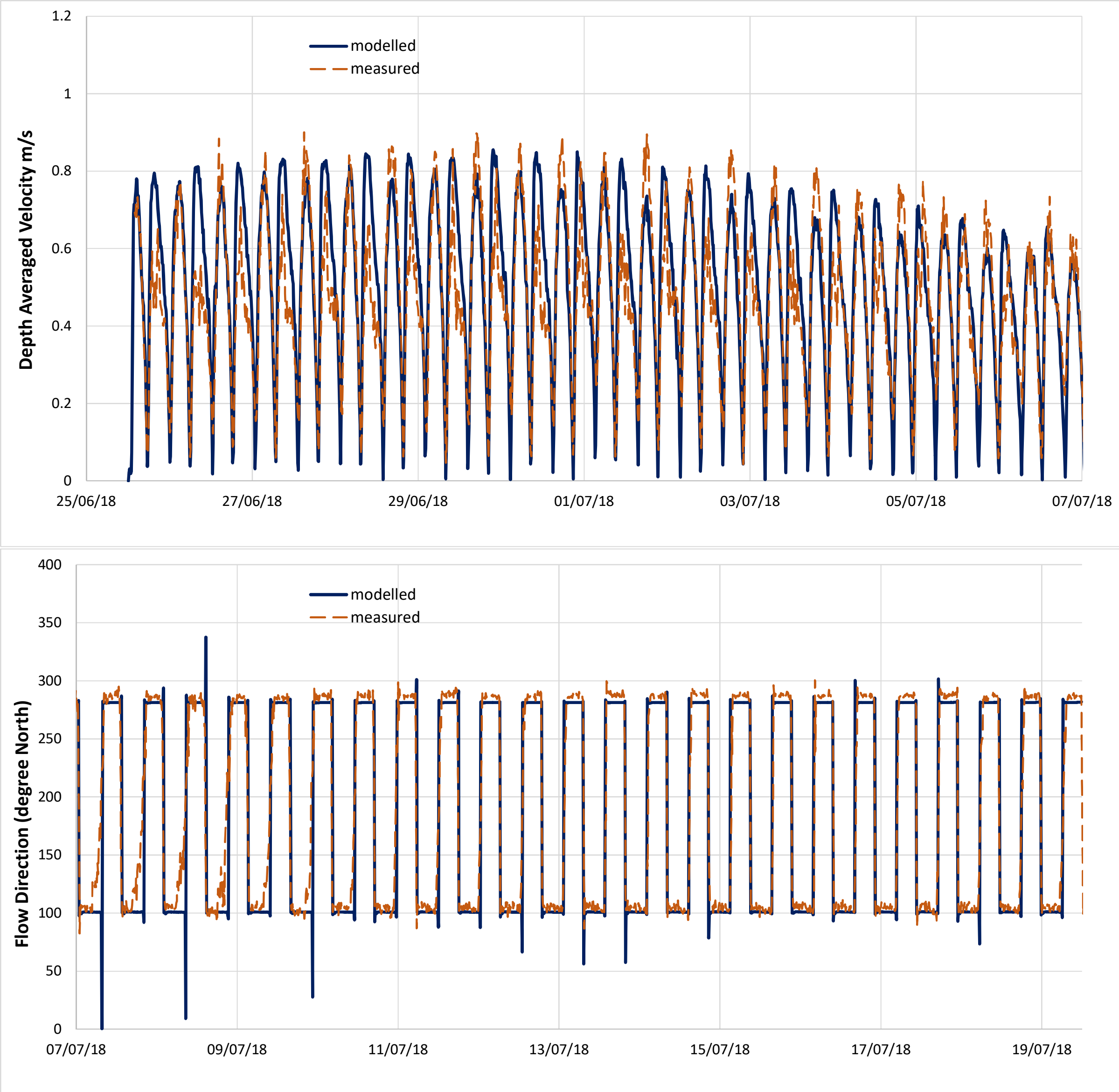


Figure 2-10 Measured and Modelled Depth Averaged Velocity Magnitude and Direction 26 June 2018 to 7 July 2018

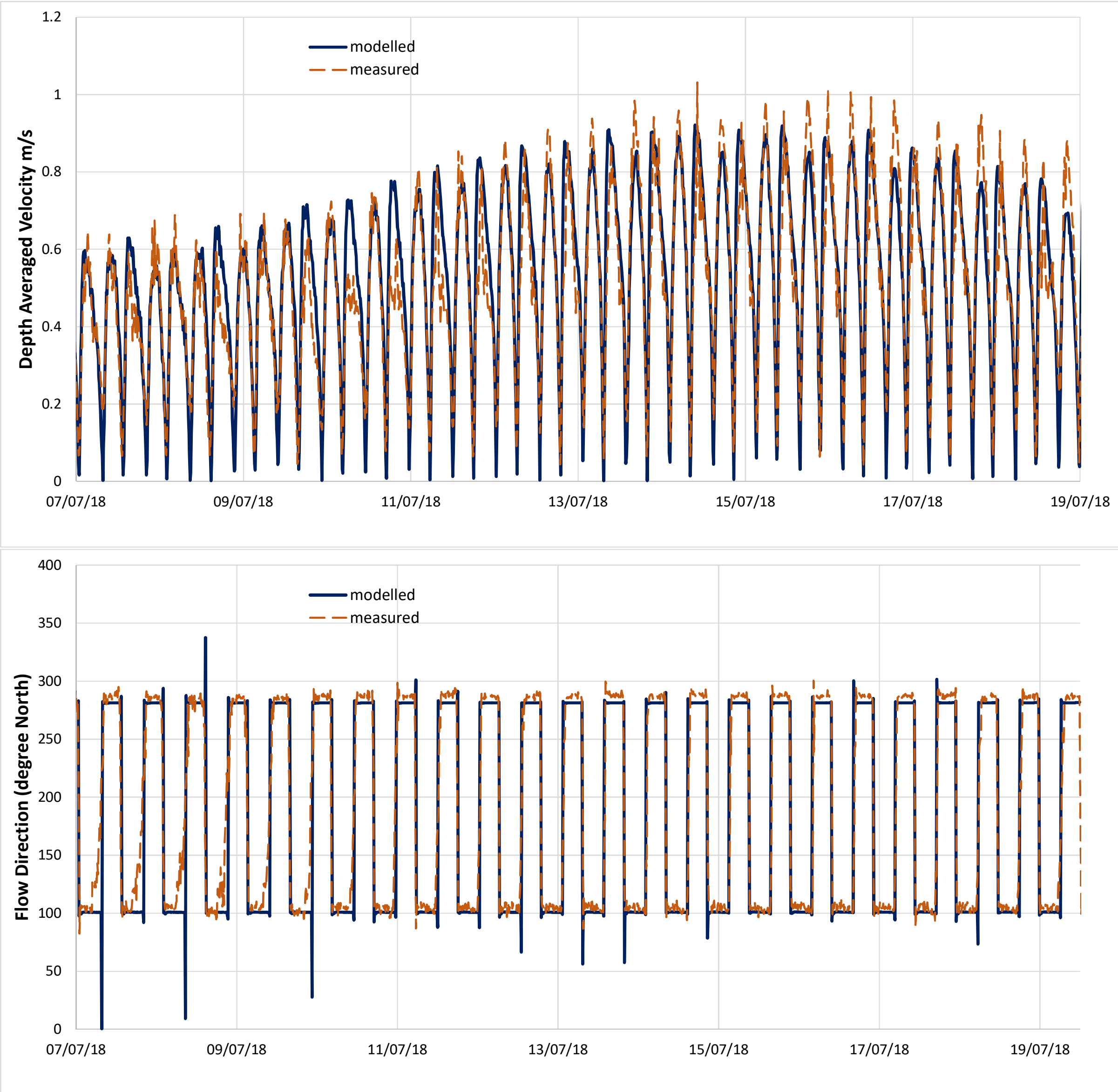


Figure 2-11 Measured and Modelled Depth Averaged Velocity Magnitude and Direction 7 July 2018 to 19 July 2018

2.8 Proposed Flood Wall Finite Element Model

The proposed case which includes the proposed 740m long sheet piled flood Wall and three no. proposed drainage outfalls was modelled using the same mesh structure as the existing case model but with the defended land behind the flood wall removed and a lateral model boundary included along the proposed flood wall alignment, refer Figure 2-12. This is the preferred method for modelling a vertical structure such as a flood wall. The avoidance of remeshing for the proposed case eliminates potential for additional numerical noise associated with the performance of two different finite element meshes which can generate differences that mask the impact of the physical changes being modelled.

An alternate to this approach is to raise the ground levels defended behind the flood wall to the defended level but this would model the flood wall as a sloped wall structure as opposed to a vertical wall which for 2m meshing represents a significant difference and likely to cause additional artificial roughening on the flow field in the vicinity of these elements. A regular vertical sheet piled wall is expected to produce a smoother effect with less resistance on the flow passing along the face of the wall.

The effect of the three proposed outfalls were modelled by locally rising the bathymetry at the model nodal points in the vicinity of the outfalls to the proposed top of outfall elevation.

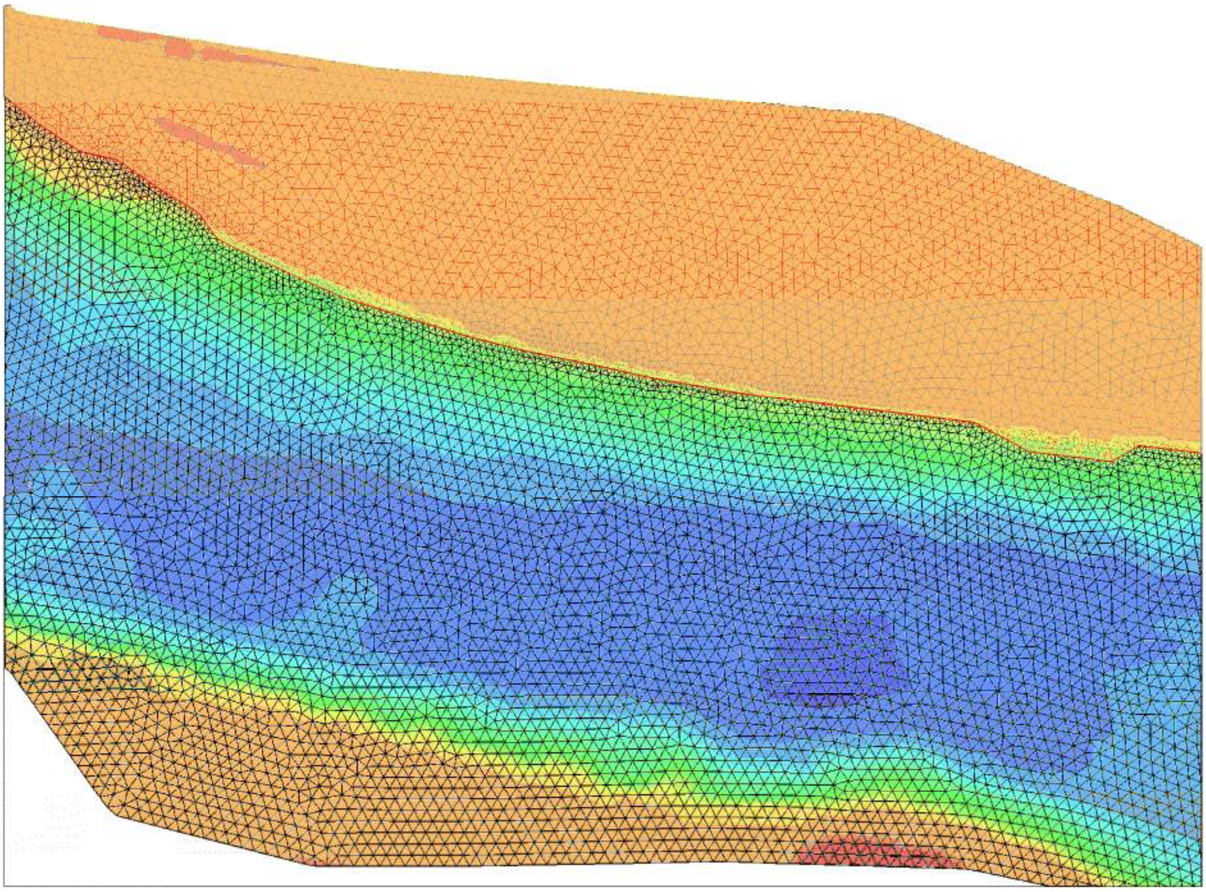


Figure 2-12 Proposed Case Model with model boundary set along the proposed flood wall alignment

3. HYDRODYNAMIC SIMULATIONS

3.1 Introduction

A 24day spring – neap – spring tide using the tidal observations recorded from the 25th June to the 19th July 2018 was simulated so as to assess the potential change in tidal velocities and bed shear stresses within the study reach under existing and proposed cases.

In addition to the normal lunar tide simulations a number of extreme flood simulations were also performed that included both tidal storm surge and fluvial flood events.

3.2 Predicted Hydrodynamic change

The computed neap and spring tide ebb and flood velocities for the existing (do nothing scenario) case are presented in Figure 3-1 to Figure 3-4. These simulation results show the strongest currents located in the middle of the channel where water depths are the largest. The plots show significant reduction in flow velocities in the shallow depths along the channel banks. The velocity plots show locally increased velocities around the existing piers at Edmund Rice Bridge. The flows are generally rectilinear with the longitudinal channel access and maximum flow velocities reaching 0.6 to 0.7m/s on the neap tides and 0.9 to 1.0m/s on spring tides towards the centre of the channel adjacent to the proposed Flood Defence Wall. Along the alignment of the Flood Wall the stronger currents along the bank and toe of the Flood Wall occur on the Flooding Tide whereas on the Ebbing tide the flow velocities slightly pull away from the bank as it navigates the slight NW to ESE bend in the river channel.

Velocity difference plots between proposed and existing cases are presented in Figure 3-5 to Figure 3-8 for neap and spring tides at mid-ebb and mid-flood respectively, These figures show the extent of the estuary area hydraulically impacted by the sheet pilled flood defence wall and associated storm outfalls. The simulations show an increase in velocity along the middle section of the flood wall alignment on both ebb and flood tidal flows and a reduction in velocity locally in the vicinity of the outfall structures with their slightly raised profile. The higher increases in velocity between existing and proposed cases occur on the spring tides and on the flooding tide with a general local increase of 0.05m/s and larger increases along the toe of the Flood wall of 0.075 to 0.1m/s. These local changes and are not significant in comparison to the computed baseline velocity magnitudes under the present existing situation. There is no perceptible change in flow velocities in the main, deeper channel section or at the far bank. The predicted upstream and downstream changes to the flow velocity magnitude at the near bank is local and not very extensive.

To demonstrate the effect of the proposed flood defence wall on tidal velocities a series of 10 output reference locations were chosen, refer to Figure 3-9. The time series plots of existing velocity magnitude under the spring and neap tidal conditions for a 24day simulation period and computed change in velocity magnitude is presented in Figure 3-10 to Figure 3-19. Location 1 to 6 show generally an increase in velocity magnitude over the existing and sites 7 and 8 near the outfalls show a reduction. These changes in velocity magnitude is small relative to the existing velocities and will not represent a significant change to the hydrodynamics of the flow regime of the bed morphology and sediment transport within the reach. Reference site 1 upstream and 9 and 10 further off shore show minimal effect on velocity magnitudes. Only local changes to velocity along this northern bank are predicted with no impacts to flows in the main channel of on the adjacent riverbank.

3.3 Predicted Channel erosion

In order to access the potential impact on bed sediments the bed shear stress is computed using the Chezy equation for bed shear. This is then compared to the critical bed shear of a given sediment particle size for initiation of mobilisation. The Mobility Factor M is defined as the ratio of bed shear to critical bed shear, such that factors exceeding 1 represent mobilisation of the fresh unconsolidated silt/sediment and less than 1 represents immobility with the deposited sediment remaining in place on the bed.

$$\theta_{cr} = \frac{0.3}{1+1.2\mathrm{D}_{gr}} + 0.055\left[1 - e^{-0.02\mathrm{D}_{gr}}\right] \qquad (1)$$

$$D_{gr} = \mathrm{D}\sqrt[3]{\frac{g(s-1)}{\vartheta^2}} \qquad (2)$$

$$\theta_{cr} = \frac{\tau_{cr}}{\rho(s-1)gD} \qquad (3)$$

$$\tau_{cr} = \theta_{cr}\rho(s-1)gD \qquad (4)$$

Where g = 9.81m/s2, s= 2.65 (specific density), D_{gr}= dimensionless grain size, θ_{cr} critical Shield's parameter, ϑ viscosity = 1.2 x 10^{-6}m^2/s, ρ water density kg/m3, D is the sediment diameter and τ_{cr} is the critical shear stress for mobilisation.

Bed Shear Stress is calculated as follows

$$\tau = \frac{U^2\rho}{C'^2} \qquad (5)$$

Where

$$C' = \frac{H^{\frac{1}{6}}}{ng} \qquad (6)$$

U depth averaged velocity, H is water depth, n is manning roughness.

The mobility Factor is expressed as

$$\mathrm{M} = \frac{\tau}{\tau_{cr}} \qquad (7)$$

***M*=1**	At some point, the fluid shear will just be in balance with the critical shear stress for erosion (*M*=1). As flow increases past this point, the grain will start to move along the bed: at first by 'saltating' or jumping along the bed (bed load). These jumps are caused by turbulence in the flow.
1<*M*<8	In this range, the size and mass of the grain is sufficient that it falls back to the bed quite quickly after each jump. As the amount of bed load increases, bedforms such as ripples and/or dunes develop. Bedform length of ripples is mainly a function of grain-size while the height of the bedform is dependent on flow intensity. For dunes, bedform length is mainly a function of flow depth.
8<*M*<14	As flow intensity increases, the bedforms start to reduce in height, the 'hang time' of the particles increases.
14<*M*<65	Sediment is now being swept higher into the flow field. The lift forces in this increasingly turbulent flow field are sufficient to keep the grain in suspension. The onset and characterisation of suspended load is, in large part, controlled by the ratio of sediment fall velocity to the total shear velocity, (w/u_*).

The sediment sampling indicates a silty sediment. This sediment forms over time a cohesive consolidated sediment which provides strong resistant to erosion. Only in the slacker waters towards the channel banks was unconsolidated silt encountered and retrieved by the grab sampling, which is likely to have been freshly laid and the underlying sediment is likely to be a consolidated cohesive clayey silt. Such consolidated cohesive material provides good resistance to erosion and can have a critical shear stresses that exceed a coarse sand in respect to bed erosion.

The computed maximum Bed Shear Stresses for the existing and proposed flood wall case is presented in Figure 3-20 to Figure 3-27 for neap and spring, flood and ebb flows respectively. These generally show relatively low shear stress magnitudes along the riverbank of less than 0.7Pa and typically below 0.5 Pa, which would be of insufficient shear force to erode a consolidated cohesive sediment but sufficient both under the existing and proposed cases, particularly on spring tides (ebb and flood) to mobilise unconsolidated silt and fine sand primarily on the flooding tide but also to a lesser extent on the ebbing tide. The computed mobility factors for fine silt is presented in Figure 3-28 to Figure 3-35 for the neap and spring tides and existing and proposed cases and shows local increases in the silt mobility factor in the vicinity of the bank area immediately adjacent to the flood wall encroachment into the riverbank from Chainage Ch.540 to Ch.900.

The conclusion reached from this analysis is that the computed velocity increases from the proposed vertical sheet piled wall are relatively small and of insufficient magnitude to produce shear stresses (i.e., generally <0.7Pa) that would result in any potential significant erosion of the permanent consolidated sediments on the channel bed and banks in the vicinity of the affected area. Fresher unconsolidated silts will be mobile under ebb and flood conditions both for the proposed and existing cases.

3.4 Extreme Flood Conditions

The impact of the proposed flood defence wall on the hydrodynamics was also assessed under worse case scenarios in respect to a combined fluvial and coastal storm surge event. The extreme flood simulations considered were

- A 200year storm Surge Tide (over two highwater cycles coinciding with a 2year fluvial flood event in the Rivers
- A 100year Fluvial Flood event in the rivers coinciding with a high spring tide event.

The predicted impact on flow velocity magnitudes for these extreme flood events are presented in Figure 3-36 to Figure 3-39. These show the fluvial 100year flooding event to generate lower velocities and velocity change than the 200year tidal storm surge event. The 200 year storm surge event which limited to a very short period of a 12.5 hour tidal cycle produces slightly higher velocities and velocity change over the normal range of tidal events considered earlier in section 3.2 as to be a local impact with the maximum change occurring along the toe of the Sheet pile and no effect to the deeper channel sections. The conclusion reached given the low probability of such an event and the limited duration of the mid-flood and mid-ebb flows that insignificant morphological change is likely to occur along the impacted section adjacent to the sheet piled wall.

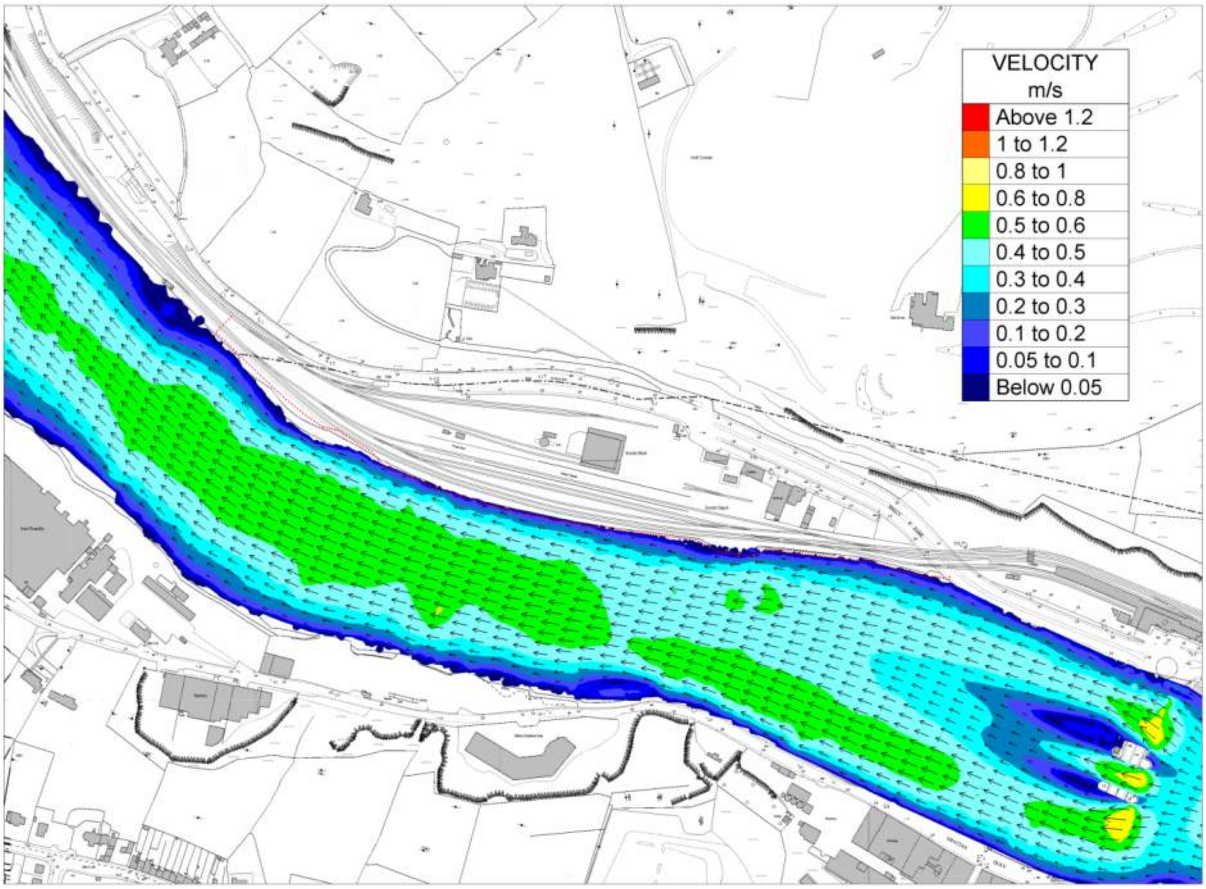


Figure 3-1 Mid-Flood velocities under existing conditions - Neap Tide

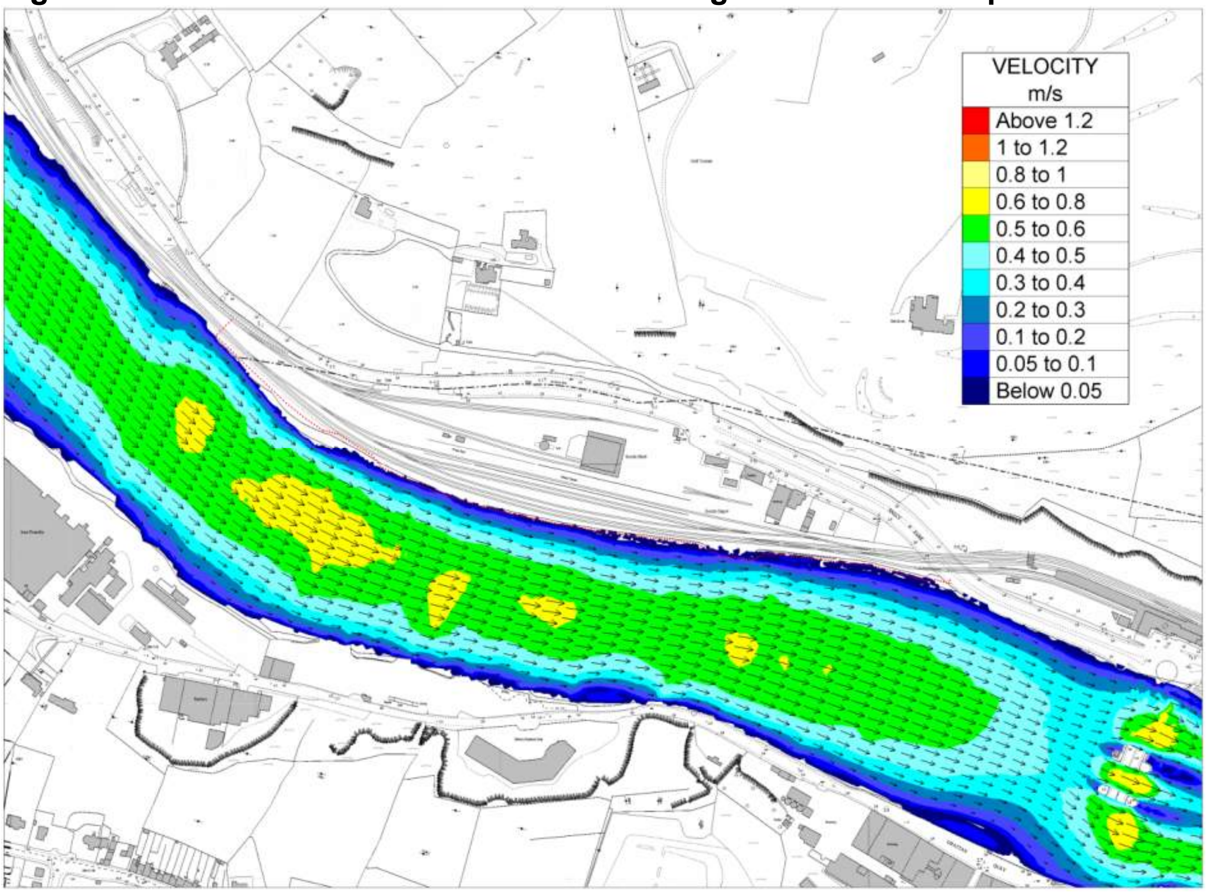


Figure 3-2 Mid-Ebb velocities under existing conditions - Neap Tide

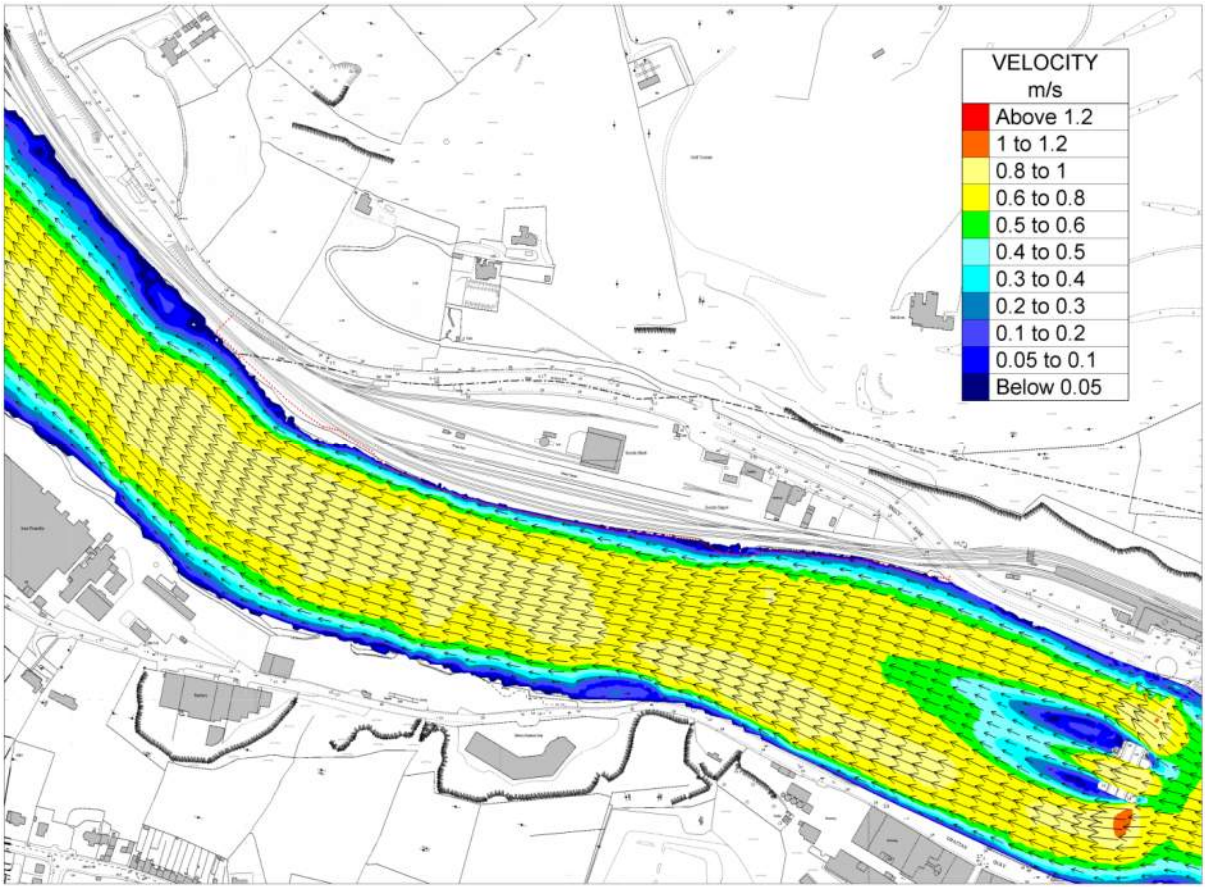


Figure 3-3 Mid-Flood velocities under existing conditions - Spring Tide

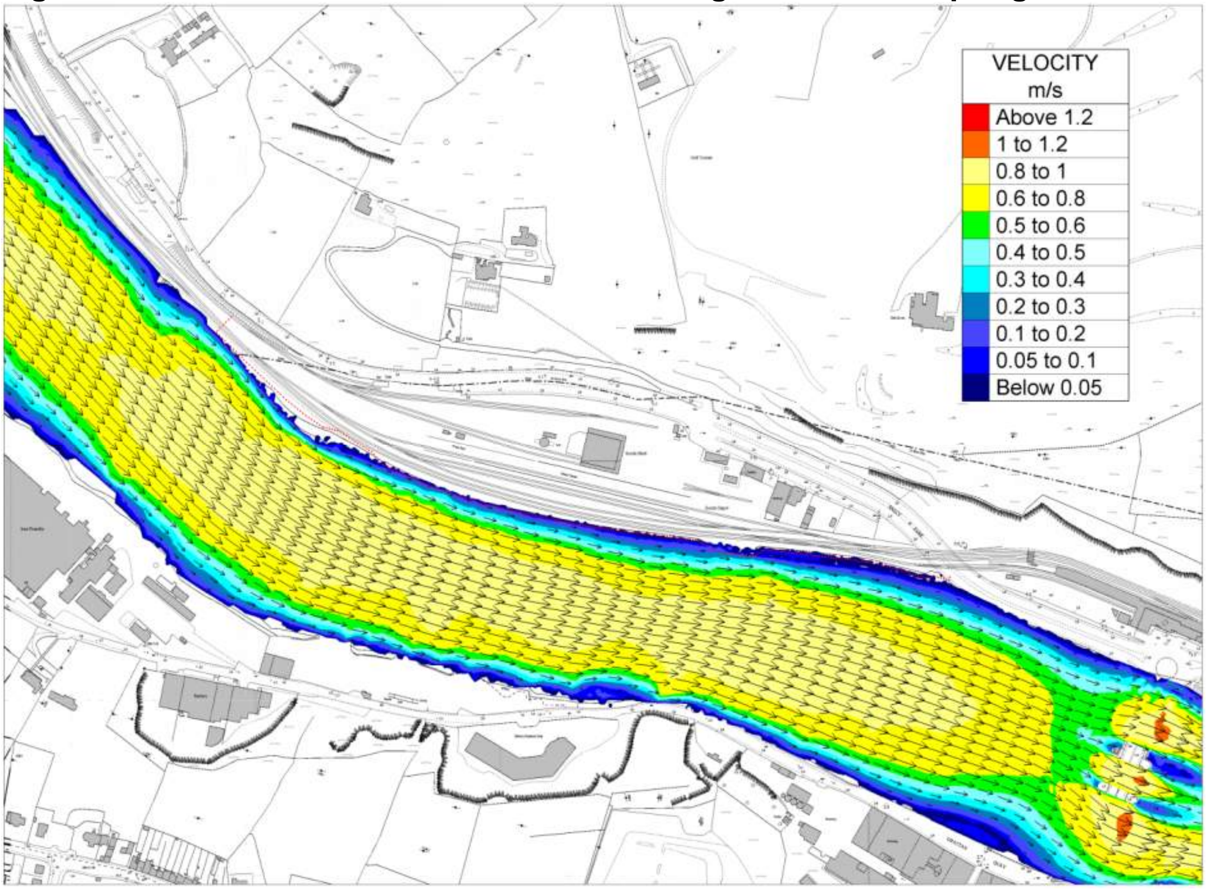


Figure 3-4 Mid-Ebb velocities under existing conditions - Spring Tide

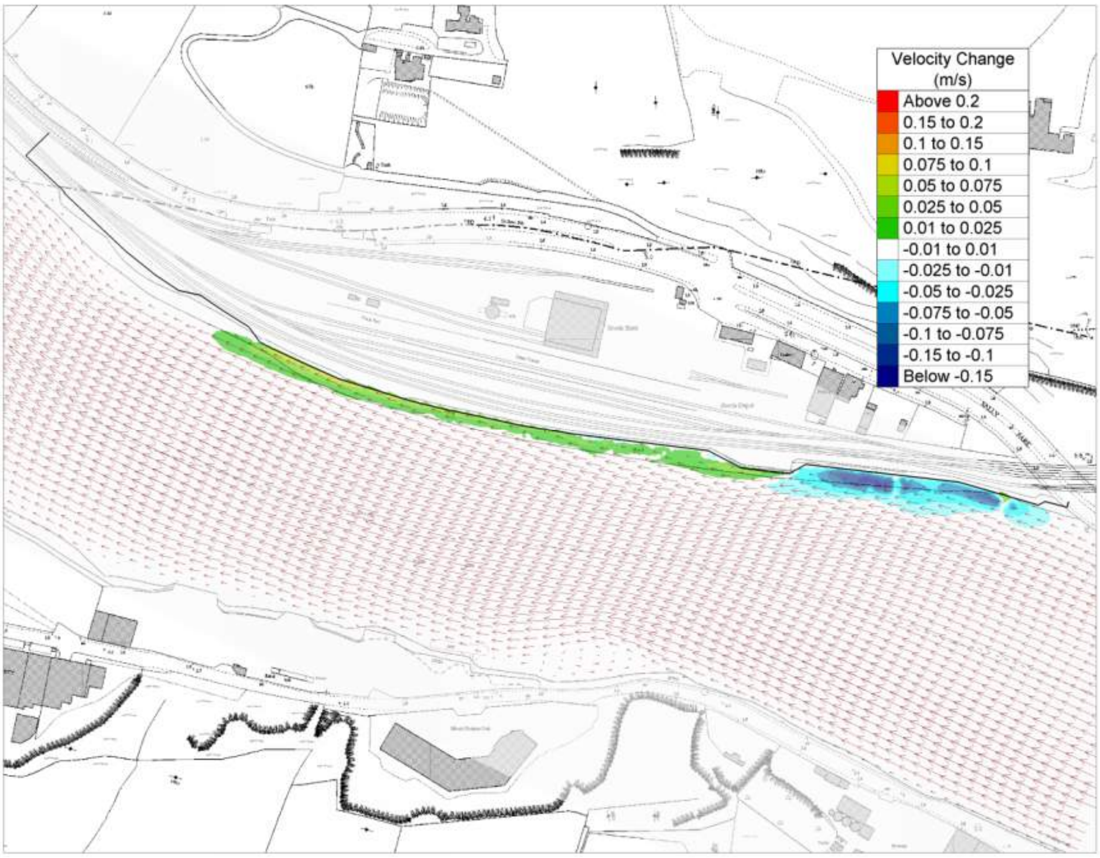


Figure 3-5 Computed change in velocity magnitude Neap Tide Mid-Flood

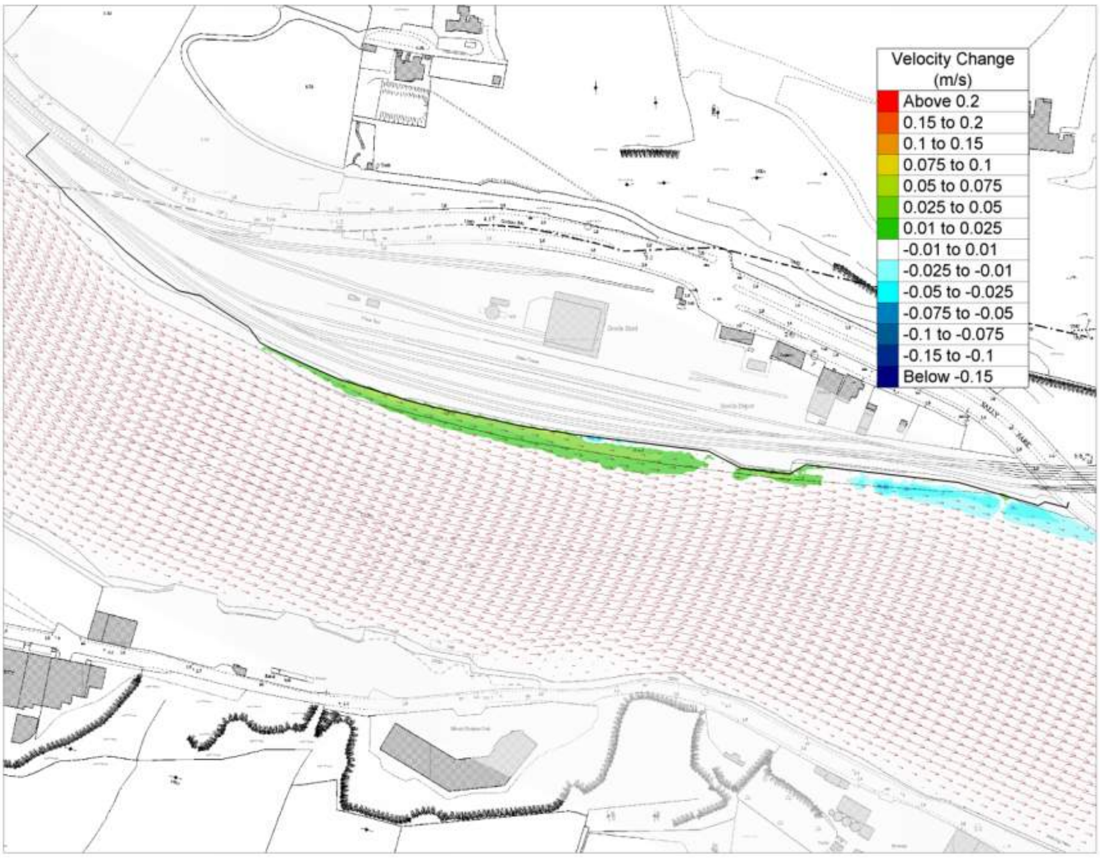


Figure 3-6 Computed change in velocity magnitude– Neap Tide Mid-Ebb

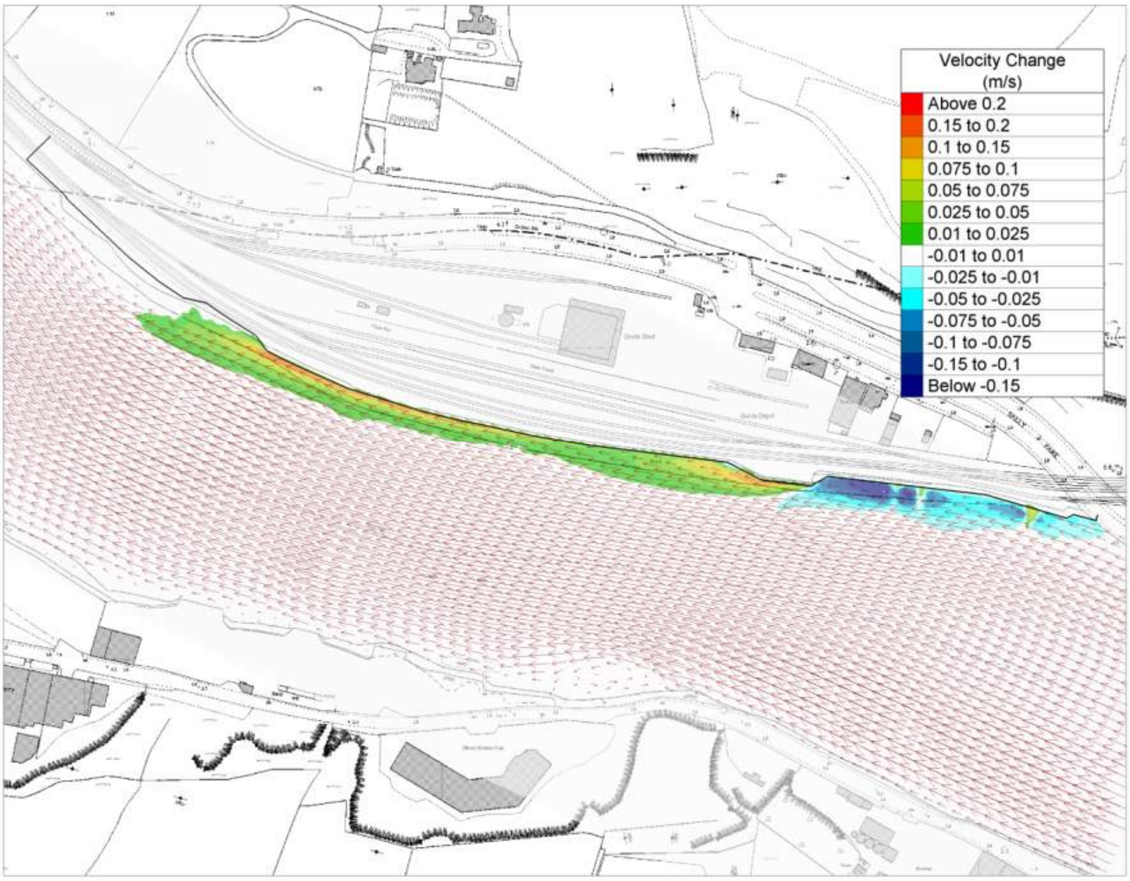


Figure 3-7 Computed change in velocity magnitude – Spring Tide Mid-Flood

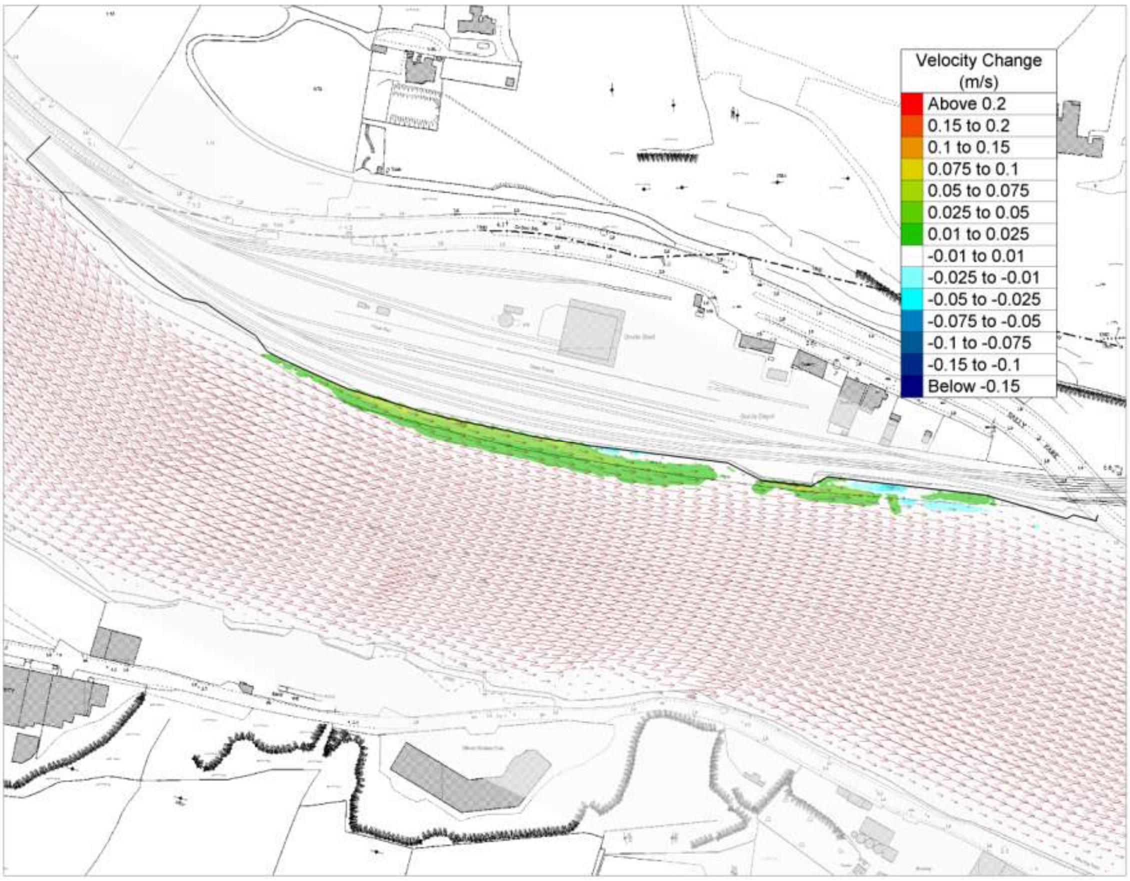


Figure 3-8 Computed change in velocity magnitude – Spring Tide Mid-Ebb

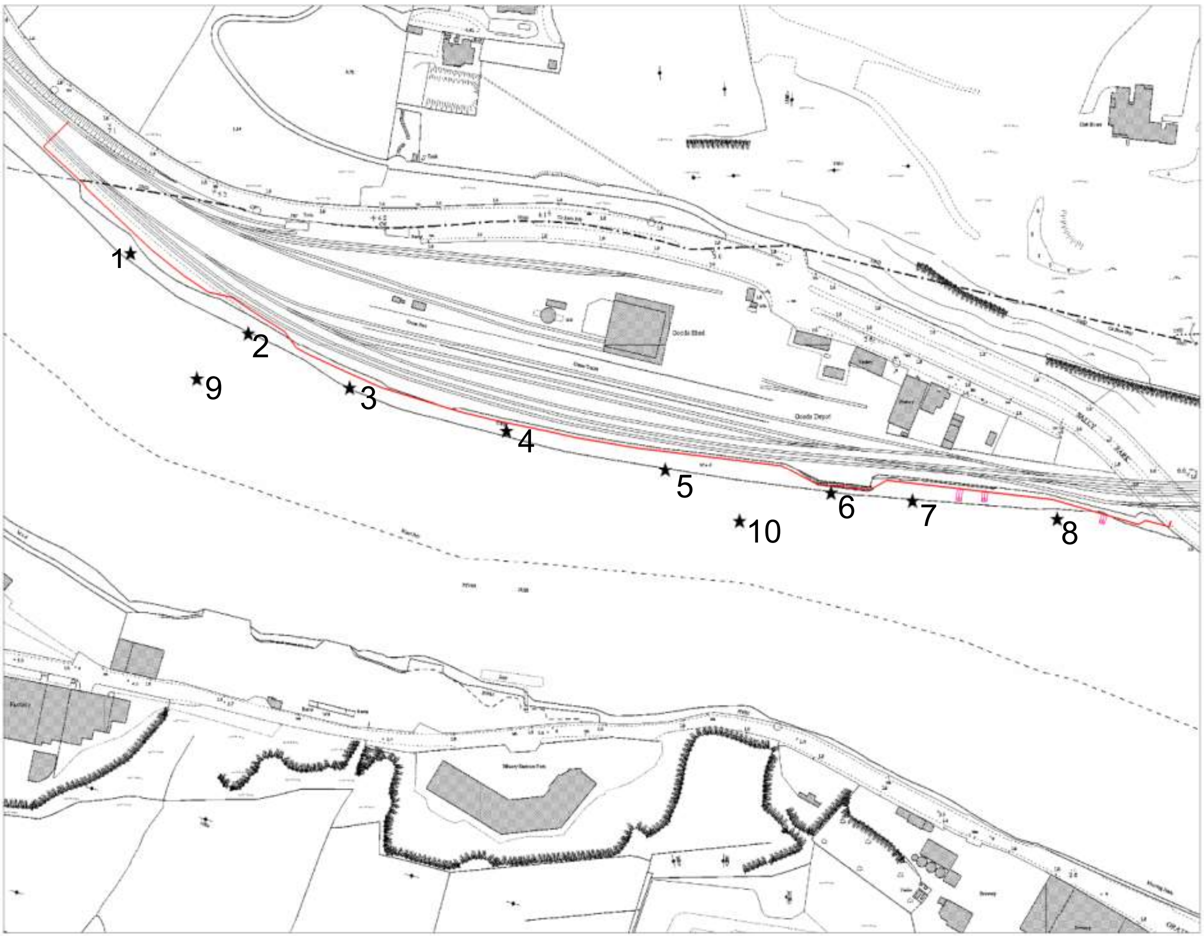


Figure 3-9 Reference Points for Time series output of existing Velocity and change in Velocity

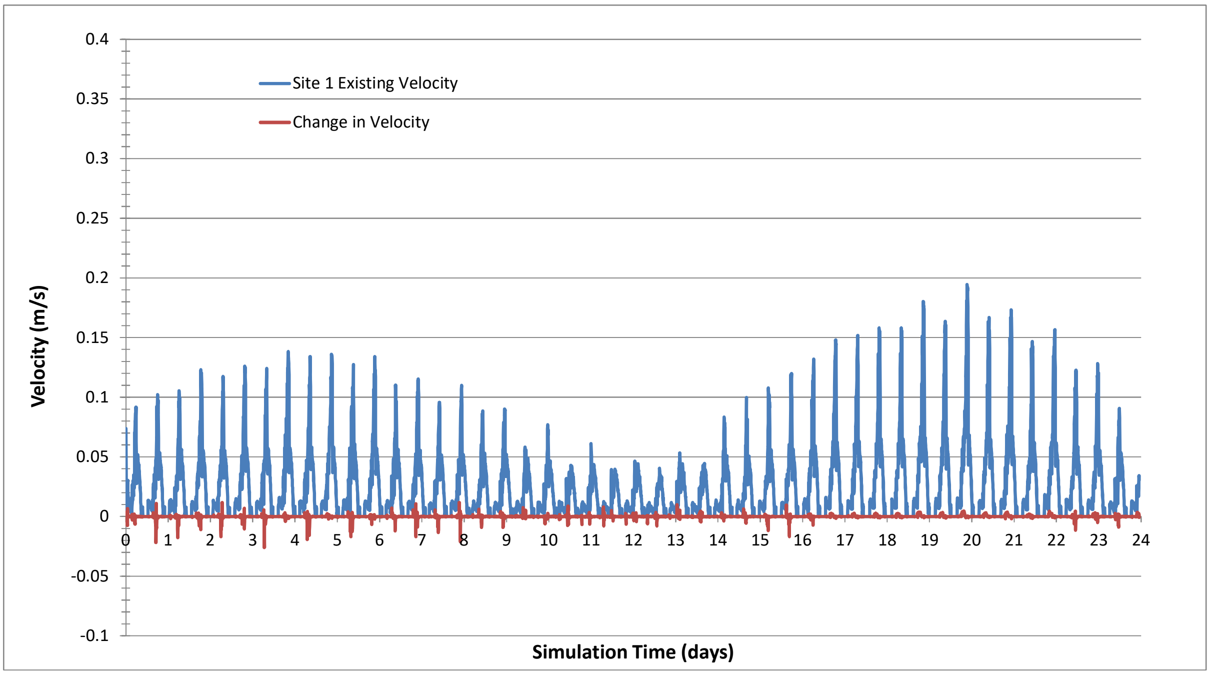


Figure 3-10 Time Series of existing velocity magnitude and computed change at Site 1

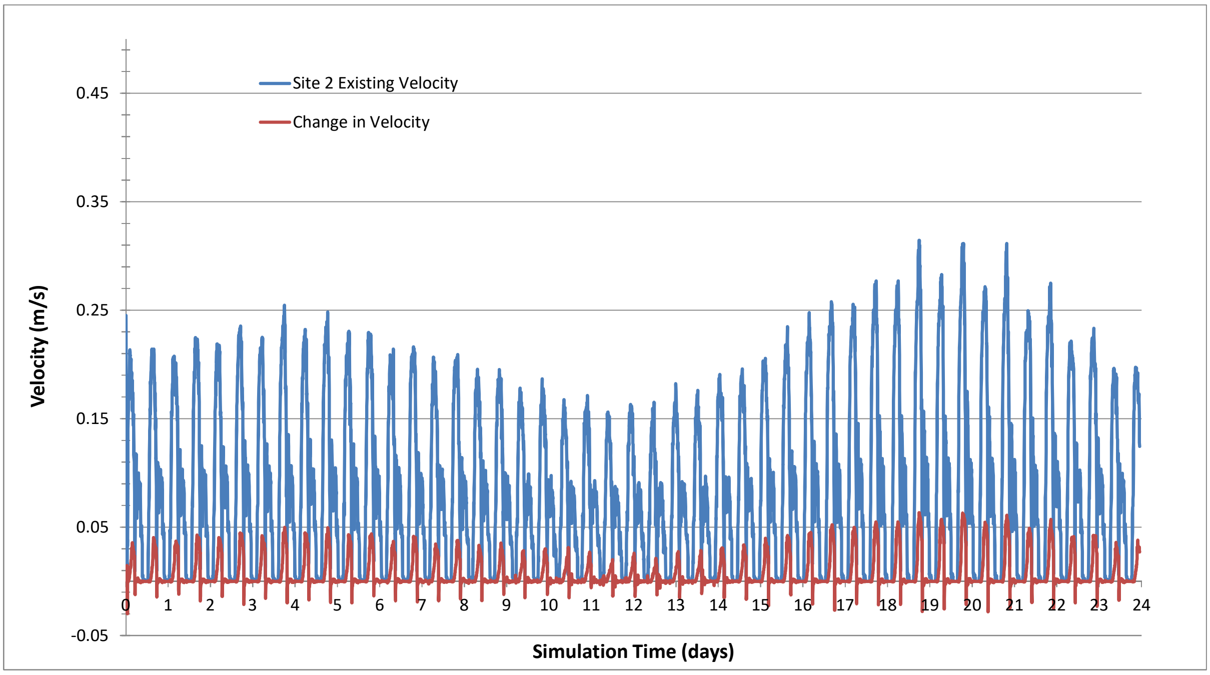


Figure 3-11 Time Series of existing velocity magnitude and computed change at Site 2

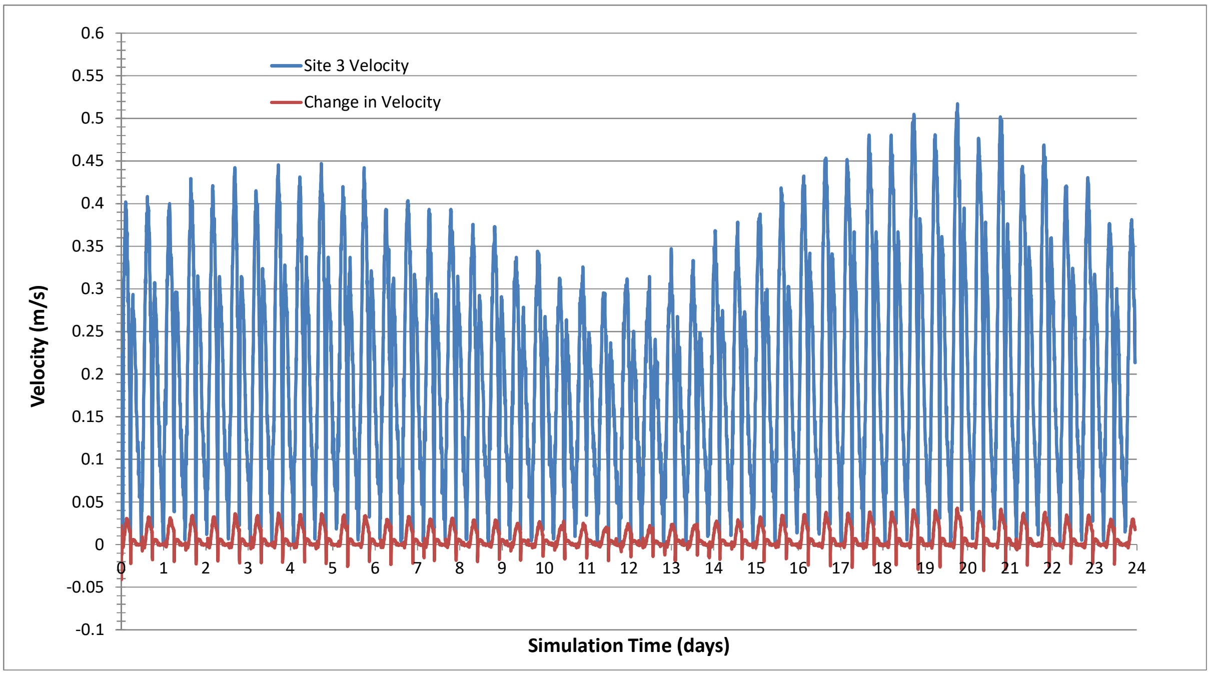


Figure 3-12 Time Series of existing velocity magnitude and computed change at Site 3

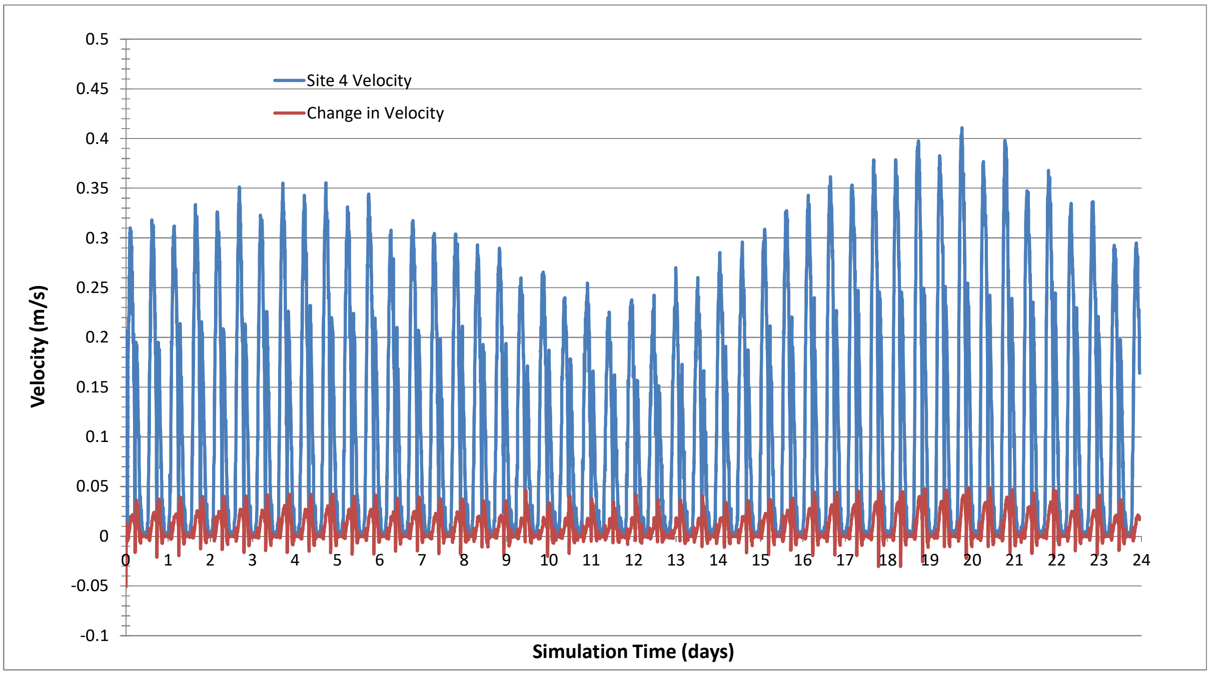


Figure 3-13 Time Series of existing velocity magnitude and computed change at Site 4

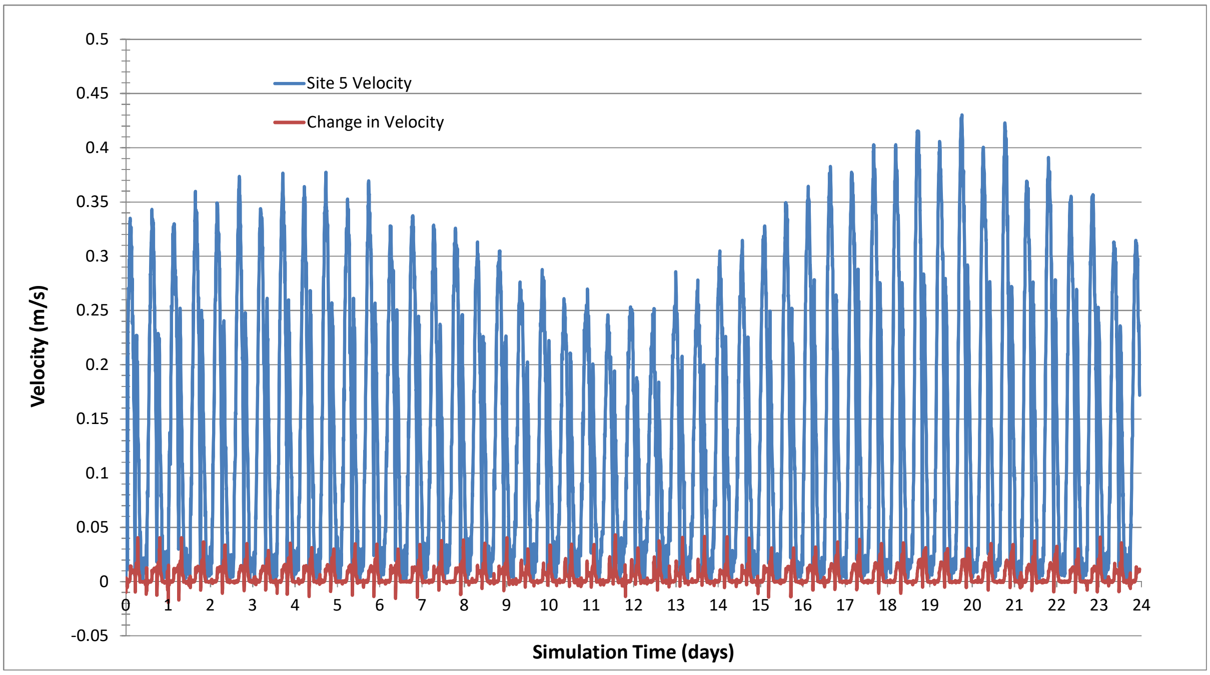


Figure 3-14 Time Series of existing velocity magnitude and computed change at Site 5

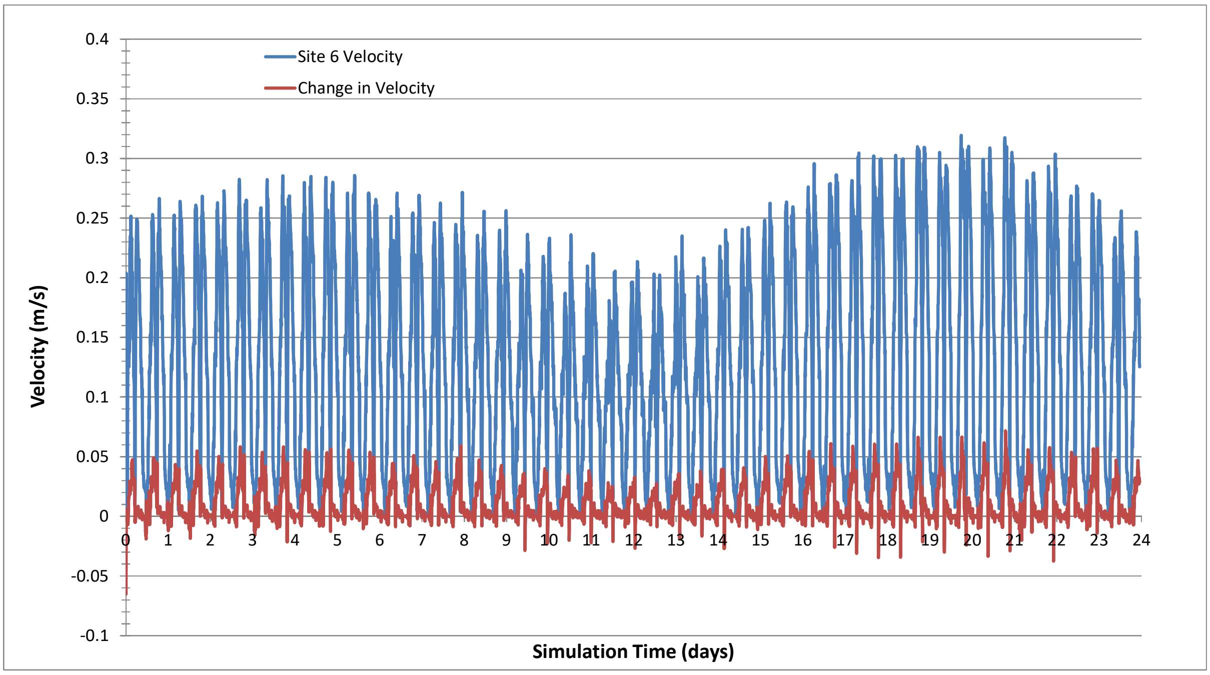


Figure 3-15 Time Series of existing velocity magnitude and computed change at Site 6

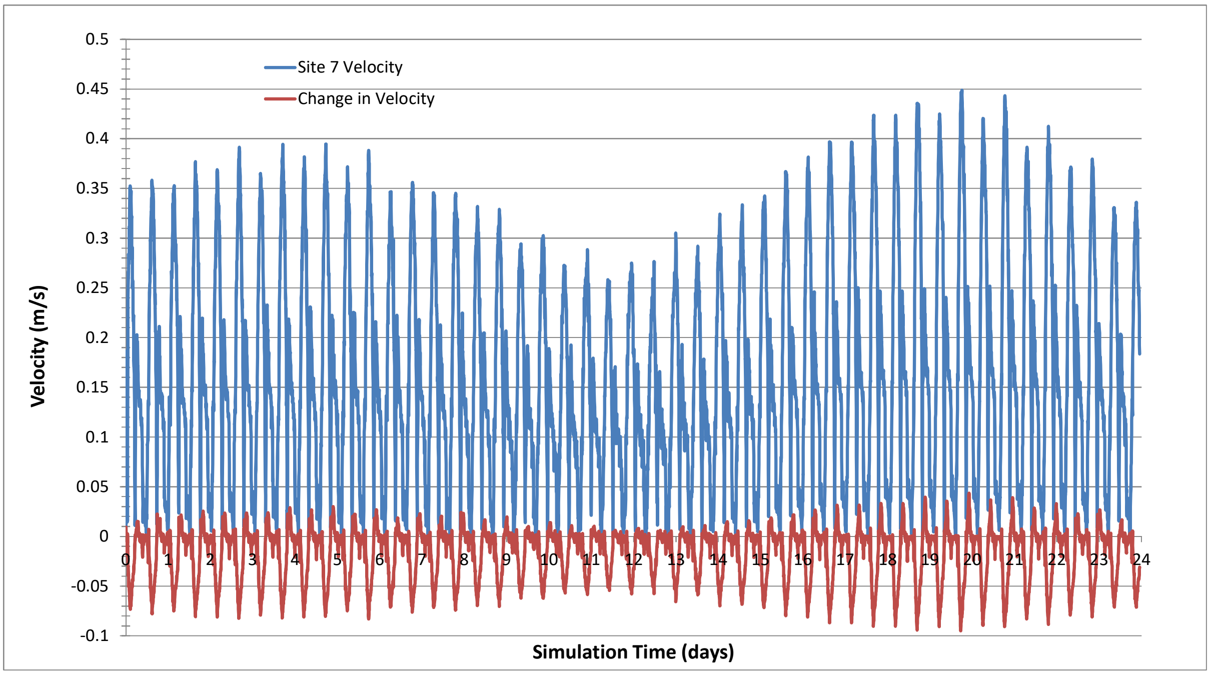


Figure 3-16 Time Series of existing velocity magnitude and computed change at Site 7

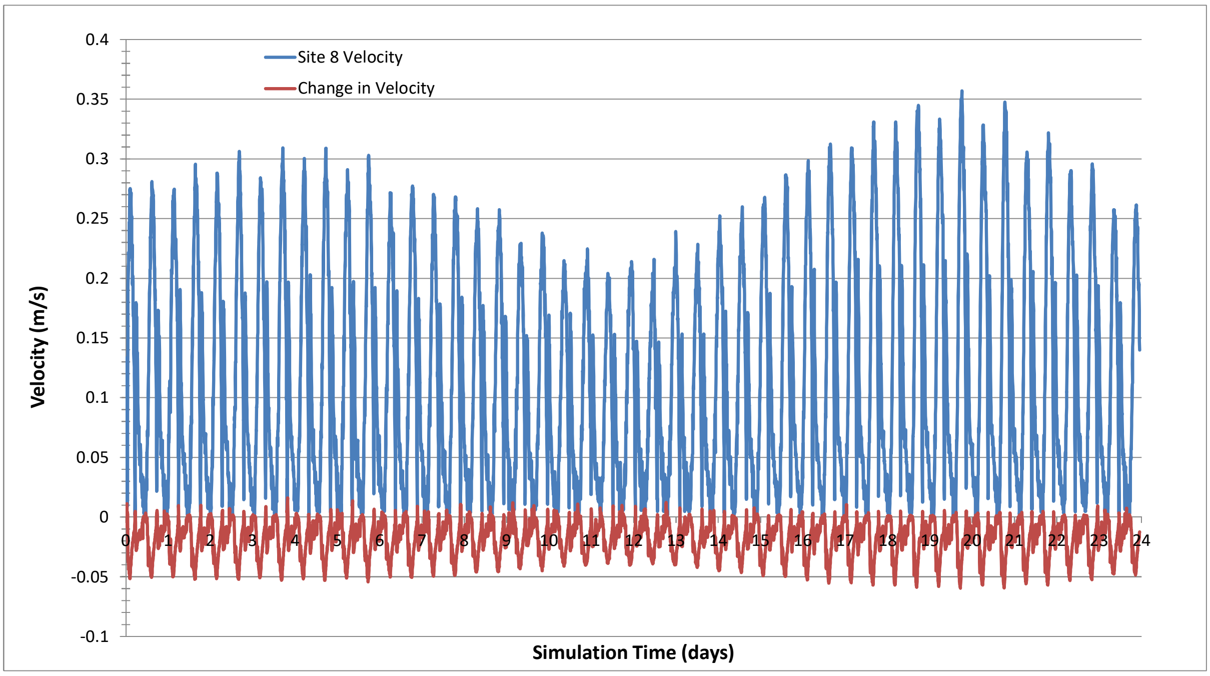


Figure 3-17 Time Series of existing velocity magnitude and computed change at Site 8

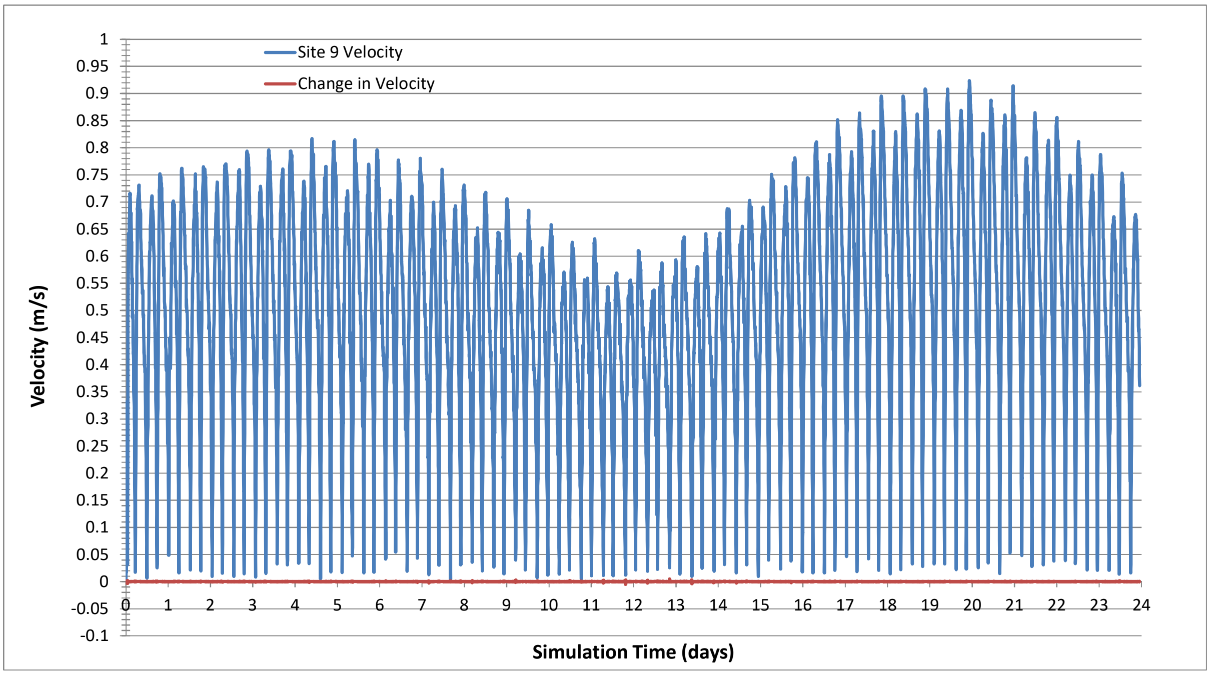


Figure 3-18 Time Series of existing velocity magnitude and computed change at Site 9

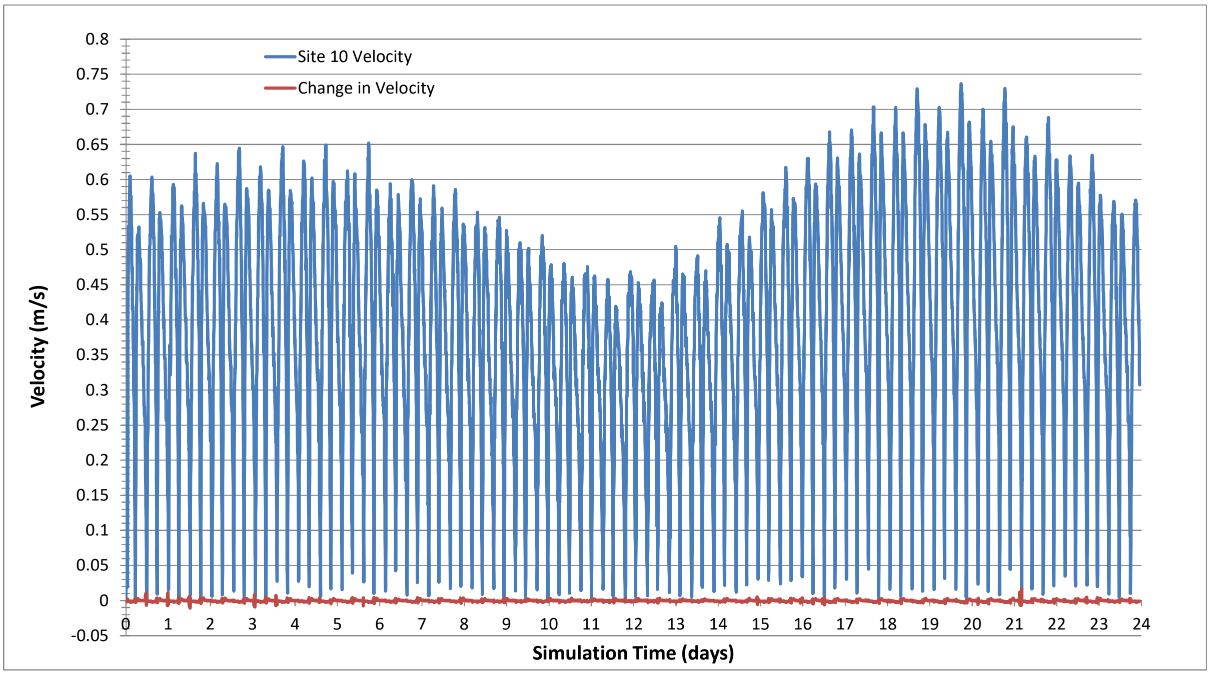


Figure 3-19 Time Series of existing velocity magnitude and computed change at Site 10

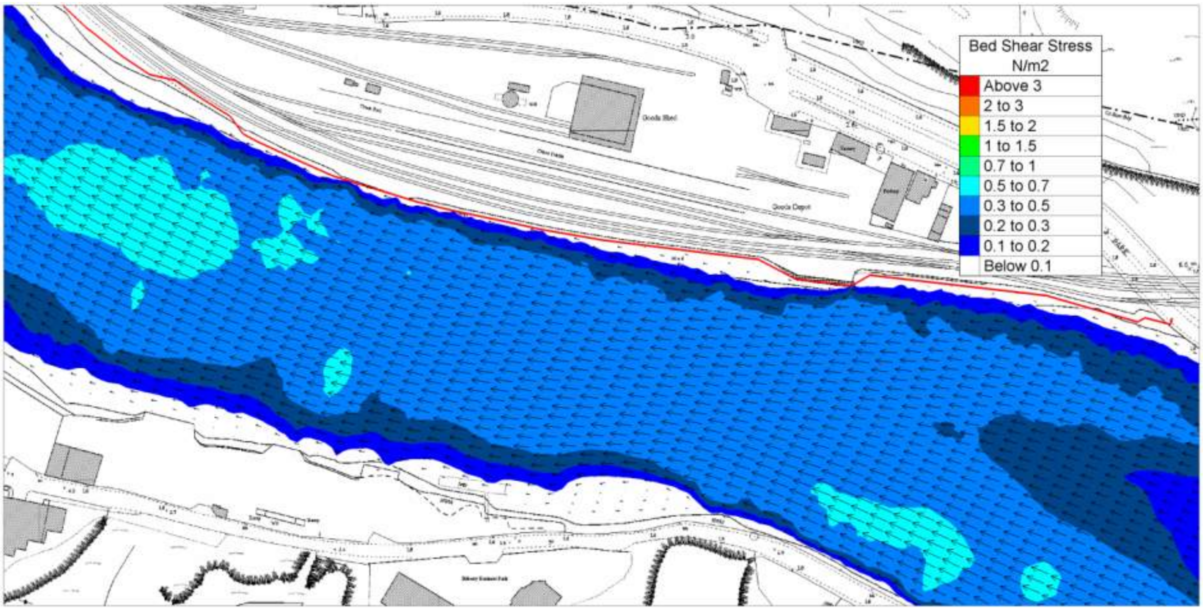


Figure 3-20 Mid-Flood Bed Shear Stress - existing case Neap Tide

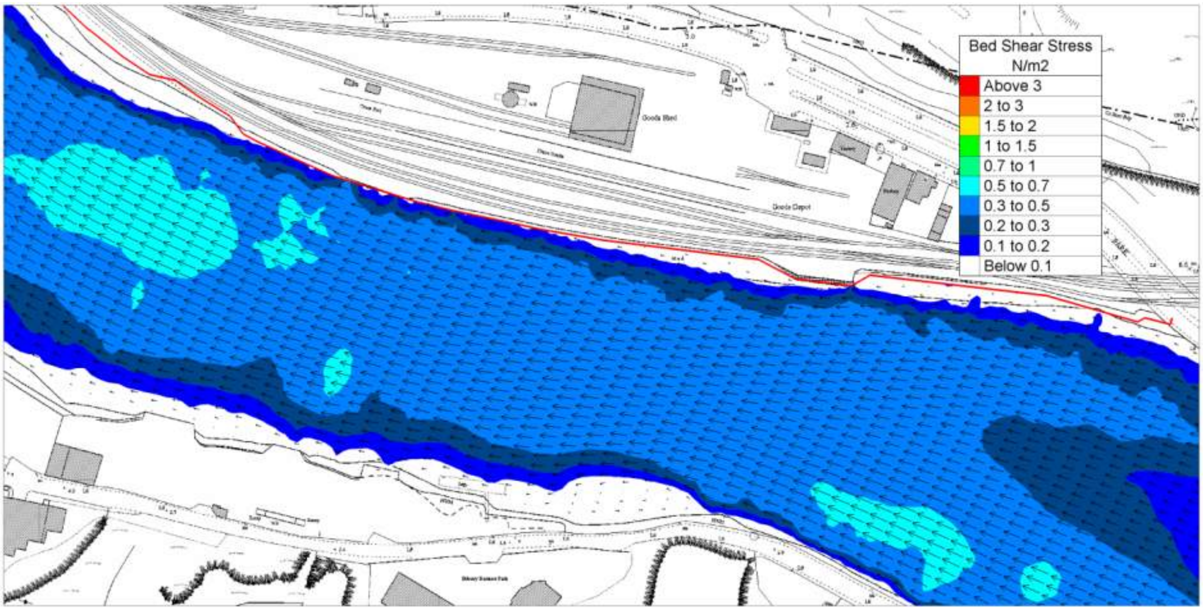


Figure 3-21 Mid-Flood Bed Shear Stress – proposed case Neap Tide

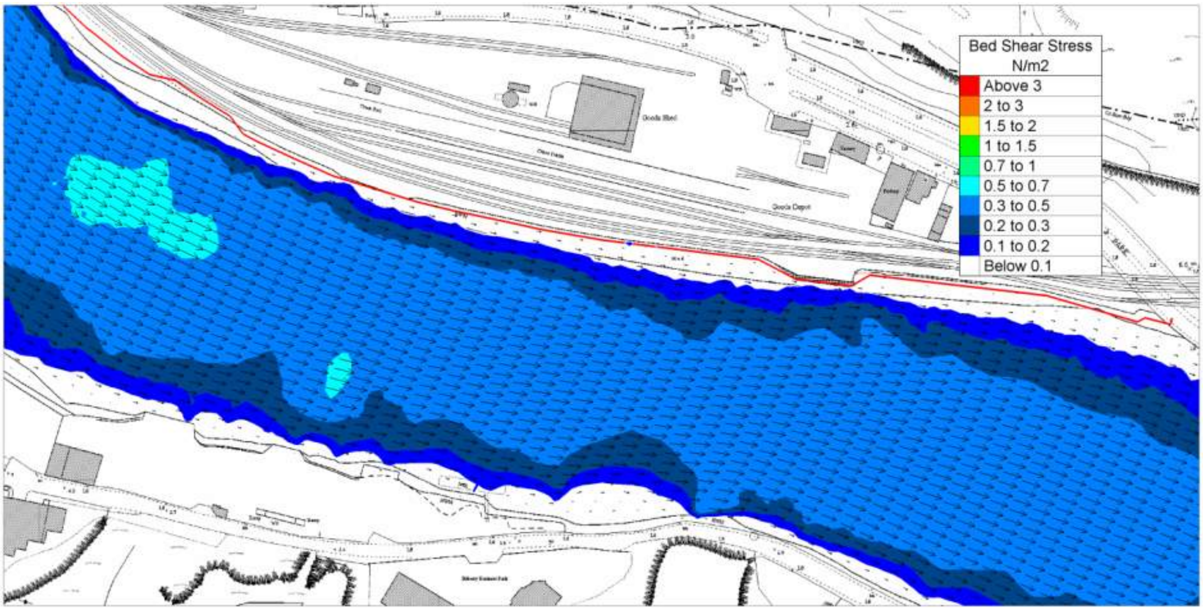


Figure 3-22 Mid-Ebb Bed Shear Stress - existing case Neap Tide

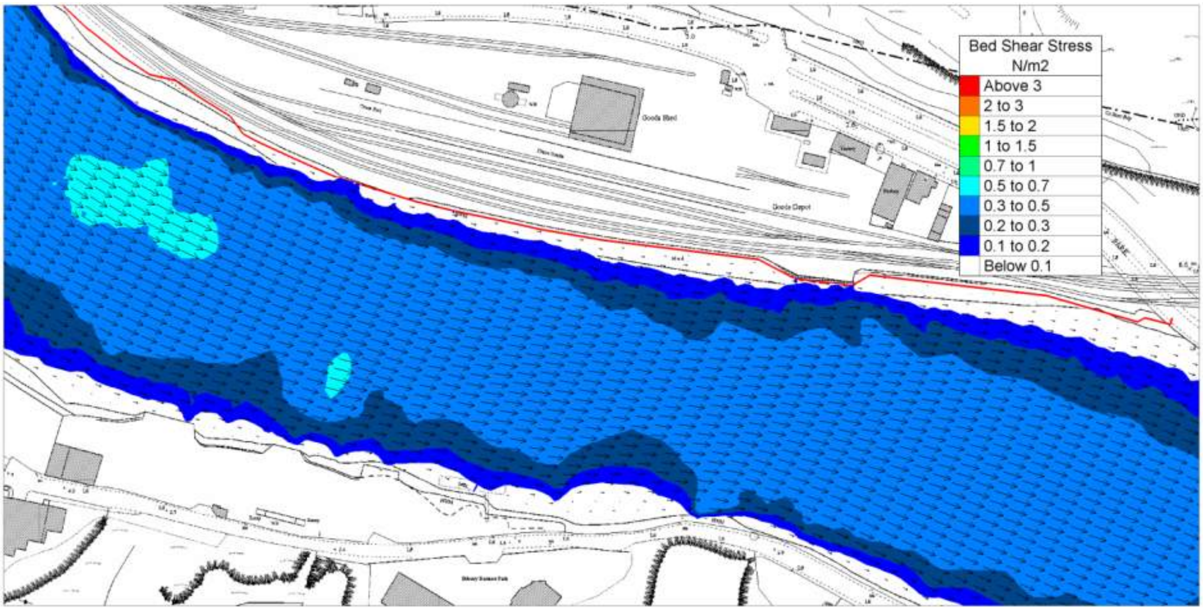


Figure 3-23 Mid-Ebb Bed Shear Stress – proposed case Neap Tide

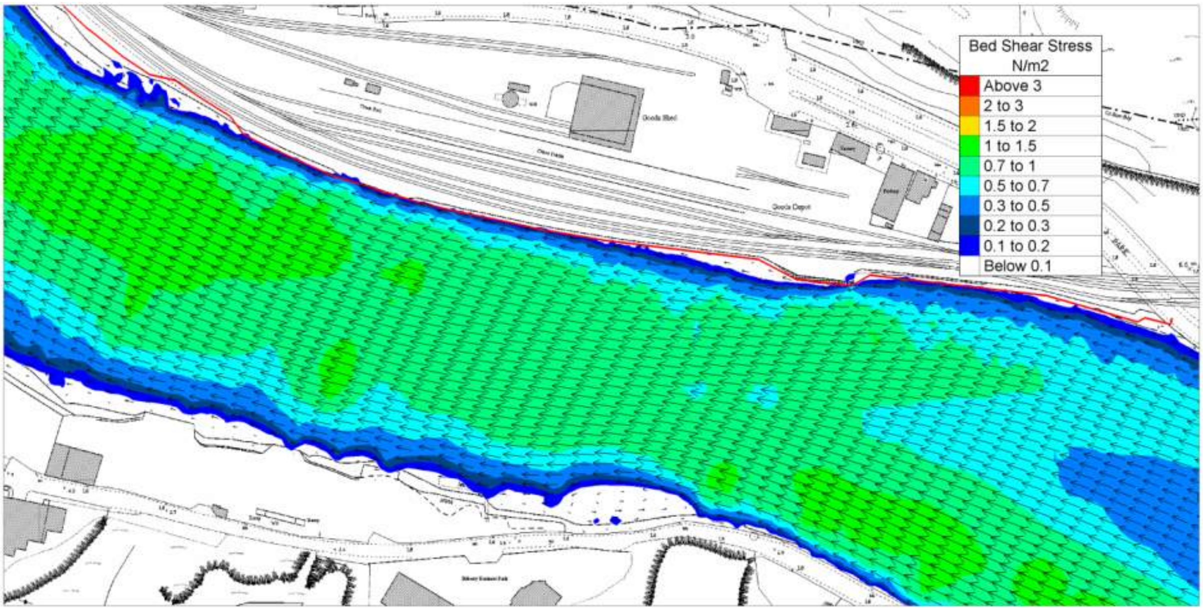


Figure 3-24 Mid-Flood Bed Shear Stress - existing case Spring Tide

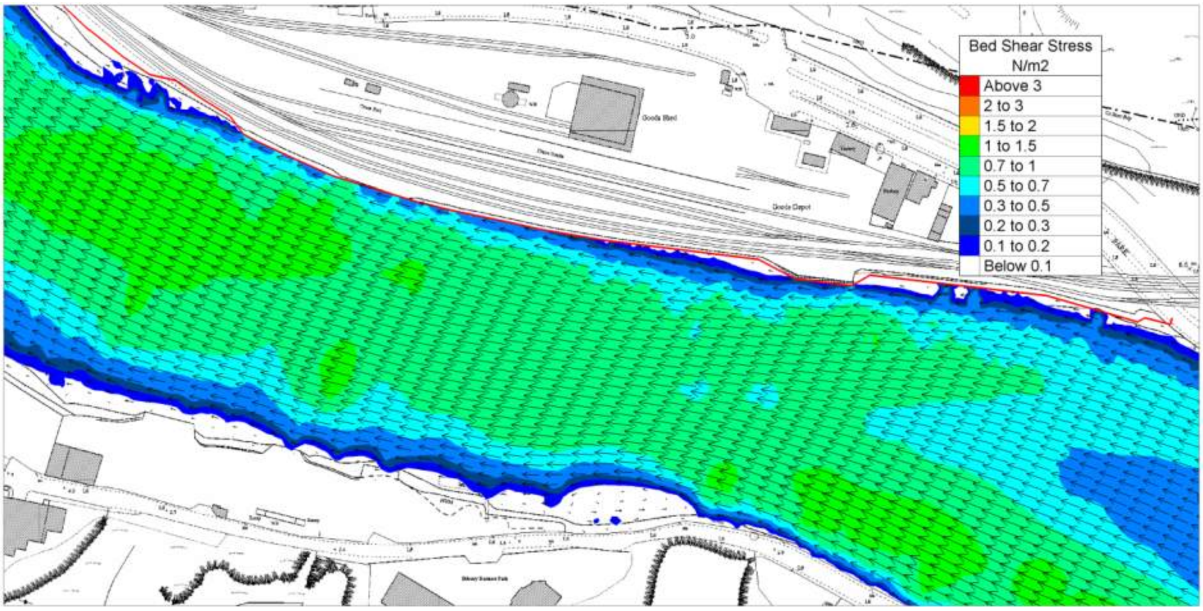


Figure 3-25 Mid-Flood Bed Shear Stress – proposed case Spring Tide

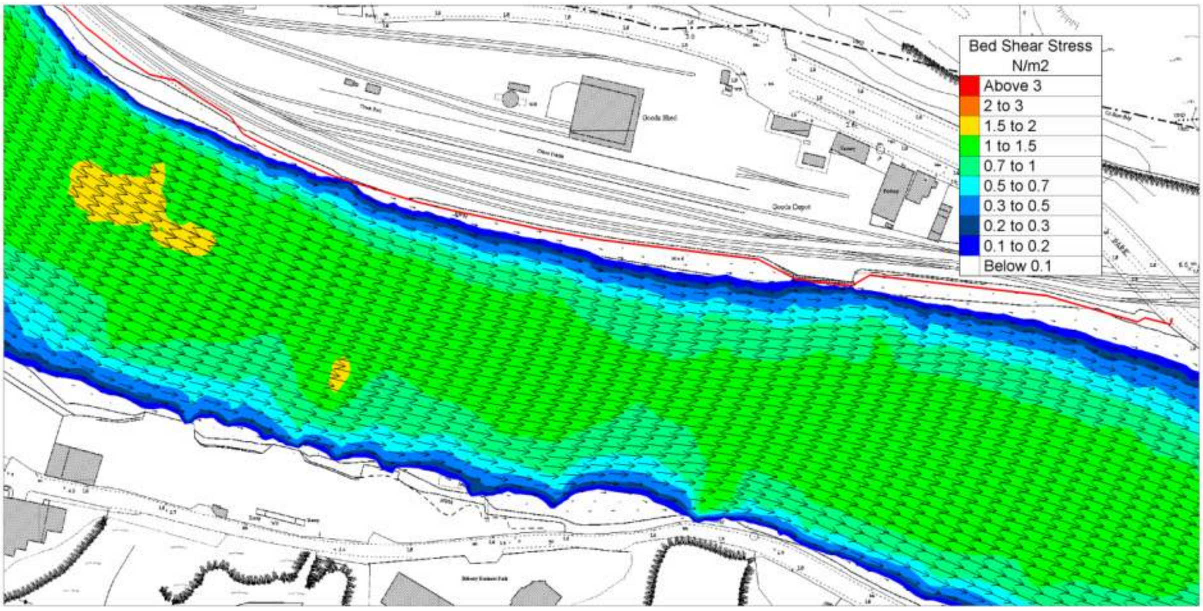


Figure 3-26 Mid-Ebb Bed Shear Stress - existing case Spring Tide

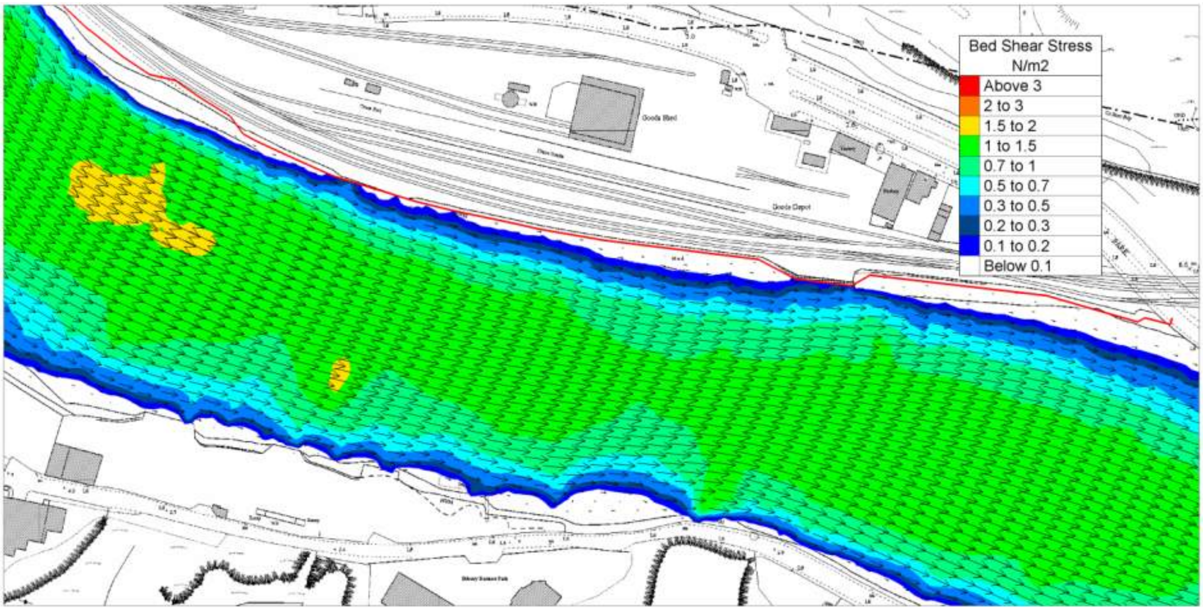


Figure 3-27 Mid-Ebb Bed Shear Stress – proposed case Spring Tide

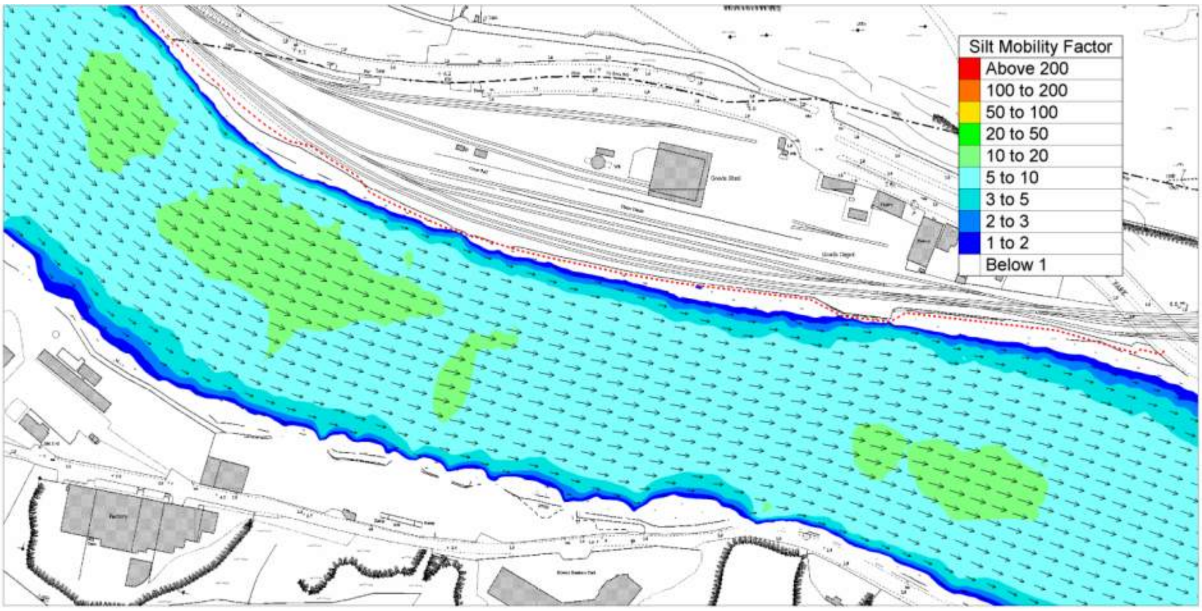


Figure 3-28 Fine Silt Mobility Factor at Mid-Ebb Neap Tide – existing case

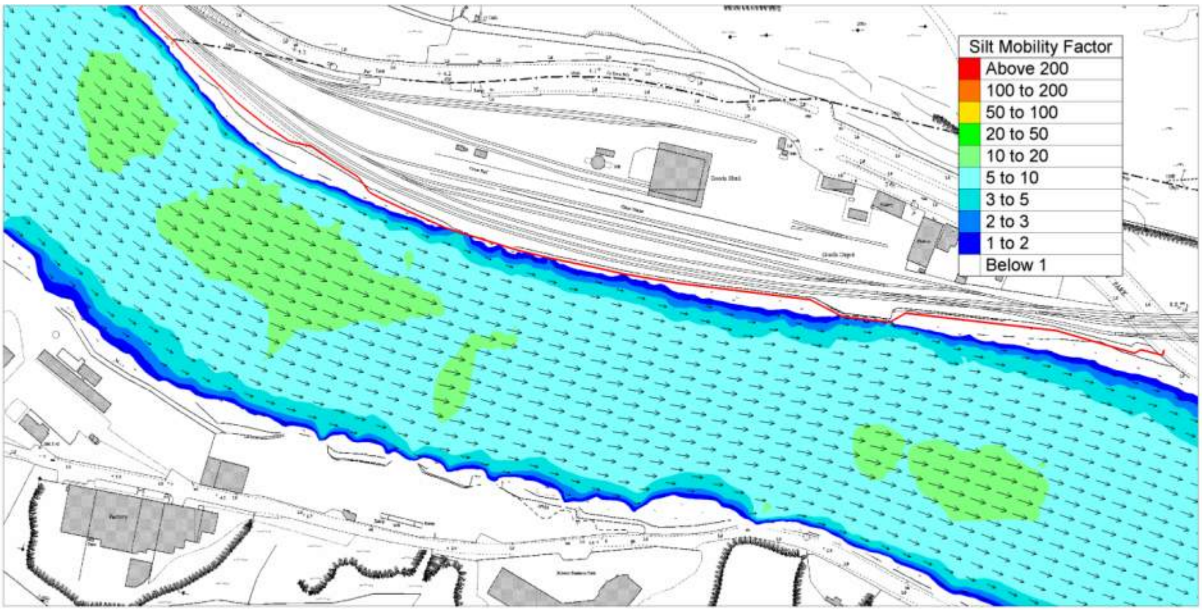


Figure 3-29 Fine Silt Mobility Factor at Mid-Ebb Neap Tide– proposed case

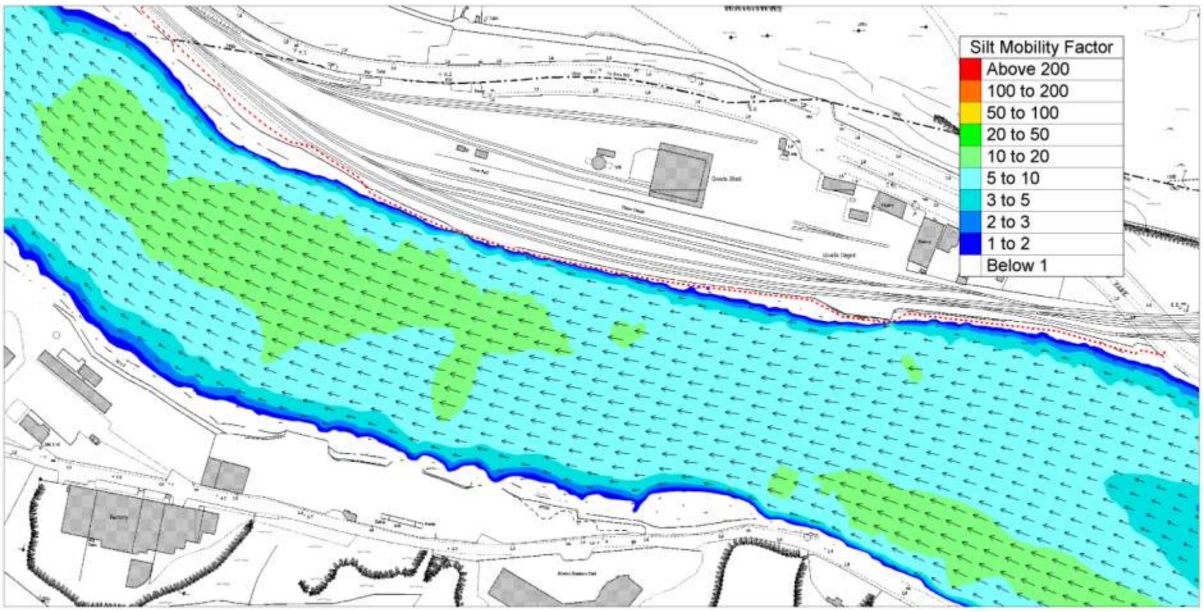


Figure 3-30 Fine Silt Mobility Factor at Mid-Flood Neap Tide– existing case

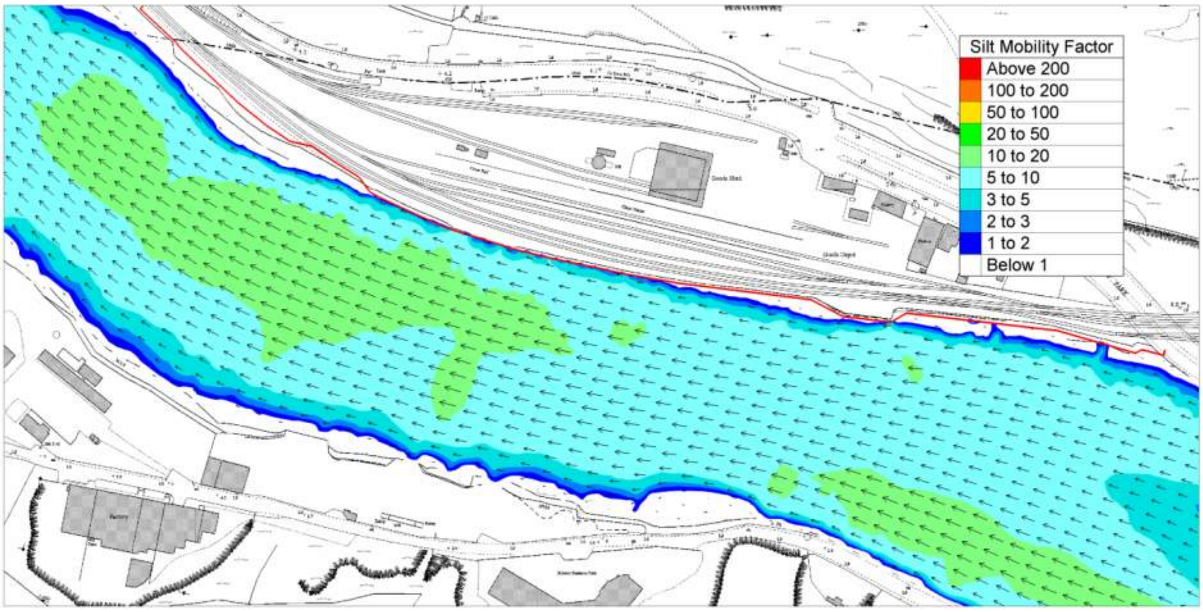


Figure 3-31 Fine Silt Mobility Factor at Mid-Flood Neap Tide– proposed case

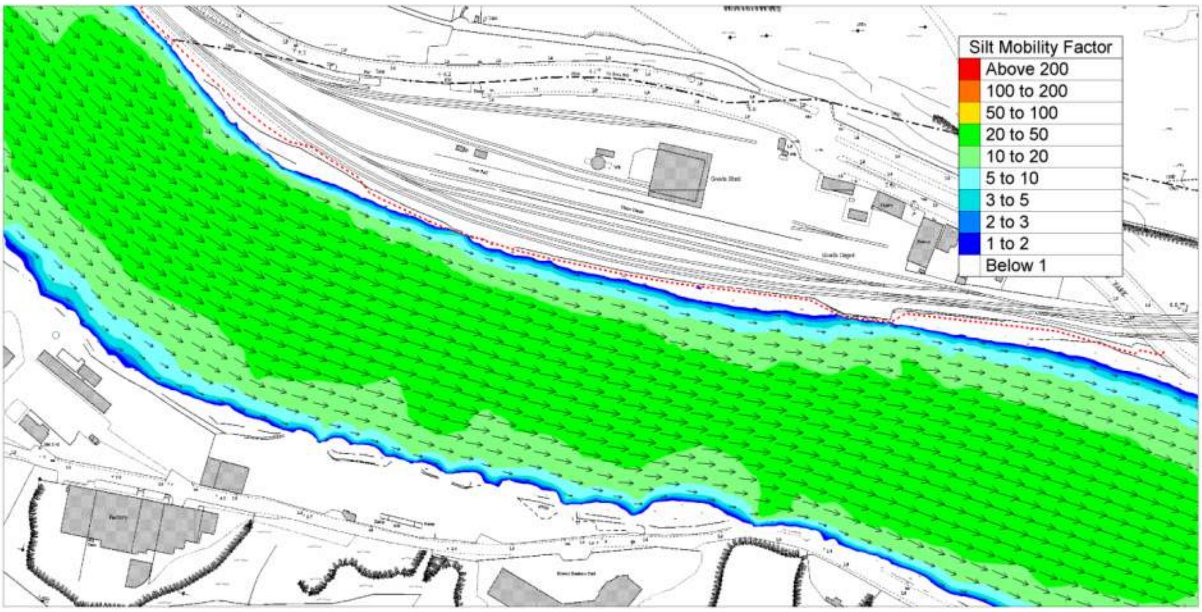


Figure 3-32 Fine Silt Mobility Factor at Mid-Ebb Spring Tide – existing case

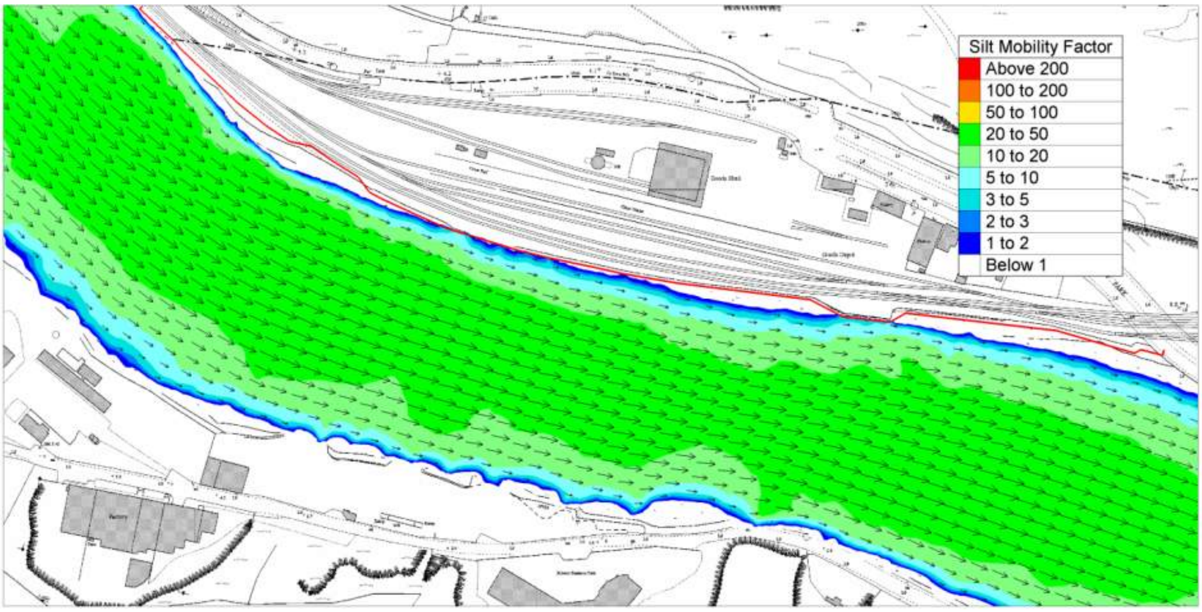


Figure 3-33 Fine Silt Mobility Factor at Mid-Ebb Spring Tide– proposed case

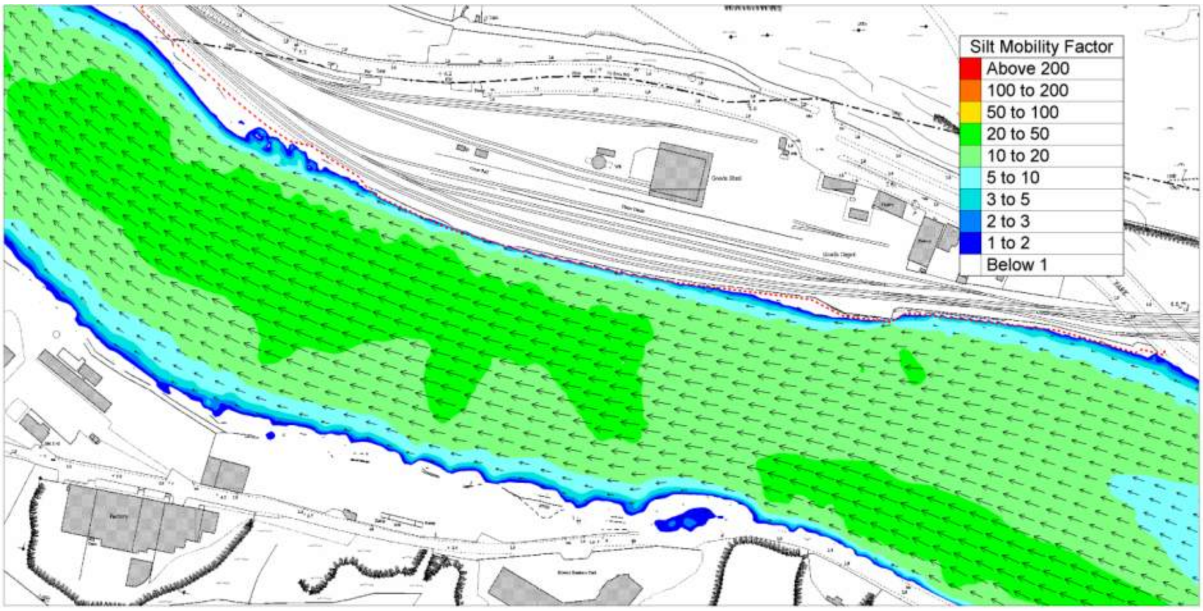


Figure 3-34 Fine Silt Mobility Factor at Mid-Flood Spring Tide – existing case

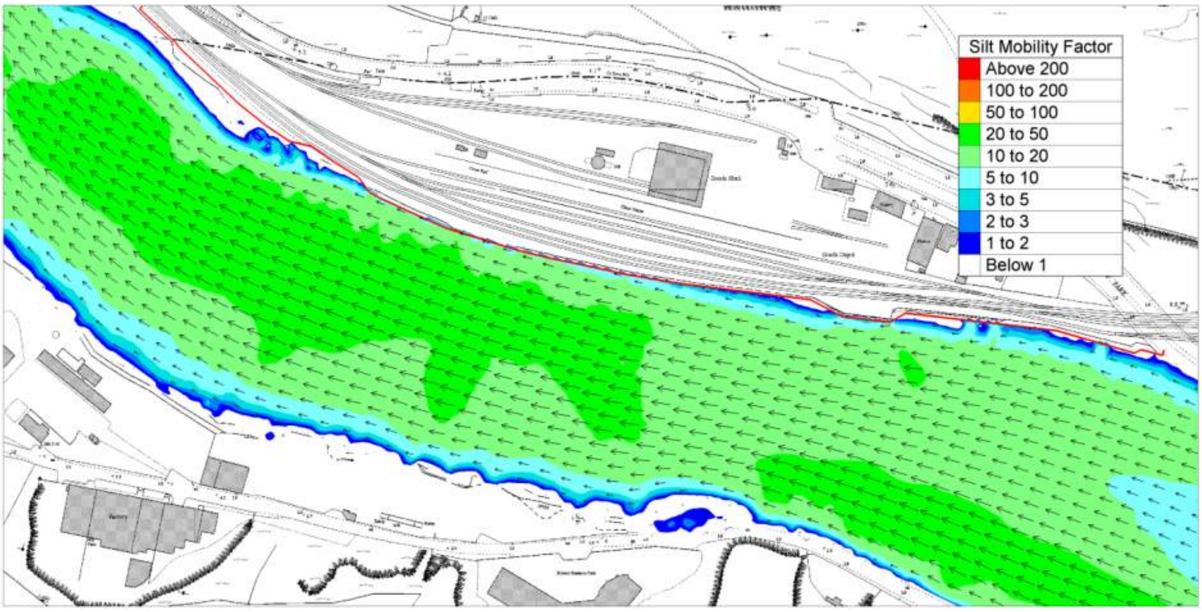


Figure 3-35 Fine Silt Mobility Factor at Mid-Flood Spring Tide– proposed case

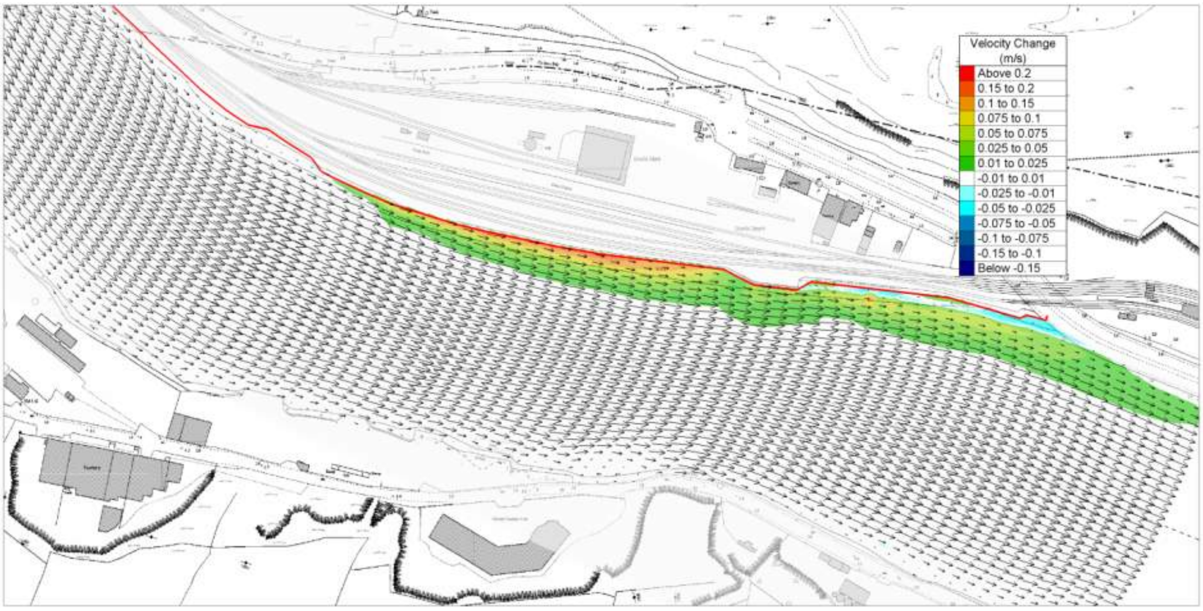


Figure 3-36 Computed change in velocity magnitude ebbing tide for a 200year return period storm surge event

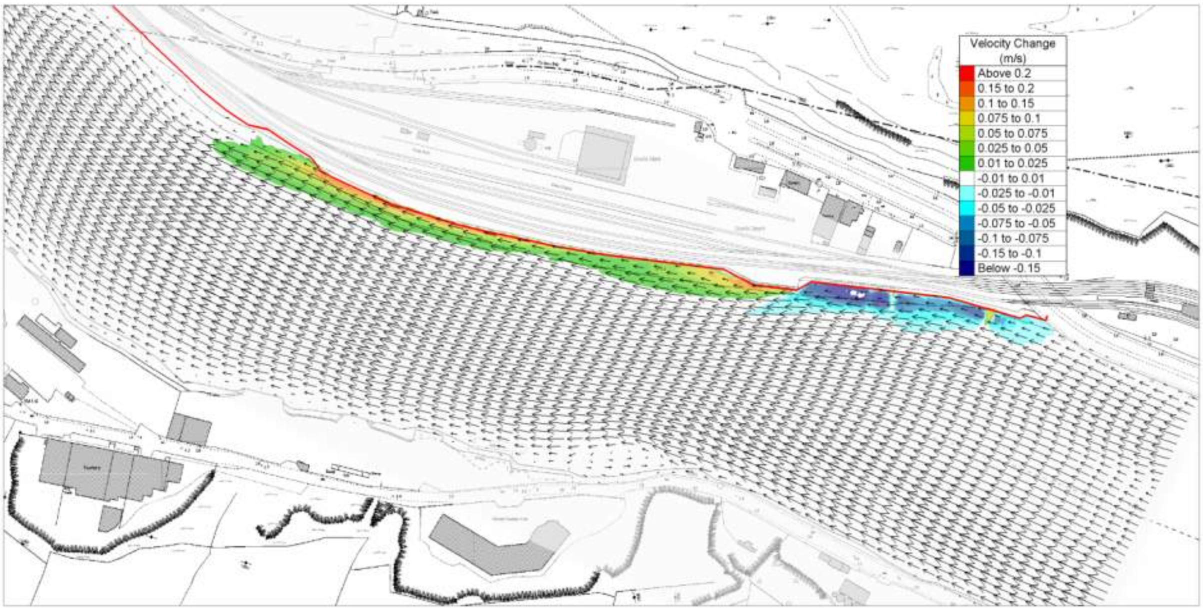


Figure 3-37 Computed change in velocity magnitude flooding tide for a 200year return period storm surge event

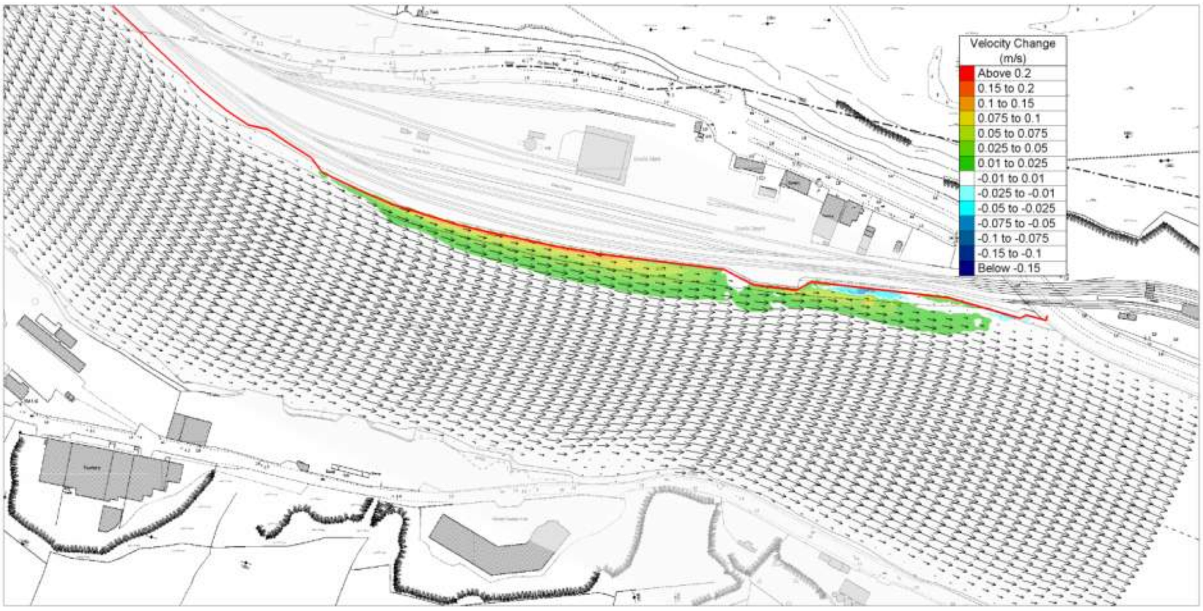


Figure 3-38 Computed change in velocity magnitude ebbing tide for a 100year return period river flood event coinciding with a high spring tide

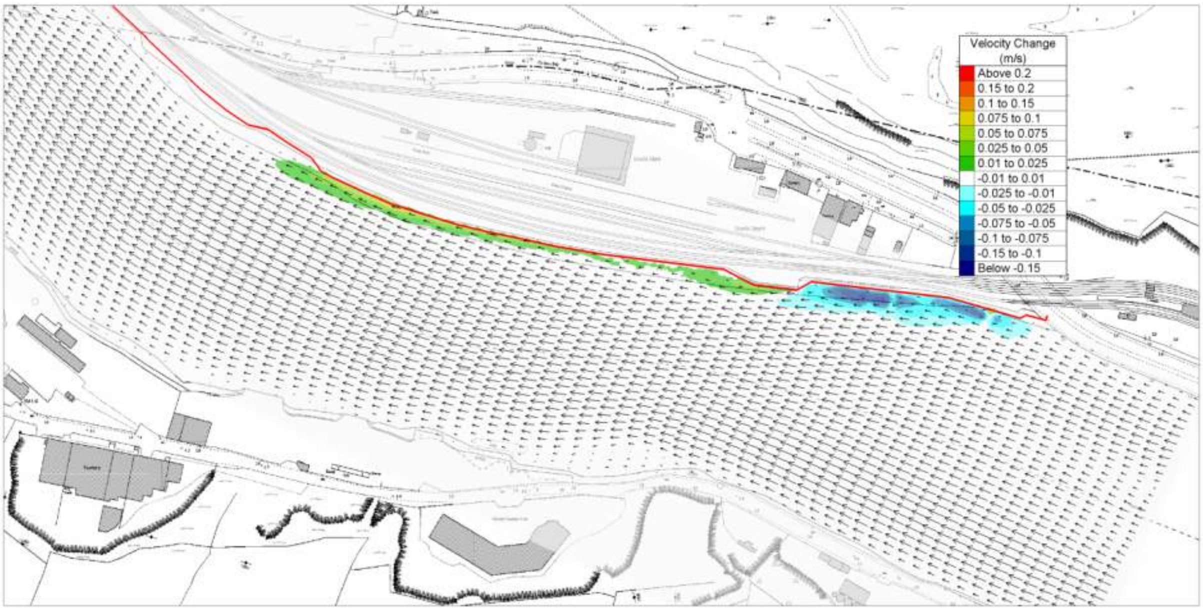


Figure 3-39 Computed change in velocity magnitude flooding tide for a 100year return period river flood event coinciding with a high spring tide

4. CONCLUSIONS

A hydrodynamic assessment was performed on the proposed sheet piled flood wall associated with the proposed Waterford City and County Council Flood Defences West Scheme to assessment the potential implications on scouring within the River Suir Estuarine channel. A local Telemac2d model was developed for this purpose with a high-resolution variable mesh. Pre-development and post -development models were developed using the same mesh structure to minimise numerical error in comparing hydrodynamic results.

A high-resolution bathymetric survey of the estuarine channel was conducted by Murphy Surveys Ltd. to provide recent bed elevations for input to the hydrodynamic model. The two-dimensional local model was driven by a 1-dimensional model that covered the entire tidal zone from Open Sea at Waterford Harbour Mouth and extending up the full Barrow, Nore and Suir tidal reaches so as to ensure correct tidal flows and elevations are computed for driving the local 2-d model.

The hydrodynamic model examined normal river flow and tidal conditions, both spring and neap tides and also the more extreme flood events associated with tidal storm surges and fluvial flood events in the River. The effect of the proposed flood defence wall and associate storm outfall structures (3 No. storm outfall) will generally increase flows along the bank in the vicinity of the vertical Flood Wall over the existing case.

The hydrodynamic simulations both normal tidal conditions and extreme flood events show an increase in velocity magnitude along the middle section of the flood wall alignment on both ebb and flood flows and a reduction in velocity locally in the vicinity of the outfall structures. The higher increases in velocity between existing and proposed cases occur on the spring tides and on the flooding tide with a general local increase of 0.05m/s and larger increases along the toe of the Flood wall of 0.075 to 0.1m/s. These local changes are not significant in comparison to the computed baseline velocity magnitudes under the present existing situation. There is no perceptible change in flow velocities in the main, deeper channel section or at the opposite far bankside. The predicted upstream and downstream changes to the flow velocity magnitude at the near bank is local and not very extensive or significant.

The sediment mobility assessment shows that under both existing and proposed cases sufficient velocities are generated on both flooding and particularly ebbing spring tides to mobilise only the fresher unconsolidated fine silts that might at slack tides temporarily deposit along the channel bank in the vicinity of the proposed flood wall. The conclusion reached from this analysis is that the computed velocity increases from the proposed vertical sheet piled wall are relatively small and of insufficient magnitude to produce sufficient shear stresses (i.e. generally <0.7Pa) that would result in any potential significant erosion of the permanent consolidated sediments /muds on the channel bed and banks in the vicinity of the affected area.

The proposed storm outfalls and extension towards the channel bank edge associated with the proposed defences are shown due to their raised bed elevation at their soffit and outfall wing walls and apron to reduce the tidal velocities on the ebbing and flooding tides at the bank immediately local to the outfalls. These works do not result in any noticeable increases in flow velocities elsewhere. The construction of these outfalls will involve temporary sheet piling cofferdams to protect construction activities at each outfall. The effect of these cofferdams will be to result in a similar pattern as the permanent outfalls in respect to local reduction in velocities but over the complete tidal cycle. Such localised sheltering is likely to give rise to a local increase in the deposition rate of silt at the channel bank immediately in the wake of the outfalls.

Chapter 11
The Landscape

Chapter 11 The Landscape

11.1 Introduction

Murray & Associates have conducted this landscape and visual assessment for the proposed Flood Defences West, hereafter referred to as the 'proposed development'. The site of proposed c.1.1km development is located within the north quays area of Waterford City stretching approximately 1km to the west and 100m to the east of the Waterford railway station, Plunkett Station.

The landscape and visual assessment of the proposed development is a means of appraising the affect the proposed development would have on the receiving environment in terms of quality of landscape – both physically and visually.

As part of the assessment, the site and its environs were visited in March 2021.

11.2 Methodology

The landscape and visual assessment of the proposed development is a means of appraising the effect the proposed development would have on the receiving environment in terms of the quality of landscape – both physically and visually. Also considered are construction and demolition works, the operational phase and the cumulation of effects with other existing and/or approved projects. In an urban context, the term 'townscape' is used to refer to the urban landscape.

11.2.1 Terminology

Landscape impacts are defined as changes in the fabric, character and quality of the landscape as a result of the development. This includes direct impacts to landscape receptors and greater effects that can alter the wider distinctiveness of the landscape. Landscape receptors are the physical or natural resource, special interest or viewer group that will experience an impact. The sensitivity (of a landscape receptor) is the vulnerability to change. The extents of the landscape impacts have been assessed by professional evaluation using the terminology defined as per Tables 11.1, 11.3 and 11.4. The terminology is based on the criteria set down in the *Guidelines for Landscape and Visual Impact Assessment* (3rd Edition, by The Landscape Institute / Institute of Environmental Assessment published by E&FN Spon, 2013). Landscape impacts are assumed to be permanent.

The UK Landscape Institute's Technical Information Note *Townscape Character Assessment* recommends that where a proposed development is within or dominated by built elements that the term 'Townscape' is used instead of 'Landscape'. Though the existing site is developed and is peri-urban in character with infrastructural elements (railways and roads, as well as constructed quay walls), it is located adjacent to and within the River Suir, which is almost 200m wide and an important landscape element in its own right. The immediate context to the north of the proposed development is dominated by rock faces which are partially vegetated and semi-wild. Therefore, for the purposes of this study it is considered that the term 'Townscape' does not fully describe the nature of the site, and the term 'Landscape', as applied throughout, should be read as being inclusive of the urban fabric of the city and the built environment.

Table 11.1 Extent of Landscape Effects

Extent of Effect	Description
Imperceptible Effects	An effect capable of measurement but without noticeable consequences. There are no noticeable changes to landscape context, character or features.
Not significant	An effect which causes noticeable changes in the character of the landscape but without noticeable consequences. There are no appreciable changes to landscape context, character or features.
Slight Effects	An effect which causes noticeable changes in the character of the landscape without affecting its sensitivities. There are minor changes over a small proportion of the area or moderate changes in a localised area or changes that are reparable over time.
Moderate Effects	An effect that alters the character of the landscape in a manner that is consistent with existing and emerging trends. There are minor changes over some of the area (up to 30%) or moderate changes in a localised area.
Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the landscape. There are notable changes in landscape characteristics over a substantial area (30-50%) or an intensive change over a more limited area
Very Significant Effects	An effect which, by its character, magnitude, duration or intensity significantly alters the majority of a sensitive aspect of the environment. There are notable changes in landscape characteristics over a substantial area (50-70%) or a very intensive change over a more limited area
Profound Effects	An effect which obliterates sensitive characteristics. There are notable changes in landscape characteristics over an extensive area (70-100%) or a very intensive change over a more limited area

Visual impacts relate solely to changes in available views of the landscape and the effects of those changes on people viewing the landscape. They include the direct impact of the development on views, the potential reaction of viewers, their location and number and the impact on visual amenity. The intensity of the visual impacts is assessed by professional evaluation using the terminology defined as per Tables 11.2, 11.3 and 11.4.

Table 11.2 Extent of Visual Effects

Extent of Effect	Description
Imperceptible Effects	There are no changes to views in the visual landscape.
Not significant	An effect which causes noticeable changes in the character of the visual environment but without noticeable consequences. The proposal is adequately screened due to the existing landform, vegetation or constructed features.

Extent of Effect	Description
Slight Effects	An effect which causes noticeable changes in the character of the visual environment without affecting its sensitivities. The affected view forms only a small element in the overall visual composition, or changes the view in a marginal manner.
Moderate Effects	An effect that alters the character of the visual environment in a manner that is consistent with existing and emerging trends. The proposal affects an appreciable segment of the overall visual composition, or there is an intrusion in the foreground of a view.
Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the visual environment. The proposal affects a large proportion of the overall visual composition, or views are so affected that they form a new element in the physical landscape.
Very Significant Effects	An effect which, by its character, magnitude, duration or intensity significantly alters the majority of a sensitive aspect of the visual environment. The proposal affects the majority of the overall visual composition, or views are so affected that they form a new element in the physical landscape.
Profound Effects	An effect which obliterates sensitive characteristics. The view is entirely altered, obscured or affected.

Table 11.3 Quality of the Landscape and Visual Effects

Quality of Effect	Description
Neutral Impact	Neither detracts from nor enhances the landscape of the receiving environment or view.
Positive Impact	Improves or enhances the landscape of the receiving environment or a particular view.
Negative Impact	Detracts from the quality of the landscape or view.

Table 11.4 The Duration of the Visual Effects

Duration of Effect	Description
Temporary	Impacts lasting one year or less
Short-term	Impacts lasting one to seven years
Medium-term	Impacts lasting seven to twenty years
Long-term	Impacts lasting twenty to fifty years
Permanent	Impacts lasting over fifty years

Note: Landscape impacts are assumed to be permanent, unless otherwise stated in the assessment.

The landscape and visual assessment methodology will be utilised in conjunction with a professional evaluation of the proposed development to determine the degree of impact.

The term 'study area' as used in this report refers to the site itself and its wider landscape context in the study of the physical landscape and landscape character. This may extend for approximately 1km in all directions from the site in order to achieve an understanding of the overall landscape. In terms of the visual assessment, the study of visual amenity may extend outside the study area, to areas where views of the site are available, but the majority of visual impacts for a development of this nature would be most significant within 200m.

11.2.2 Methodology

The methodology employed in the landscape and visual impact assessment is as follows:

1. Desktop survey of detailed maps, aerial photography, and other information relevant to the study area, including the following:
   (I) Waterford City Development Plan 2013 – 2019 (as extended)
   (II) Waterford County Development Plan 2011-2017 (as extended)
   (III) The Waterford North Quays Planning Scheme 2018 has also been reviewed, along with the Strategic Environmental Assessment Environmental Report (part of the preparation of the Planning Scheme for the Waterford North Quays Strategic Development Zone (S.I. No. 30 of 2016)), February 2018.
   (IV) Ferrybank Belview Local Area Plan 2017
2. Site survey and photographic survey undertaken in March 2021 to determine landscape character of the general study area and specific landscape of the site.
3. Assessment of the potential significant impacts of the proposed development utilising the plan and elevation drawings of the development to determine the main impacting features and the degree to which these elements would be visible in relation to observations made during the field survey. In determining visibility, the views to and from the proposed Flood Defences West project are considered based on the heights, finishes, design and other visual characteristics of the proposed structures and setting. Verified photomontages have also been prepared to give an accurate visual representation of the proposals from a selection of viewpoints, and are included in Appendix 11.1 to 11.12 in Volume 3 of the EIAR.
4. The proposal of a scheme of mitigation measures, where relevant. These will be defined as measures which will be generally implemented and specific landscape measures which would be site-specific and address particular landscape or visual issues identified.
5. An evaluation of the impacts of the proposed development with and without amelioration. For the purposes of assessment, the predicted visual effects of the proposed Flood Defences West are assumed at 10 years following the completion of the proposed development.

The assessment follows prescribed methodologies, as set down in the following publications:

- Guidelines for Landscape and Visual Impact Assessment 3rd Edition, by The Landscape Institute / Institute of Environmental Assessment published by E&FN Spon (2013),
- Environmental Protection Agency (2003), Advice notes on Current Practice in the Preparation of Environmental Impact Statements;

- Environmental Protection Agency (2002), Guidelines on the information to be contained in environmental impact statements;
- Draft Environmental Protection Agency (2017) Guidelines on the Information to be contained in Environmental Impact Assessment Reports; and
- Draft Environmental Protection Agency (2015), Advice Notes for preparing Environmental Impact Statements.

11.3 Description of Receiving Environment

11.3.1 Site Setting/Landscape Character

The site of the proposed Flood Defences West project is located on the north quays, approximately 0.7-1.5km northwest / west of Waterford City centre (Broad St/Barrow St). The proposed development is located on the northern edge of the River Suir, and stretches 100m to the east and c.1km to the west of Plunkett Station and Rice Bridge Roundabout.

The North Quays was an industrialised port until the 1990s and the area is now predominantly disused and semi-derelict in visual terms. Many disused industrial buildings, landing stages and wharves have been largely demolished in recent years, whilst Sallypark industrial area includes warehousing and other commercial / industrial buildings and structures. Rail tracks and sidings cover much of the site as well as an Irish Rail depot. A dual carriageway road (R448) runs east-west to the north and rises to cross over the rail line c.200m west of Plunkett Station. The land rises steeply up from the road / rail level, most notably to the peak of Mount Misery, and the cliff-like edifice along the approach road to Waterford from the west (R448) and around the existing train station, immediately north of the project site. To the north of the Sallypark industrial area, a small number of residential properties are accessed from the R448, set in extensive grounds with mature trees.

Residential developments of a suburban character are located to the north and east of the North Quays, east of the site. The residential areas are elevated above Dock Road and the North Quay but are largely hidden from this site by the topography which rises to a ridge which limits views east and is often punctuated with areas of tree cover. A large derelict building, a former hotel, dominates the ridge to the northeast of the site.

Waterford city centre to the south / southeast is set on the side of a hill which falls towards the river. The city rises to a maximum ground level of 70m OD in the vicinity of Carrig Heights residential estate to the northwest of the city centre, with the commercial centre around Broad Street and Arundal Square and O'Connell Street c.10-20m OD. In views from elevated areas to the west of the city looking north, north-east and east, there are distant views towards Kilkenny and Wexford counties, with varied topography and hills on the horizons.

11.3.2 Landscape Planning Context

The landscape planning context for the area is set down in the Waterford County Development Plan 2011-2017 (as extended) and the Waterford City Development Plan 2013 – 2019 (as extended). The Waterford North Quays Strategic Development Zone Planning Scheme 2018 also sets out several policies relevant to the landscape and visual assessment of the proposed Flood Defences West project.

Chapter 8 Environment and Heritage of the Waterford County Development Plan 2011-2017 (as extended) sets out policies with regard to the landscape of the county. Section 8.1 Landscape states:

"The *management of the County's landscape involves:*

- *Sustaining and conserving the landscape;*
- *Protecting the landscape from inappropriate and unsustainable development;*
- *Providing for development that will enhance and benefit the receiving environment; and*
- *Ensuring adequate protection to sensitive and vulnerable landscapes through appropriate policies and objectives".*

Appendix A9 Scenic Landscape Evaluation to the Waterford County Development Plan 2011-2017 (as extended) considers that Waterford City is in an area designated as "Robust"; i.e. *"areas of concentrated existing development and infrastructure"*. It states that: *"Appropriate new development in these areas can reinforce the existing desirable landuse patterns. The overall aim is to ensure that the inherent character of the town and village centres is maintained."*

The Waterford City Development Plan 2011-2017 (as extended) notes the importance of the Quays as a waterfront: *"The width of the river, the length of the Quays, their uniformity and the activities along the South Quays make for an element of major visual and townscape importance"*. By implication, the lack of uniformity and lack of activities along the North Quays and the site area suggests that these areas are less visually important.

The proposed flood defence works are planned in the context of several other adjacent developments, all part of the Waterford North Quays Strategic Development Zone (SDZ), notably the Waterford Sustainable Transport Bridge, Transport Hub and the development of a mixed use new urban quarter on the North Quays in accordance with the Waterford North Quays SDZ Planning Scheme (NQ SDZ PS) 2018. Permission was granted in July 2020 for the Waterford North Quays Development (Planning Register Number 19/928) and the bridge and transport hub have also been granted permission in recent years. Work has not yet commenced on these projects.

The NQ SDZ PS summarises the existing significant views as identified in previous plans for the North Quays in Section 4.5 as follows:

"South to North

(A) Bridge Street

(B) Barronstrand Street

(C) The Mall

(D) Panoramic view from South Quays to North Quays

North to South

(E) Western approach to Rice bridge

(F) Rockshire Road

(G) Panoramic view from North Quays to South Quays

It is generally recognised that the most significant views are those generally available from the north to the south and vice versa from any point on the river's edge. It is the objective of the Planning Scheme that these views will be retained as the defining views of the City".

Views A and E are most relevant to the proposed development as they may include potential views of the site of the proposed flood defence works. Plate 11.1 illustrates the location of the views and is taken from Figure 25 of the North Quays Planning Scheme (WCCC, 2018).

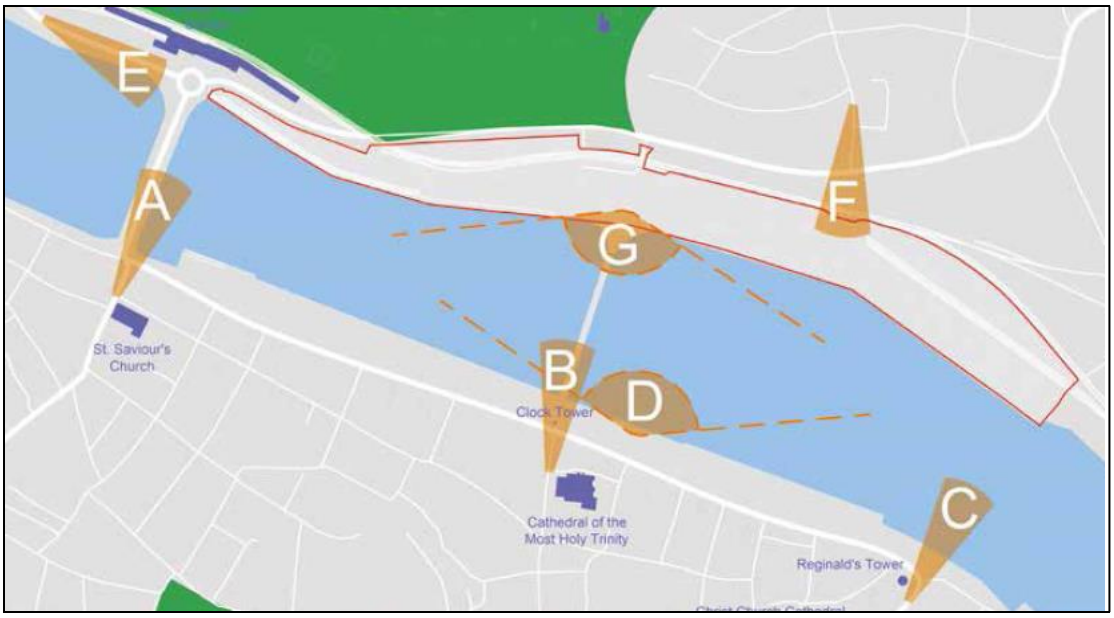


Plate 11.1 Figure 25 of the NQ SDZ PS – Views to be retained

The Ferrybank Belview Local Area Plan 2017 also lists views for protection, but none are considered relevant as the viewsheds do not cover the site of the proposed works. Therefore, there is no likelihood of effects being generated.

11.3.3 Description of Site

The site of the proposed Flood Defences West project is located to the northwest of the city centre on the northern edge of the River Suir, to the west of Rice Bridge. It is located approximately 0.7-1.5km northwest / west of Waterford city centre (Broad St / Barrow St). It extends for approximately 1.1km and is oriented generally east-west. The site is narrow as it follows the existing quay wall south of the IÉ train tracks, but widens out at the eastern side, south of Plunkett Station to almost 100m, where it encompasses the existing railway station and the Rice Bridge roundabout. Most of the landuse within the footprint of the site is infrastructure. There are no trees or significant landscape vegetation within the site.

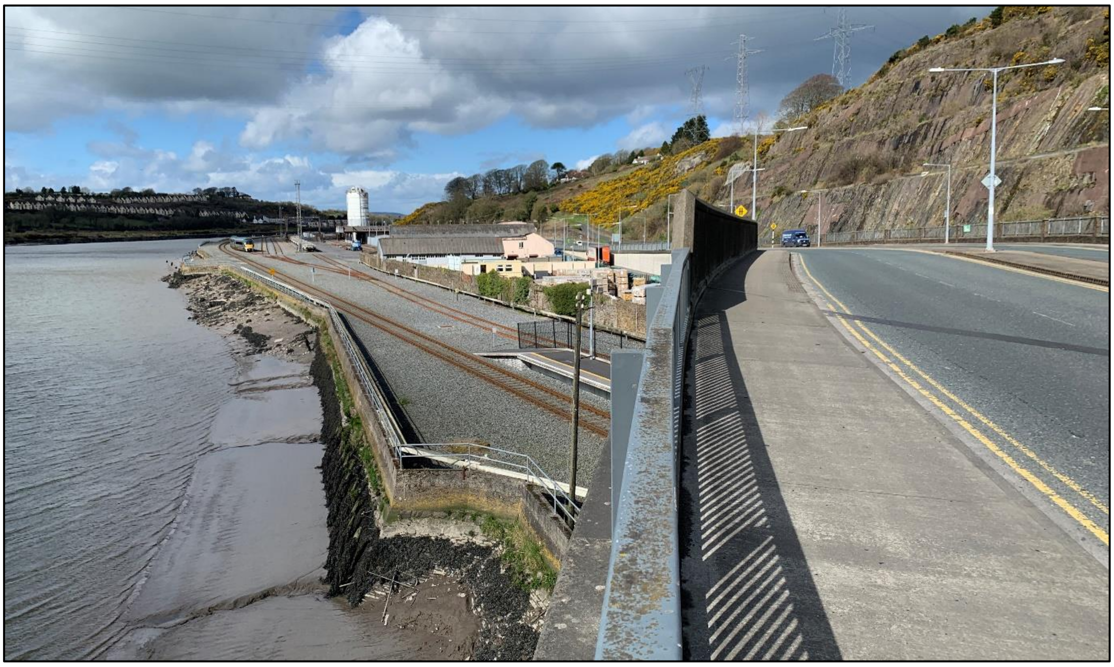


Plate 11.2 View west along Terminus Street with rockface to right (north) and rail / industry / commercial to the left (south)

Plate 11.3 View east along Terminus Street with rockface / ridgeline to left (north) and River Suir (south); note that rail below is screened from angle of view from elevated road.

The natural topography rises up at Mount Misery and Mount Sion to the north / northeast and creates a ridgeline which is quite heavily wooded and limits views to and from the north / northeast / east.

The River Suir is the main feature of the landscape in this area, flowing in an eastward direction and it is approximately 150-200m wide as it flows into and through the city. The river transitions from a semi-natural state to the west / north-west of the site as it flows into the city, with the riverbanks and edges become increasingly less naturalised and vegetated as it approaches the city. The river becomes somewhat canalised to the west of Rice Bridge, with quay walls to north and south as it passes the site. Past Rice Bridge, both banks become more urbanised wharves, with disused and semi-derelict elements to the north and an active waterfront to the south, with amenity spaces and car parking / transportation depots, as well as some active shipping and water-based amenity uses. As one moves east, leaving the city, the riverbanks once again become more naturalised and heavily vegetated where it joins with the River Barrow and flows out into Waterford Harbour approximately 7.5km to the east.

The site is focused on the existing quay wall of concrete / stone to the southern edge with the river. The remainder of the site is primarily in use as an operational railway line. Historic mapping from the early to mid-20th century show a number of landing stages indicating that this was once part of a busy shipping port, but this activity has now ceased, and the landing stages are no present, with the only remaining elements being a number of surviving timber fenders visible at low tide and part of an abutment which was once associated with a landing stage (see Chapter 14 Archaeological and Cultural Heritage for further information). The landscape of the site is dominated by the railway line and Terminus Street (R448). Terminus Street is estimated to be elevated above the level of the rail by some 6-8m where it crosses over the railway line. Further east, there has been an extensive programme of demolition on the North Quays in recent years resulting in the presence of spoil heaps and large areas of open space and hard standing on the wharves. Overall, the visual quality of the existing site and context is poor.

Plunkett Station is a modern building and there is a row of low red-brick buildings alongside, which are used as offices. These are not considered sensitive receptors for this assessment. There is a 19th Century signal box to the west of the station which is a listed building, and this is considered in the context of the proposed development.

Plate 11.4 Plunkett Station viewed from Rice Bridge Roundabout

Plate 11.5 **19th Century Signal Tower, west of Plunkett Station (listed building) with rock face behind**

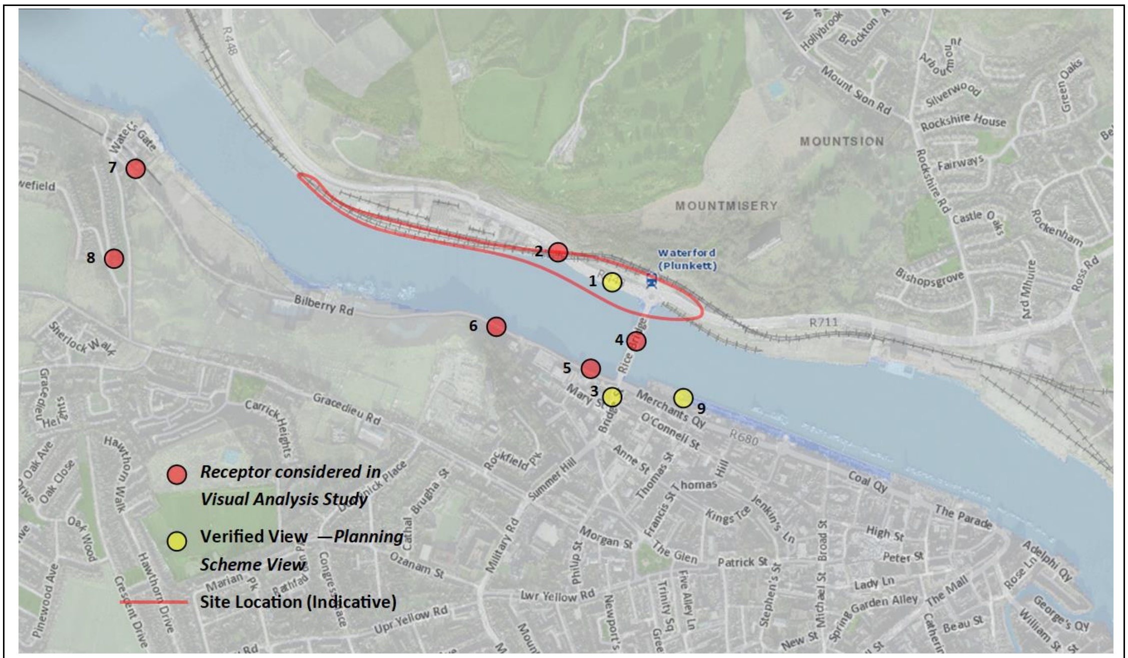
The total site area within the red line site boundary of the proposed development is approx. 9 hectares. The existing land uses of the lands required for the proposed development include: Rice Bridge Roundabout, the existing rail line and associated railway infrastructure; and the existing quay walls. The interface of the river with the quay walls is considered to be a sensitive element of the landscape.

11.3.4 Views

Views of the site for the proposed Flood Defence West are available from the following locations in the public realm:

- View from R448 Terminus Street Approaching Rice Bridge from west. (Listed View E from North Quays Planning Scheme - Figure 11.1) – See Plate 11.7
- View from Bridge Street looking north across Rice Bridge (Listed View A from North Quays Planning Scheme - Figure 11.1) – See Plate 11.8
- Views Terminus Street footpaths looking west – See Plate 11.2
- Views from Rice Bridge footpaths looking north and west – See Plate 11.9
- Views from Grattan Quay north / north-west towards north bank of river – See Plate 11.10
- Views from Bilberry Road Halting Site south of the site, looking north – See Plate 11.11
- Views from waterside residential areas to the west of the site, south of the river (Water's Gate) – See Plate 11.12
- View from elevated residential areas to the west of the site, south of the river (Bowefield) – See Plate 11.13

Views from areas to the east of Rice Bridge, particularly the sensitive views from the South Quays and city centre are considered unlikely to have visibility of the proposed works due to the presence of Rice Bridge screening the majority of the areas which are likely to change. (See Plate 11.14)



1. Terminus Street (R448) approaching Rice Bridge from west (View E from Planning Scheme)
2. Terminus Street (R448) looking west from footpath
3. Bridge Street looking north—View A from Planning Scheme
4. Rice Bridge looking west
5. Grattan Quay looking north / northwest
6. Bilberry Road Halting Site looking north
7. Water's Gate—Residential
8. Bowefield —Residential
9. Panoramic view from South Quays to North Quays —View D from Planning Scheme & Variations—no visibility of proposed works from these vantage points due to screening presence of bridge and minor nature of works around Plunkett Station.

Plate 11.6 Visual Receptors

Plate 11.7 View from R448 looking east showing the river, quays, and buildings on the South Quays. The spire of Christ Church Cathedral and the top of Reginald's Tower are visible on the city skyline. (View E from Figure 11.1)

Plate 11.8 Framed View from Bridge Street (View A from Figure 11.1)

Plate 11.9 Rice Bridge looking west – views from footpaths

Plate 11.10 View from Grattan Quay, looking north towards the North Quays

Plate 11.11 Bilberry Road Halting Site looking north across river

Plate 11.12 Water's Gate—Residential – view east towards site

Plate 11.13 Bowefield —Residential – view east / north east from elevated location

Plate 11.14 Panoramic views from South Quays to North Quays —View D from Planning Scheme & Variations—no visibility of proposed works from these vantage points due to screening presence of bridge and minor nature of works around Plunkett Station.

11.3.5 Sensitivity of the Identified Receptors

In landscape terms, the site of the proposed Flood Defence West, which is composed of existing roads, rail, and low-quality landscape, is considered to have low sensitivity. The only landscape element considered to be sensitive is the interface of the river with the banks. In this location, the interface is the existing, weathered quay wall, which is composed of concrete / stone. The built edge is considered less sensitive to change than the more naturalistic sections west of the site.

Visual receptors have greater potential sensitivity to change in the landscape, however this is reduced by the following existing adverse factors:

- Low visual value of the existing site with road, rail and inharmonious spaces;
- There are visual barriers for many potential receptors, including ridgeline, walls, trees, etc. which limit views of the site;
- The existing quay wall is composed of stone / concrete and is in poor condition in many places.

Table 11.5 lists the identified receptors (as illustrated in Plate 11.6 above) and their level of sensitivity. The most sensitive views are those listed in the Planning Scheme (Viewpoints 1 & 3 referenced here). Residential receptors could also have reasonably high sensitivity, however the nearest residential receptors are at some distance from the site, therefore this reduces the potential sensitivity in this case. In general, the views identified are not amenity areas or key viewpoints that will be affected, therefore the sensitivity is limited for most other viewpoints, as the user groups are most likely to be passing through.

Table 11.5 Sensitivity of Potential Visual Receptors

Ref.	Viewpoint / Approx. Elevation	Distance from Site	Description of View	Level of Sensitivity
1	R448 Road; 8m OD	0m	View east on western approach to Rice Bridge—View E from Planning Scheme of South and North Quays with rising topography and urban landscape behind.	High
2	R448 Road; 8m OD	0m	Terminus Street footpaths looking west	Low
3	Bridge Street; 5m OD	250m south	View A from Planning Scheme from public realm on Bridge Street. Framed view of Mount Sion to north/northeast.	High
4	Rice Bridge, 5m OD	50m south	View from public footpath on Rice Bridge of site with rail and roads rising topography behind.	Low
5	Grattan Quay, 5m OD	170m south	Views from Grattan Quay north towards north bank of river. *Bilberry to Waterford City Centre Greenway Link is proposed to run into the city along Grattan Quay.*	Current: Low *Future: Medium*
6	Bilberry Road Halting Site, 5m OD	180m south	Views from Bilberry Road Halting Site south of the site, looking north; Existing walls limit views from residential area	Medium
7	Water's Gate, Quarry Road, 6-10m OD	300m west	Views from waterside residential areas to the west of the site, south of the river.	Medium
8	Bowefield residential estate; 60m OD	450m west	Elevated viewpoint from residential dwellings on side of hill with open views towards site and river.	Medium

11.4 Description of Potential Impacts

Potential landscape and visual impacts are effects created by the proposed development that have an appreciable impact, positive or negative, on the existing landscape or on views of the landscape from sensitive receptors. Mitigation measures are not considered in the calculation of potential impacts.

Prior to the consideration of potential impacts, it is important to consider the landscape and visual characteristics of the proposed development.

11.4.1 Visual Characteristics of the Proposed Development & Magnitude of Change

For a full description of the proposed development, please see Chapter 4 of this EIAR. The proposed Flood Defences West project will include the following elements:

- remedial works on the existing quay wall;

- construction of a new flood defence wall, typically in the form of a driven steel sheet pile wall with precast concrete cladding ('eco-wall') installed for the intertidal zone of the riverside sheet pile wall;
- a system of low glass walls and flood gates will be implemented at the verges of the Rice Bridge roundabout;
- other works including underground impermeable trenches and drainage works (remedial measures to existing drainage, new trackside drainage, outfalls to the River Suir and two pumping stations at Ch.390 and Ch.550).

The proposed top-of-wall level for the flood protection measures is 4.30m OD (metres above Ordnance Datum Malin). The remedial works to the existing quay wall and the installation of low glass walls for the arms of the Rice Bridge Roundabout are both considered to affect no appreciable visual change in this landscape when compared with the existing context. Similarly, any below-ground works in the locations proposed will have no landscape or visual effects beyond the construction stage.

The proposed steel sheet flood defence wall is therefore the only element which is likely to cause any landscape or visual effects. The height of the wall as proposed is lower than all receptor view heights, so no views will be blocked by the proposed works. The new wall may in fact screen or partially screen some of the existing rail infrastructure to the north. The degree of change to existing views will therefore be limited to the presence of the new flood defence wall along the banks of the River Suir and the degree of visibility of same. The flood defence wall is a functional structure and has been designed to fulfil the function of preventing future flooding. The structure is simple, but has a significant visual presence locally, with riverside-installed sheet piles projecting above the existing mudline by between 3.3m and 5.3m at low tide. The sheet piles have a coarse, corrugated profile, leading to a 3-dimensional surface, with prominent shadowing. The structure is in weathered steel and will therefore have a grey or rusty hue. An example of a finished sheet pile wall is given in Plate 11.15 and can also be seen in the Photomontages shown in Figures 11.1 to 11.12 in Volume 3 of this EIAR.

Plate 11.15 Example of finished sheet pile wall in urban environment

Pre-cast concrete cladding ("eco-wall") is proposed for the intertidal zone of the riverside sheet pile wall which will soften the interface with the River Suir. Over time, this cladding will be colonised with vegetation and will take on the colouring of the mud and silt from the river, resulting in a more grounded and sympathetic interface with the river. As the main visual effects arise from the presence of the new structure and not from its aesthetic appearance, this cladding is unlikely to fundamentally change the main visual effects of the proposed structure, but it will help it to integrate the proposed development with the landscape of the river. With the passage of time, this transition at the interface of the river and the proposed flood defence wall will become similar in appearance and texture to that of the existing quay wall. The proposed cladding may also result in some small visual improvements, such as reduced corrugation at the interface and shadowing which may help to make the structure less visually heavy and less likely to draw the eye.

Overall, the magnitude of change in the landscape as a result of the proposed works is considered to be low, as the proposed wall will be slightly taller than the existing quay wall, but won't significantly alter the landscape pattern or structure. It will be relatively low lying and will be somewhat consistent with the built, industrialised nature of the quays in this area.

It is also relevant to note that the consequences of not constructing the wall would lead to further deterioration to the existing quay wall and further dereliction and damage to the area.

The quality of the proposed change in the landscape is considered to be marginally negative, due to the increase in the height and scale of the wall, and the rusty appearance.

11.4.2 Potential Landscape and Visual Impacts - Construction Phase

Construction phase impacts, where they occur, are considered to be of negative quality and temporary, as the construction stage is expected to last less than 12 months.

There will be moderate temporary negative impacts associated with the construction works of this development on the river edge and around Plunkett Station / northern end of Rice Bridge. This will be due to the presence of construction equipment and building processes required to construct the proposed development, which will include jack-up barges (up to two at once) on the river with a long reach excavator, an additional barge and tugboat to transport the sheet piles for the riverside construction, and other plant and machinery including excavators for the landside elements, that will contrast with the existing landscape and create negative visual impact. The landscape of the site is not currently of value in general but will undergo change from that of an area comprising riverbank and transport infrastructure to a construction site. The riverbank is a constructed quay wall in this location and the construction will extend further into the river than the current wall.

Visual impacts will be most acute for pedestrians in proximity to the works, on Terminus Street and Rice Bridge. Construction plant will be more visible than the permanent works due to the height of the plant involved, meaning that it will be visible. All of the identified visual receptors (see Table 11.5) will have visibility of the construction activity.

The impacts on the visual receptors during construction are therefore *slight, negative* impacts in general, but this could rise to *moderate* due to the large size of the machinery likely to be required for some of the work and its visibility in the landscape and the visual disruption caused by construction activity on the river itself. However, due to the width of the river and the distance of the receptors at more than 170m to the south / west, the level of impact will not exceed *moderate, negative, temporary* impact.

Plate 11.16 Example of Spud-can Barge with long-reach excavator to be used in the construction of the works.

11.4.3 Potential Landscape and Visual Impacts - Operation Phase

11.4.3.1 Potential Landscape Impact

During the operational phase, the main landscape impacts of the proposed development are associated with the presence of the proposed flood defence works along the river edge. The proposed riverside sheet pile wall will be present at a level of 3.3-5.3m above the level of the existing mud flats at low tide, up to 2m higher than the existing quay wall and offset further into the river approximately 1m from the existing quay wall. This changes the interface with the river generating *slight, negative* landscape effects on the riverside landscape. The landscape is considered to be of low sensitivity due to the current poor quality of the quay wall, and this is considered to be a *slight, negative, permanent* impact due to the colour and form of the proposed sheet pile wall in corrugated / folded steel with grey or potentially rusty hues in terms of colouration.

11.4.3.2 Potential Visual Impact

During the operational phase, the main visual impacts of the proposed development are associated with the views of the proposed riverside sheet pile wall, present in views at a level of 3.3-5.3m above the level of the existing mud flats at low tide, up to 2m higher than the existing quay wall and offset further into the river approximately 1m from the existing quay wall. This visual change is marginal in more distant views, and remains lower in height than the surrounding riverbanks and structures associated with the railway and roads. Thus, across the range of views identified, the overall level of visual impact is considered to be *slight, negative, and permanent* due to the current poor quality of the existing quay wall and visual environment. The colour and form of the proposed sheet pile wall in corrugated / folded steel with grey or potentially rusty colouration imposes a minor additional negative change in the views.

Views from Terminus Street

In viewpoint 1 (see Tables 11.5 & 11.6) approaching Rice Bridge along the R448 Terminus Street, which is protected in the Planning Scheme (View E), the proposed development will have a very minor and marginal, almost imperceptible, change on the view in this direction, classified as a very low magnitude of change. The top of the proposed quay wall may be just visible on the boundary of the river edge, resulting in a small change to the view at a sensitive point in this view, with the water behind. In views from the footpath travelling west, viewpoint 2, there will be views over the wall and at certain points, the quay wall and infill behind will be visible from above, and will constitute a noticeable change in the views from specific points, again at the more sensitive interface at the river edge. This user group is considered to have low sensitivity as they are walking past an area with a built-up and semi-derelict or untidy character and the main focus of the views is the wider areas of the river and riparian scenery beyond. Thus, the visual impact is considered to be *slight and negative* for this viewpoint. See Photomontage 2 for an illustration of this view. (Note that the works proposed will have no impact on the setting of Plunkett Station and the adjacent 19th Century Signal Box, a protected structure.)

Views from Rice Bridge & Environs

Similar to the foregoing receptor, views from Rice Bridge footways, nearing the northern end of the bridge, viewpoint 4, will have a noticeable change in the views, again at the more sensitive interface at the river edge. This user group is considered to have low sensitivity as they are walking past an area with a built-up and semi-derelict or untidy character and the main focus of the views is the wider areas of the river and riparian scenery beyond. Thus, the visual impact is considered to be *slight and negative* for this viewpoint. From View A as listed in the Planning Scheme, from Bridge Street (viewpoint 3), the view will not change perceptibly due to the peripheral nature of the elements and the focus of the view being the backdrop of Mount Sion / Mount Misery, resulting in *imperceptible* effects.

Views from Grattan Quay / Bilberry Road Halting Site / Water's Gate

These viewpoints (5, 6 and 7) are located close to the riverside on the southern bank.

The flood defence wall will be visible from Grattan Quay (viewpoint 5) as a change at the edge of the northern edge of the River Suir, c.170m from the viewpoint, with the corrugated sheet pile wall resulting in a *slight, negative* visual impact, due to the overall low level of sensitivity. It is proposed to develop the Bilberry to Waterford City Centre Greenway Link along the South Quays and Grattan Quay in the future, so allowing for this additional tourism-related use and greater sensitivity, the visual impact would be *moderate and negative* to the Greenway users. See Photomontage 1 for an illustration of this view. Views from Bilberry Road Halting Site (viewpoint 6) are very similar and will be similarly affected. The residential receptors are considered to be more sensitive, so the visual impact rating is higher at *moderate and negative*.

Water's Gate residential area (viewpoint 7) is also considered more sensitive as residential receptors. The level of change to the view is relatively minor at c.300m distance and doesn't significantly affect the most sensitive elements of the view, i.e. the riparian landscape, ridgeline backdrop, etc., the visual impact is considered *slight, negative, and permanent* due to the change in the view from fixed residential receptors.

Views from Bowefield

Bowefield residential area (viewpoint 8) is an elevated group of residential receptors, all with views over the River Suir, with the proposed site central in the views, approximately 450m west of the nearest point of the site and 1.4km to Rice Bridge. The level of change to the view is relatively minor at this distance and doesn't significantly affect the most sensitive elements of the view, i.e. the riparian landscape, ridgeline backdrop, etc. The visual impact is considered *slight, negative, and permanent* due to the change in the view from fixed residential receptors.

Table 11.6 Summary of Visual Impacts

Ref.	Viewpoint / Approx. Elevation	Level of Sensitivity	Magnitude of Change to View	Level of Impact
1	R448 Road; 8m OD (View E)	High	Very Low	Slight, Negative
2	R448 Road; 8m OD	Low	Medium	Slight, Negative
3	Bridge Street; 5m OD (View A)	High	Imperceptible	Imperceptible
4	Rice Bridge, 5m OD	Low	Medium	Slight, Negative
5	Grattan Quay, 5m OD	Low	Medium	Slight, Negative
6	Bilberry Road Halting Site, 5m OD	Medium	Medium	Moderate, Negative
7	Water's Gate, Quarry Road, 6-10m OD	Medium	Low	Slight, Negative
8	Bowefield residential estate; 60m OD	Medium	Low	Slight, Negative
Note: All impacts are considered to be permanent.				

11.5 Mitigation & Monitoring Measures

Due to the nature of the site and the works proposed, there are no practical landscape or visual mitigation measures that would make a significant difference to the impacts identified at either construction or operational stage. As the levels of landscape and visual impact generated by the proposed development are relatively low, this is considered acceptable.

As part of the design process, the type and details of the proposed solution were challenged, but the solution is considered the most suitable for the engineering challenges to be solved by the proposed project and there were no alternatives with a different finish or typology which could be reasonably considered.

11.6 Residual Impacts

As there are no mitigation measures possible which will avoid or reduce impacts, the residual impacts remain as per the potential impacts outlined in Section 11.4.

11.6.1 Cumulative Impacts

In the context of the other developments associated with the development of the North Quays to the east of the proposed development site into a substantial new urban quarter with residential, commercial and community buildings, a new bridge, a transport hub and new waterfront areas, this development is not considered to add any appreciable additional landscape and visual impacts due to the low levels of change and impacts associated with this development. Therefore, significant cumulative landscape and visual impacts will not arise.

11.6.2 'Do Nothing' Scenario

The do-nothing impact refers to the non-implementation of the proposed development. The primary effect of this would be that the impacts and effects identified would not directly occur. Without the development of the proposed Flood Defence West however, the likelihood is that the quay wall would continue to degenerate and could generate negative landscape and visual effects over time for the identified receptors. The quay wall would likely fail over time leading to potential damage and landscape and visual deterioration.

11.6.3 'Worst Case' Scenario

The views selected for analysis are those from where the proposed development is most likely to be visible and so the analysis of impacts represents a worst-case scenario.

11.7 Difficulties Encountered

There were no difficulties encountered during the landscape and visual impact assessment. Please note that the assessment is conducted from publicly accessible areas only and views from dwellings are understood / photographed from the adjacent public realm.

11.8 References

Waterford County Development Plan 2011-2017 (as extended), published by Waterford City and County Council (2011)

Waterford City Development Plan 2013 – 2019 (as extended), published by Waterford City and County Council (2013)

Waterford North Quays Planning Scheme, published by Waterford City and County Council (2018)

Strategic Environmental Assessment Environmental Report (part of the preparation of the Planning Scheme for the Waterford North Quays Strategic Development Zone (S.I. No. 30 of 2016)), published by Waterford City and County Council (2018)

Guidelines for Landscape and Visual Impact Assessment 3rd Edition, by The Landscape Institute / Institute of Environmental Assessment, published by E&FN Spon (2013)

Advice notes on Current Practice in the Preparation of Environmental Impact Statements, published by the Environmental Protection Agency (EPA) (2003)

Guidelines on the information to be contained in environmental impact statements, published by the EPA (2002)

Discovery Series Mapping Sheet no. 76 4th Edition, published by Ordnance Survey Ireland

Various Ordnance Survey Maps, accessed on-line at www.geohive.ie, March 2021.

Chapter 12
Noise and Vibration

Chapter 12 Noise and Vibration

12.1 Introduction

This chapter assesses the potential noise and vibration impacts associated with the proposed Flood Defences West, hereafter referred to as the 'proposed development' in Waterford City, Co. Waterford. The proposed development aims to develop flood defence measures for the protection of critical infrastructure including the existing Iarnród Éireann Waterford (Plunkett) Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout.

The flood defence measures will comprise remedial works to the existing quay wall and the construction of a new flood defence wall, typically in the form of a driven steel sheet pile wall. The works will also involve upgrading the drainage, installation of two pumping stations, remediation of the existing drainage outfalls and extending them through the new sheet pile wall.

12.2 Methodology

12.2.1 Construction Assessment Criteria

12.2.1.1 Noise

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. In lieu of statutory guidance, an assessment of significance has been undertaken as per British Standard *BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise*.

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. Table 12.1 sets out the values which, when exceeded, signify a significant effect at the façades of residential receptors.

Table 12.1 Example Threshold of Potential Significant Effect at Dwellings

Assessment category and threshold value period	Threshold value, in decibels (dB) ($L_{Aeq, T}$)		
	Category A[A]	Category B[B]	Category C[C]
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
Evenings and weekends [D]	55	60	65
Night-time (23:00 to 07:00hrs)	45	50	55

[A] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

[B] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.

[C] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.

[D] 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

For the appropriate assessment period (i.e. daytime in this instance) the ambient noise level is determined through a logarithmic averaging of the measurements for each location and then rounded to the nearest 5 dB. If the construction noise exceeds the appropriate category value, then a significant effect is deemed to occur.

Commercial Receptors

BS5228-1:2009+A1 gives several examples of acceptable limits for construction or demolition noise, the most simplistic being based upon the exceedance of fixed noise limits. For example paragraph E.2 states:

> *"Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut."*

Paragraph E.2 goes on to state:

> *"Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:*
>
> *70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise;*
>
> *75 decibels (dBA) in urban areas near main roads in heavy industrial areas".*

It is considered appropriate to adopt the 75 dB(A) criterion during the day for commercial properties located in Sally Park Yard.

12.2.1.2 Vibration

In terms of vibration, BS 5228-2:2009+A1:2014 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak component particle velocity (PPV) (in frequency range of predominant pulse) of 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. The standard also notes that below 12.5 mm/s PPV the risk of damage tends to zero. It is therefore common, on a cautious basis, to use this lower value. Taking the above into consideration the vibration criteria in Table 12.2 are recommended.

Table 12.2 Defined Construction Vibration Thresholds

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of:-		
Less than 15 Hz	**15 to 40 Hz**	**40 Hz and above**
15 mm/s	20 mm/s	50 mm/s

Note that the above thresholds are specified for transient or intermittent vibrations. Some construction activities, such as piling, may give rise to continuous vibrations. In these instances, the guidance recommends that the previously defined thresholds are reduced by at least 50%.

12.2.2 Operational Assessment Criteria

Due to the nature of the proposed development, there are no predicted emissions during the operational phase. Therefore, there is no potential for operational phase noise impacts and no assessment is required.

12.2.3 Baseline Noise Survey

12.2.3.1 Guidelines and Standards

Noise measurements were conducted in general accordance with the guidance contained in *ISO 1996-1:2016 Acoustics – Description measurement and assessment and environmental noise. Part 1: Basic quantities and assessment procedures (ISO 2016) and ISO 1996-2:2017 Part 2: Determination of sound pressure levels (ISO 2017).*

12.2.1.3 Instrumentation

The baseline noise measurements were performed using a Brüel & Kjær Type 2250 Sound Level Meter. Before and after the survey the measurement apparatus was check calibrated using a Brüel & Kjær Type 4231 Sound Level Calibrator.

12.2.1.4 Survey Periods and Location

Baseline noise surveys have been conducted at locations representative of the nearest noise sensitive areas which have the potential to be impacted by the proposed development, typically within a 300m radius of the development. An attended noise survey was conducted at 3 locations on 22 February 2021 between 11:20 and 15:00 hours.

12.2.3.1. Procedure

Measurements were conducted on a cyclical basis at the 3 locations, refer to Section 12.3.1 below for location descriptions. Sample periods for the noise measurements were 15 minutes at each location with each location sampled three times. The results were noted onto an Environmental Noise Survey Record Sheet immediately following each sample and were also saved to the instrument memory for later analysis where required. Survey personnel noted the primary noise sources contributing to noise build-up.

12.2.3.2. Measurement Parameters

The noise survey results are presented in terms of the following five parameters:

$L_{Aeq,T}$ is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the period T. It is typically used as a descriptor for ambient noise.

L_{Amax} is the instantaneous maximum sound level measured during the sample period.

L_{Amin} is the instantaneous minimum sound level measured during the sample period.

L_{A10} is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.

L_{A90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to 2×10^{-5} Pa.

12.3 Description of the Receiving Environment

A baseline environmental noise survey was conducted in the vicinity of the proposed development and within Waterford City in order to quantify the existing noise environment in the vicinity of the noise-sensitive locations that may be affected by the proposed development.

12.3.1 Measurement Locations

The measurement location descriptions are presented in Table 12.3 below and illustrated in Plate 12.1. The weather during the survey period was mainly dry with mild temperatures of approximately 10°C for the duration of the survey and light winds of 5 m/s or less.

Table 12.3 Baseline Noise Monitoring Locations

Survey Location	Description
Location A	Outside the residential property located in Sally Park
Location B	Outside commercial properties in Sally Park yard
Location C	Outside residential and commercial properties on Grattan Quay

Plate 12.1 Selected Noise Survey Locations

The identified sensitive receptors are presented in Table 12.4 and illustrated in Plate 12.2.

Plate 12.2 Identified Sensitive Receptors

Table 12.4 Sensitive Receptor Descriptions

Receptor Reference	Description
R1	Waters Gate (Residential Properties)
R2	Newrath House (Residential Properties)
R3	R448 (Residential Properties)
R4	Offices (Commercial)
R5	Residences and Hotels on Grattan Quay (Residential)

12.3.2 Measurement Results

Tables 12.5 to 12.7 present the results of the attended measured noise levels for each of the three survey locations.

12.3.2.1. Location A

At location A, the noise climate was dominated by road traffic and train movements. Ambient noise levels were measured as a range between 51 and 52 dB L_{Aeq}. Background noise levels were in the range of 45 to 48 dB L_{A90}.

Table 12.5 Measurement Results for Location A

Time	L_{Aeq}	L_{AFmax}	L_{AFmin}	L_{AF10}	L_{AF90}
11:23	52	70	45	55	48
12:11	51	77	42	53	45
12:56	51	62	45	54	48

12.3.2.2. Location B

At location Location B, the noise climate was also dominated by road traffic movements. Ambient noise levels ranged from 69 to 71 dB L_{Aeq}. Background noise levels were in the range of 54 to 59 dB L_{A90}.

Table 12.6 Measurement Results for Location B

Time	L_{Aeq}	L_{AFmax}	L_{AFmin}	L_{AF10}	L_{AF90}
11:51	71	82	48	75	59
12:37	70	83	46	74	56
13:17	69	80	49	73	54

12.3.2.3. Location C

At location C, the noise climate was dominated by road traffic. Ambient noise levels ranged from 70 to 71 dB L_{Aeq}. Background noise levels were in the range of 60 to 62 dB L_{A90}.

Table 12.7 Measurement Results for Location C

Time	L_{Aeq}	L_{AFmax}	L_{AFmin}	L_{AF10}	L_{AF90}
13:43	70	85	56	73	60
14:00	70	85	56	73	62
14:21	71	84	55	74	61
14:37	71	87	55	74	62

12.3.3 Construction Noise Thresholds

Table 12.8 presents the assigned *BS 5228-1:2009+A1:2014* categories and threshold values for each receptor location. Each identified receptor has been assigned measured baseline values that are expected to represent the noise characteristics of their location and/or the expected noise levels at each location.

Table 12.8 Defined Construction Noise Thresholds

Receptor Reference	Survey Location	$L_{Aeq,\ 12\ hr}$	Ambient Noise Level Rounded to Nearest 5 dB L_{Aeq}	BS 5228-1:2009+A 1:2014 Category	Construction Noise Threshold Value (dB) ($L_{Aeq,\ T}$)	
					Day	Night
R1	Location A	51	50	A	65	45
R2	Location A	51	50	A	65	45
R3	Location A	51	50	A	65	45
R4	Location B	70	Assigned appropriate commercial threshold as per Section 12.2.1.1		75	-
R5	Location C	70	70	C	75	55

12.4 Description of Potential Impacts

12.4.1 Construction Phase

12.4.1.1. Noise

Noise levels associated with construction have been calculated in accordance with methodology set out in British Standard, *BS5228: Part 1: 2009 +A1 2014: Code of practice for noise and vibration control on construction and open sites – Noise*. This standard sets out noise levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations. Table 12.9 lists the noise levels of the plant used for calculations. It is often not possible, however, to conduct detailed prediction calculations for the construction phase of a project; for instance, if the programme for construction works has not been established in detail. Under such circumstances, best practice involves the consideration of appropriate mitigation measures to ensure that, where practicable, construction activities do not exceed the recommended noise criteria as set out in Table 12.1.

A variety of items of plant will be in use including breakers, excavators, piling rigs and other ancillary items of plant. Due to the nature of the activities undertaken on the proposed construction site, there is potential for generation of high levels of noise. Note that barges (2 maximum) will also be used during the works. It assumed that the barge noise levels are lower than those of the construction items of plant that will be operational during this period, hence they aren't expected to contribute significantly to overall noise levels. Additionally, it is expected that a barge's noise characteristic is not untypical of the surrounding area.

Note that the construction programme has been established in a high level, outline form only. It is noted that the majority of activities will take place during typical daytime hours of 07:00 – 19:00 hrs with the exception of night-time possession works that will occur for approx. 4 weeks for the landside piling to construct an underground isolation structure at Ch.1090 and the landside flood defence wall between Ch.900 and Ch.950. Approx. 3-4 weeks of night time works will also be required for landside drainage works. These night-time activities will occur from Monday evening to Friday morning, 21:30 to 05:30 hrs.

Predicted construction noise levels presented within this chapter are indicative and subject to change dependent on methodology and plant equipment. However, the following tables present calculations of indicative noise levels for typical noise sources associated with construction works likely to be experienced for this development.

Table 12.9 Construction Plant Noise Levels and Source of Information

Activity	Plant	Data Source	% on Time	L_{Aeq} dB at 10 m
Sheet Pile Defence Walls	Crane	BS 5228-1:2009 Table C.3:30	33	70
	Excavator (Installing Sheet Piles)	BS 5228-1:2009 Table C.3:8	33	88
	Deliveries	Average of BS 5228-1:2009 Table C.11:4-20	10	82
Sheet pile Defence Walls (incl. Underground Isolation Structure) – Rail Possession	Crane	BS 5228-1:2009 Table C.3:30	33	70
	Excavator (Installing Sheet Piles)	BS 5228-1:2009 Table C.3:8	33	88

Activity	Plant	Data Source	% on Time	L_{Aeq} dB at 10 m
	Deliveries	Average of BS 5228-1:2009 Table C.11:4-20	10	82
Quay Wall Demolition	Excavator with Breaker	BS 5228 (C1-1)	66	92
	Excavator	BS 5228 (C2-30)	10	79
	Lorry	Average of BS 5228-1:2009 Table C.11:4-20	10	82
	Cement mixer truck (Discharging)	BS 5228-1:2009 Table C.4:28	20	75
Quay Wall Remediation	Cement mixer truck (Discharging)	BS 5228-1:2009 Table C.4:28	20	75
Drainage	Excavator with Breaker	BS 5228 (C1-1)	10	92
	360 Excavator	BS 5228-1:2009 Table C.1:9	75	71
	Lorry	Average of BS 5228-1:2009 Table C.11:4-20	10	82
	Hand Tools	BS 5228-1:2009 Table C.4:72	20	75
Drainage (Night)	360 Excavator	BS 5228-1:2009 Table C.1:9	75	71
	Crane	BS 5228-1:2009 Table C.3:30	33	70
Construction of New Structures (Outfall structures and pumping stations)	Cement mixer truck (Discharging)	BS 5228-1:2009 Table C.4:28	20	75
	360 Excavator	BS 5228-1:2009 Table C.1:9	75	71
	Excavator (Lifting)	BS 5228-1:2009 Table C.4:56	20	83
	Lorry	Average of BS 5228-1:2009 Table C.11:4-20	10	82
Activities at construction Compound	Excavator (Lifting)	BS 5228-1:2009 Table C.4:56	20	83
	Lorry	Average of BS 5228-1:2009 Table C.11:4-20	10	82
	Hand Tools	BS 5228-1:2009 Table C.4:72	20	75

The results of the noise modelling exercise are presented in Table 12.10. Construction noise calculations have been conducted at receptor locations closest to the development construction works (receptor locations are identified in Plate 12.2). Mitigation measures have been included within the predictions. These are further detailed in Section 12.5.

Table 12.10 Construction Noise Predictions

Activity	Period	Noise Level at Receptor Location (dBA)				
		R1	**R2**	**R3**	**R4**	**R5**
Sheet Pile Defence Walls	Day	< 55	< 55	< 55	67	< 55
Quay Wall Demolition	Day	< 55	< 55	< 55	74	58
Quay Wall Remediation	Day	< 55	< 55	< 55	< 55	< 55
Underground Isolation Structure	Night	< 45	< 45	51	< 45	< 45
Drainage	Day	< 55	< 55	< 55	66	< 55
Drainage	Night	< 45	< 45	< 45	< 45	< 45
Construction of New Structures (Outfall structures and pumping stations)	Day	< 55	< 55	< 55	62	< 55
Compound	Day	< 55	< 55	< 55	60	< 55

Noise levels for all other day time construction activities at all other receptors are predicted to be lower than the designated construction noise thresholds defined in Table 12.8. At R4 it is predicted that a *negative, moderate and temporary impact* will occur. At other receptors it is expected that the impacts will be *negative, not significant to slight and temporary*.

The night-time piling activities to construct the underground isolation structure and a 50m section of the landside sheet pile wall will be undertaken over a four-week period during night-time possession works. It is expected that night-time piling to construct these elements of the proposed development may cause a *temporary, potentially significant* impact at receptor R3. The night-time drainage works are not predicted to cause a significant impact.

12.4.1.2. Vibration

The potential for elevated levels of vibration at sensitive locations during construction is typically associated with excavation works, rock-breaking and piling operations.

For the purposes of this assessment, vibration levels associated with vibratory driven piles are assessed in order to determine potential worst-case impacts. British Standard BS 5228 2 :2009+A1:2014: Vibration, includes measured magnitude of vibration associated with different piling types. Table 12.11 reproduces those associated with steel sheet piling.

Table 12.11 Vibration Magnitudes associated with Steel Sheet Piling

Soil Conditions	Pile Dimensions	Distance, m	PPV, mm/s
4 m to 5 m soft saturated sand over soft to firm clay	Steel sheet piling, dimensions N/R	6, 8	2.6, 2.2
N/R	Sheet steel piling, dimensions N/R	10	11
Gravel over London clay	Sheet steel piling, dimensions N/R	5	4.3

Glacial till/ gravelly sandy silt mixture with occasional cobbles	Sheet steel piling, Frodingham 3 N 12 m depth	10, 20, 40	2.4, 2.2, 0.8
Gravel	Steel sheet piling	3, 9, 25	42, 3.8, 0.95

Given that the closest receptors to the sheet piling works are the commercial properties at Sally Park yard, at approximately 20m distance from the works, it can be seen that vibration magnitudes at 20m distance are below those associated with cosmetic damage to buildings.

During breaking, there is also the potential for vibration to propagate through the ground. Empirical data for this activity is not provided in BS 5228-2:2009+A1:2014; however, the likely levels of vibration from this activity are expected to be significantly below the vibration criteria for building damage, based on experience from other sites. AWN Consulting have previously conducted vibration measurements under controlled conditions, during trial construction works, on a sample site where concrete slab breaking was carried out. The trial construction works involved the use of a 3-tonne hydraulic breaker on a small CAT tracked excavator, and a 6-tonne hydraulic breaker on a large Liebherr tracked excavator.

Vibration measurements were conducted during various staged activities and at various distances. Peak vibration levels during staged activities using the 3-tonne breaker ranged from 0.48 to 0.25 PPV (mm/s) at distances of 10m and 50m, respectively. Using the 6-tonne breaker, measured vibration levels ranged between 1.49 to 0.24 PPV (mm/s) at distances of 10m and 50m, respectively.

The range of values recorded provides some context in relation to typical ranges of vibration generated by construction breaking activity likely to be required on the proposed site. The range of vibration magnitudes indicate vibration levels at the closest neighbouring buildings are expected to be below the limits set out in Table 12.2 to avoid any cosmetic damage to buildings.

Notwithstanding the above, any construction activities undertaken on the site will be required to operate below the recommended vibration criteria set out in Table 12.2.

12.5 Mitigation & Monitoring Measures

12.5.1 Construction Phase

With regard to construction activities, best practice control measures for noise and vibration from construction sites are found within BS 5228 (2009 +A1 2014) *Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2*. Whilst day-time construction noise and vibration impacts are expected to be minimal and well within the criteria set out in this document, there are night-time works that have the potential to cause a temporary, significant impact. The contractor will ensure that all best practice noise and vibration control methods will be used, where practicable in order to minimise emissions to external noise sensitive locations. In this regard, various mitigation measures can be considered and applied during the construction of the proposed development, such as:

- No plant used on site will be permitted to cause an ongoing public nuisance due to noise;
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations;

- Where practicable vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order;
- Compressors will be attenuated 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;
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use;
- All items of plant will be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures;
- Limiting the hours during which site activities which are likely to create high levels of noise or vibration are permitted

Furthermore, it is envisaged that a variety of practicable noise and vibration control measures will be employed. These may include:

- Selection of plant with low inherent potential for generation of noise and/ or vibration;
- Erection of good quality site hoarding on the landward side of the main works which will act as a noise barrier to general construction activity at ground level;
- Situate any noisy plant as far away from sensitive properties as permitted by site constraints
- Erection of localised barriers as necessary or where practicable around noisy items of plant such as generators or high duty compressors, which is of particular importance during construction works that take place during the night-time.

Where practicable it is recommended that noise and vibration from construction activities to off-site residences be limited to the values set out in Table 12.2 and 12.8. This may be achieved by undertaking noise and vibration monitoring at locations representative of the closest sensitive receptors.

Noise monitoring should be conducted in accordance with the International Standard ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise.

Vibration monitoring should be conducted in accordance with BS 6472 for human disturbance and BS ISO 4866:2010 for building damage.

12.5.2 Operational Phase

As there are no predicted noise and vibration impacts during the operational stage, there are no mitigation measures proposed.

12.6 Residual Impacts

12.6.1 Construction Phase

12.6.1.1 Noise

At R4, daytime activities are predicted to cause a *negative, moderate and temporary* impact. At other receptors it is expected that the impacts will be *negative, not significant to slight and temporary*. Note that this is the worst case predicted noise impact, as the works are linear in nature and there will be times where they take place at a further distance from the receptors, and hence a lower noise level will impact the receptors during those periods.

During the night possession works for the construction of an underground isolation structure and a 50m section of landside sheet pile wall, it is expected that *a negative, temporary, significant* impact will occur at R3 over the four-week period, Monday to Friday. The drainage night-time works are not predicted to cause a significant impact.

12.6.1.2 Vibration

Given the distances between works and receptor locations it is expected that vibration impacts will be *negative, temporary and imperceptible to slight*.

12.6.2 Operational Phase

There are no predicted noise and vibration impacts as a result of the operational phase of the proposed development.

12.7 Difficulties Encountered

There were no difficulties encountered when compiling this assessment.

12.8 References

British Standard BS 5228 (2009 +A1 2014): Code of Practice for Control of Noise and Vibration on Construction and Open Sites Part 1: Noise & Part 2: Vibration.

British Standard BS 7385 (1993): Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration.

EPA (2002). EPA Guidelines on the Information to be contained in Environmental Impact Statements.

EPA (2003). EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements).

EPA (2017). Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports.

ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise.

ISO 9613 (1996): Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation.

Chapter 13
Air Quality and Climate

Chapter 13 Air Quality and Climate

13.1 Introduction

This chapter assesses the potential air quality and climate impacts associated with the proposed Flood Defences West, the 'proposed development' in townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City. The proposed development aims to develop flood defence measures for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout.

The flood defence measures will comprise remedial works on the existing quay wall and the construction of a new flood defence wall, typically in the form of a driven steel sheet pile wall and drainage works involving remedial works to the existing drainage system and the provision of new drainage system. The works will also involve the construction of an impermeable trench in front of the Plunkett Train Station and overground flood defences for the Rice Bridge Roundabout and its three roundabout arms (R680 Rice Bridge, R448 Terminus Street, and R711 Dock Road). Remediation of the existing drainage outfalls and extending them through the new sheet pile wall is also proposed.

13.2 Methodology

13.2.1 Criteria for Rating of Impacts

13.2.1.1 Air Quality

In order to reduce the risk to health from poor air quality, National and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set. Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011 (S.I. No. 180/2011), which incorporate EU Directive 2008/50/EC, which has set limit values for a number of pollutants. The limit values in relation to Nitrogen Dioxide (NO_2) and Particulate Matter (PM_{10} and $PM_{2.5}$) are applicable to the proposed development (see Table 13.1).

With regards to larger dust particles that can give rise to nuisance dust, there are no statutory guidelines regarding the maximum dust deposition levels that may be generated during the construction phase of a development in Ireland. Furthermore, no specific criteria have been stipulated for nuisance dust in respect of this development.

With regard to dust deposition, the German TA-Luft standard for dust deposition (non-hazardous dust) (German VDI, 2002) sets a maximum permissible emission level for dust deposition of 350 mg/(m^2*day) averaged over a one-year period at any receptors outside the site boundary. Recommendations from the Department of the Environment, Heritage & Local Government (DEHLG, 2004) apply the Bergerhoff limit value of 350 mg/(m^2*day) to the site boundary of quarries. This limit value can also be implemented with regard to potential dust impacts from construction of the proposed development.

Table 13.1 Ambient Air Quality Standards 2011 & Dust Deposition Limits

Pollutant	Regulation	Limit Type	Value
Nitrogen Dioxide (NO_2)	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 μg/m^3
		Annual limit for protection of human health	40 μg/m^3
Nitrogen Oxide (NO_X)	2008/50/EC	Critical level for protection of vegetation	30 μg/m^3 NO + NO_2
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 μg/m^3
		Annual limit for protection of human health	40 μg/m^3
Particulate Matter (as $PM_{2.5}$)	2008/50/EC	Annual limit for protection of human health	25 μg/m^3
Dust Deposition	TA Luft (German VDI 2002)	Annual average limit for nuisance dust deposition at site boundary	350 mg/m^2/day

13.2.1.2 Climate

Ireland is party to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. The Paris Agreement, which entered into force in 2016, is an important milestone in terms of international climate change agreements and includes an aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made in the Paris Agreement on elevating adaption onto the same level as action to cut and curb emissions.

In order to meet the commitments under the Paris Agreement, the EU enacted *Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No. 525/2013* (the Regulation). The Regulation aims to deliver, collectively by the EU in the most cost-effective manner possible, reductions in GHG emissions from the Emission Trading Scheme (ETS) and non-ETS sectors[1] amounting to 43% and 30%, respectively, by 2030 compared to 2005. Ireland's obligation under the Regulation is a 30% reduction in non-ETS greenhouse gas emissions by 2030 relative to its 2005 levels.

In 2015, the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) was enacted (the Act). The purpose of the Act was to enable Ireland '*to pursue, and achieve, the transition to a low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050*' (3.(1) of No. 46 of 2015). This is referred to in the Act as the '*national transition objective*'. The Act makes provision for

[1] Non-ETS sectors consist of transport, agriculture, waste and industrial sectors

a national mitigation plan, and a national adaptation framework. In addition, the Act provided for the establishment of the Climate Change Advisory Council with the function to advise and make recommendations on the preparation of the national mitigation and adaptation plans and compliance with existing climate obligations.

The *Climate Action Plan* (CAP), published in June 2019, outlines the current status across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and outlines the various broadscale measures required for each sector to achieve ambitious decarbonisation targets. The CAP also details the required governance arrangements for implementation including carbon-proofing of policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas. The CAP has set a built environment sector reduction target of 40-45% relative to 2030 pre-NDP (National Development Plan) projections.

Following on from Ireland declaring a climate and biodiversity emergency in May 2019 and the European Parliament approving a resolution declaring a climate and environment emergency in Europe in November 2019, the Government approved the publication of the General Scheme for the Climate Action (Amendment) Bill 2019 in December 2019. The General Scheme was prepared for the purposes of giving statutory effect to the core objectives stated within the CAP. The draft Climate Action and Low Carbon Development (Amendment) Bill (the Bill) was published on 23rd of March 2021.

In October 2020, the Climate Action and Low Carbon Development (Amendment) Bill 2020 was published in draft format (draft 2020 Climate Act) which amends and enhances the 2015 Climate Act. Once approved, the purpose of the 2020 Climate Act is to provide for the approval of plans '*for the purpose of pursuing the transition to a climate resilient and climate neutral economy by the end of the year 2050'*. The 2020 Climate Act will also '*provide for carbon budgets and a decarbonisation target range for certain sectors of the economy'*. The 2020 Climate Act removes any reference to a national mitigation plan and instead refers to both the Climate Action Plan, as published in 2019, and a series of National Long Term Climate Action Strategies. In addition, the Environment Minister shall request each local authority to make a 'local authority climate action plan' lasting five years and to specify the mitigation measures and the adaptation measures to be adopted by the local authority.

13.2.2 Construction Stage Methodology

13.2.2.1 Air Quality

The Institute of Air Quality Management in the UK (IAQM) guidelines (2014) outline an assessment method for predicting the impact of dust emissions from demolition, earthworks, construction and haulage activities based on the scale and nature of the works and the sensitivity of the area to dust impacts. The IAQM methodology has been applied to the construction phase of this development in order to predict the likely magnitude of the dust impacts in the absence of mitigation measures. The use of UK guidance is considered best practice in the absence of specific Irish guidance.

Firstly, the sensitivity of the area is defined by determining the number of sensitive receptors within various distance bands from the proposed works area. The distance bands extend from 0m to 350m from the works area as per the IAQM guidance (2014). Significant dust emissions are not predicted at distances further than 350m from the site. The sensitivity of the area is then combined with the magnitude of the proposed works in order to determine the risk level of potential dust impacts, high, medium or low risk. The risk associated with the proposed works is then used to determine the level of site specific mitigation required to prevent significant dust impacts occurring.

Construction phase traffic has the potential to impact air quality. The UK DMRB guidance (UK Highways Agency, 2019a), states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment. The use of the UK guidance is recommended by the TII (2011) in the absence of specific Irish guidance. This approach is considered best practice and can be applied to any development that causes the following changes in traffic:

- Annual average daily traffic (AADT) changes by 1,000 or more;
- Heavy duty vehicle (HDV) AADT changes by 200 or more;
- A change in speed band; and
- A change in carriageway alignment by 5m or greater.

By definition of the criteria above, there are no road links impacted as a result of the proposed development. Therefore, no assessment using the DMRB model was required for the proposed development as there is no potential for significant impacts to air quality as a result of traffic emissions.

13.2.2.2 Climate

The impact of the construction phase of the development on climate was determined by a qualitative assessment of the nature and scale of greenhouse gas generating construction activities associated with the proposed development.

Construction traffic also has the potential to impact climate through the release of GHG emissions such as CO_2. The UK Highways Agency DMRB guidance document in relation to climate impact assessments *LA 114 Climate* (UK Highways Agency, 2019b) outlines the following scoping criteria to determine whether a detailed climate assessment is required for a proposed project. If any of the road links impacted by the proposed development meet the below criteria, then further assessment is required:

- A change of more than 10% in AADT;
- A change of more than 10% to the number of heavy duty vehicles; and
- A change in daily average speed of more than 20 km/hr.

None of the road links in the vicinity of the proposed development meet the above criteria and therefore no assessment using the DMRB model was required as there is no potential for significant impacts to climate as a result of traffic emissions.

13.2.3 Operational Phase Methodology

Due to the nature of the proposed development, there are no predicted emissions to atmosphere during the operational phase. Therefore, there is no potential for operational phase impacts to air quality or climate and no assessment is required.

13.3 Description of Receiving Environment

13.3.1 Meteorological Data

A key factor in assessing temporal and spatial variations in air quality are the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e., traffic levels) (WHO, 2006). Wind is of key importance in dispersing air pollutants. The potential for dust dispersion and deposition depends on local meteorological factors such as rainfall, wind speed and wind direction.

The nearest representative weather station collating detailed weather records is Johnstown Castle, which is located approximately 42km east of the proposed development. Johnstown Castle met data has been examined to identify the prevailing wind direction and average wind speeds over a five-year period (see Figure 13.1). For data collated during five representative years (2016 - 2020), the predominant wind direction is south-westerly with predominantly moderate wind speeds. In addition, dust generation is considered negligible on days where rainfall is greater than 0.2mm. A review of historical 30-year average data (1978 – 2007) for Kilkenny, the closest station with 30-year average data, indicates that on average 193 days per year have rainfall over 0.2mm (Met Eireann, 2021) and therefore it can be determined that over 50% of the time dust generation will be reduced.

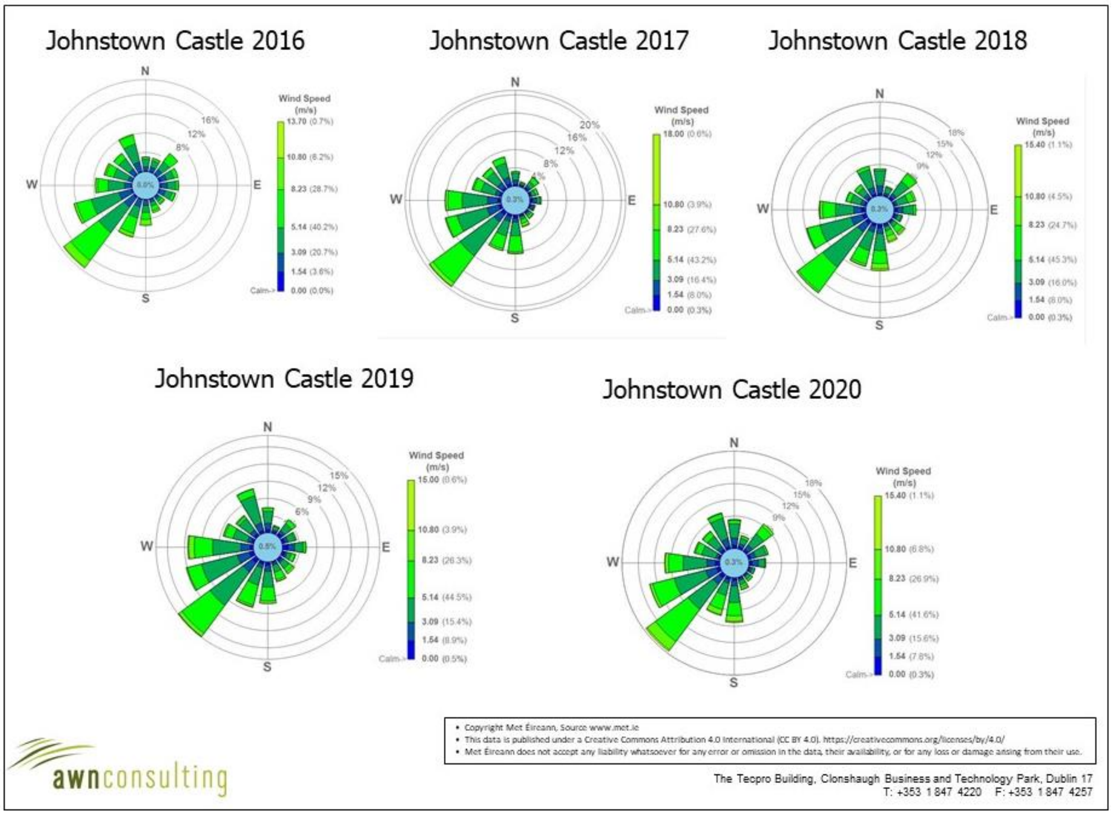


Figure 13.1 Johnstown Castle Windrose 2016 - 2020

13.3.2 Baseline Air Quality

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality in Ireland is "*Air Quality In Ireland 2019*" (EPA, 2020a). The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments (EPA, 2021).

As part of the implementation of the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2021). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D.

In terms of air monitoring and assessment, the proposed development is within Zone C (EPA, 2021). Long-term monitoring data has been used to determine background concentrations for the key pollutants in the region of the proposed development. The background concentration accounts for all non-traffic derived emissions (e.g., natural sources, industry, home heating etc.).

With regard to NO_2, continuous monitoring data from the EPA (2020a) at the Zone C locations of Kilkenny, Portlaoise and Dundalk show that levels of NO_2 are below both the annual and 1-hour limit values (see Table 13.2). Average long-term concentrations range from 5 – 14µg/m^3 for the 2015 – 2019 period; suggesting an upper average over the five year period of no more than 13µg/m^3. There were no exceedances of the maximum 1 hour limit of 200 µg/m^3 in any year (18 exceedances are allowed per year). Based on these results, a conservative estimate of the current background NO_2 concentration in the region of the proposed development is 14µg/m^3.

Table 13.2 Trends In Zone C Air Quality - Nitrogen Dioxide (NO_2)

Station	Averaging Period Notes 1,2	Year				
		2015	2016	2017	2018	2019
Kilkenny	Annual Mean NO_2 (µg/m^3)	5	7	5	6	5
	Max 1-hr NO_2 (µg/m^3)	70	51	58	71	59
Portlaoise	Annual Mean NO_2 (µg/m^3)	10	11	11	11	11
	Max 1-hr NO_2 (µg/m^3)	84	86	80	119	77
Dundalk	Annual Mean NO_2 (µg/m^3)	-	-	-	14	12
	Max 1-hr NO_2 (µg/m^3)	-	-	-	91	144

Note 1 Annual average limit value - 40 µg/m^3 (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

Note 2 1-hour limit value - 200 µg/m^3 as a 99.8th%ile, i.e. not to be exceeded >18 times per year (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

Continuous PM_{10} monitoring carried out at the locations of Galway, Ennis and Portlaoise showed 2019 annual mean concentrations of 12 – 15µg/m^3 (Table 13.3), with at most 12 exceedances (in Ennis) of the 24-hour limit value of 50 µg/m^3 (35 exceedances are permitted per year) (EPA, 2020a). Long-term data for the 2015 – 2019 period show concentrations ranging from 10 – 18µg/m^3; suggesting an upper average concentration over the five-year period of no more than 17µg/m^3. Based on the EPA data (Table 13.3) a conservative estimate of the current background PM_{10} concentration in the region of the proposed development is 18µg/m^3.

Table 13.3 Trends In Zone C Air Quality - PM_{10}

Station	Averaging Period Notes 1,2	Year				
		2015	2016	2017	2018	2019
Galway	Annual Mean PM_{10} (µg/m^3)	15	15	-	15	13
	24-hr Mean > 50 µg/m^3 (days)	2	3	-	0	0
Ennis	Annual Mean PM_{10} (µg/m^3)	18	17	16	16	18
	24-hr Mean > 50 µg/m^3 (days)	10	12	9	4	12
Portlaoise	Annual Mean PM_{10} (µg/m^3)	12	12	10	11	15
	24-hr Mean > 50 µg/m^3 (days)	1	1	0	1	0

Note1 Annual average limit value - 40 $\mu g/m^3$ (EU Council Directive 2008/50/EC & S.I. No. 180 of 2011).

Note 2 24-hour limit value - 50 $\mu g/m^3$ as a 90.4^{th}%ile, i.e. not to be exceeded >35 times per year (EU Council Directive 1999/30/EC & S.I. No. 180 of 2011).

Continuous $PM_{2.5}$ monitoring carried out at the Zone C locations of Ennis and Bray showed average levels of 5 - 14$\mu g/m^3$ over the 2015 - 2019 period, with a $PM_{2.5}/PM_{10}$ ratio in Ennis ranging from 0.63 – 0.78 (EPA, 2020a). Based on this information, a conservative ratio of 0.8 was used to generate a background $PM_{2.5}$ concentration in the region of the proposed development of 14.4$\mu g/m^3$.

13.3.3 Climate Baseline

Anthropogenic emissions of greenhouse gases (GHG) in Ireland included in the EU 2020 strategy are outlined in the most recent review by the EPA which details provisional emissions up to 2019 (EPA, 2020b). The data published in 2020 states that Ireland will exceed its 2019 annual limit set under the EU's Effort Sharing Decision (ESD), 406/2009/EC1 by an estimated 6.98 Mt. For 2019, total national greenhouse gas emissions are estimated to be 59.90 million tonnes carbon dioxide equivalent (Mt CO_2eq) with 45.71 MtCO_2eq of emissions associated with the ESD sectors[2] for which compliance with the EU targets must be met. In Ireland, agriculture is the largest contributor at 35.3% of the total emissions recorded for 2019, with the transport sector accounting for 20.3% of emissions of CO_2.

GHG emissions for 2019 are estimated to be 4.5% lower than those recorded in 2018. Emission reductions have been recorded in 6 of the last 10 years. However, compliance with the annual EU targets has not been met for four years in a row. Emissions from 2016 – 2019 exceeded the annual EU targets by 0.29 MtCO_2eq, 2.94 MtCO_2eq, 5.57 MtCO_2eq and 6.98 MtCO_2eq respectively. Agriculture is consistently the largest contributor to emissions with emissions from the transport and energy sectors being the second and third largest contributors respectively in recent years.

The EPA 2019 GHG Emissions Projections Report for 2018 – 2040 (EPA, 2019) notes that there is a long-term projected decrease in greenhouse gas emissions as a result of inclusion of new climate mitigation policies and measures that formed part of the National Development Plan (NDP) which was published in 2018. Implementation of these mitigations are classed as a "*With Additional Measures scenario*" for future scenarios. A change from generating electricity using coal and peat to wind power and diesel vehicle engines to electric vehicle engines are envisaged under this scenario. While emissions are projected to decrease in these areas, emissions from agriculture are projected to grow steadily due to an increase in animal numbers. However, over the 2013 – 2020 period, Ireland is projected to cumulatively exceed its compliance obligations with the EU's Effort Sharing Decision (Decision No. 406/2009/EC) 2020 targets by approximately 10 Mt CO_2eq under the "*With Existing Measures*" scenario and 9 Mt CO_2eq under the "*With Additional Measures*" scenario (EPA, 2019).

13.3.4 Sensitivity of the Receiving Environment

In line with the UK Institute of Air Quality Management (IAQM) guidance document '*Guidance on the Assessment of Dust from Demolition and Construction'* (2014) prior to assessing the impact of dust from a proposed development, the sensitivity of the area must first be assessed as outlined below.

Both receptor sensitivity and proximity to proposed works areas (between 0m and 350m from the proposed works as outlined in Table 13.4 below) are taken into

[2] Sectors not included in the EU Emissions Trading System (ETS) such as transport, buildings, agriculture and waste.

consideration. For the purposes of this assessment, high sensitivity receptors are regarded as residential properties where people are likely to spend the majority of their time. Commercial properties and places of work are regarded as medium sensitivity, while low sensitivity receptors are places where people are present for short periods or do not expect a high level of amenity.

In terms of receptor sensitivity to dust soiling, there are over 100 high sensitivity residential receptors within 100m - 350m of the proposed site boundary as well as a number of commercial/residential units along R680 and O'Connell Street near Rice Bridge (see Figure 13.2). Therefore, the overall sensitivity of the area to dust soiling impacts is considered **low** based on the IAQM criteria outlined in Table 13.4.

Table 13.4 Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number Of Receptors	Distance from source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	**Low**
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

In addition to sensitivity to dust soiling, the IAQM guidelines also outline the assessment criteria for determining the sensitivity of the area to human health impacts from dust emissions. The criteria take into consideration the current annual mean PM_{10} concentration, receptor sensitivity based on type (residential receptors are classified as high sensitivity) and the number of receptors affected within various distance bands from the construction works. A conservative estimate of the current annual mean PM_{10} concentration in the vicinity of the proposed development is 18µg/m^3 and there are over 100 residential properties within 200m - 350m of the proposed site boundary as well as commercial/residential properties along the R680 and O'Connell Street near Rice Bridge (see Figure 13.2). Based on the IAQM criteria outlined in Table 13.5, the worst-case sensitivity of the area to human health is considered to be **low**.

Table 13.5 Sensitivity of the Area to Dust Related Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number Of Receptors	Distance from source (m)				
			<20	<50	<100	<200	<350
High	< 24 µg/m^3	>100	Medium	Low	Low	Low	**Low**
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	< 24 µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	< 24 µg/m^3	>1	Low	Low	Low	Low	Low

The IAQM guidance also outlines the criteria for determining the sensitivity of an ecological receptor to dust impacts. The sensitivity is determined based on the distance to the source, the designation of the site, (European, National or local designation) and the potential dust sensitivity of the ecologically important species present (see Table 13.6). Works will take place directly beside and within a section of the Lower River Suir SAC (site code 002137) (see Figure 13.2). The vegetation within the SAC is potentially dust sensitive. The Lower River Suir SAC is considered a high sensitivity receptor to potential dust soiling impacts on vegetation due to its European designation. As the works will take place directly beside and within a section of the SAC the overall sensitivity of the area to dust related ecological impacts is considered **high** as per Table 13.6.

Table 13.6 Sensitivity of the Area to Dust Related Ecological Impacts

Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
High	**High**	Medium
Medium	Medium	Low
Low	Low	Low

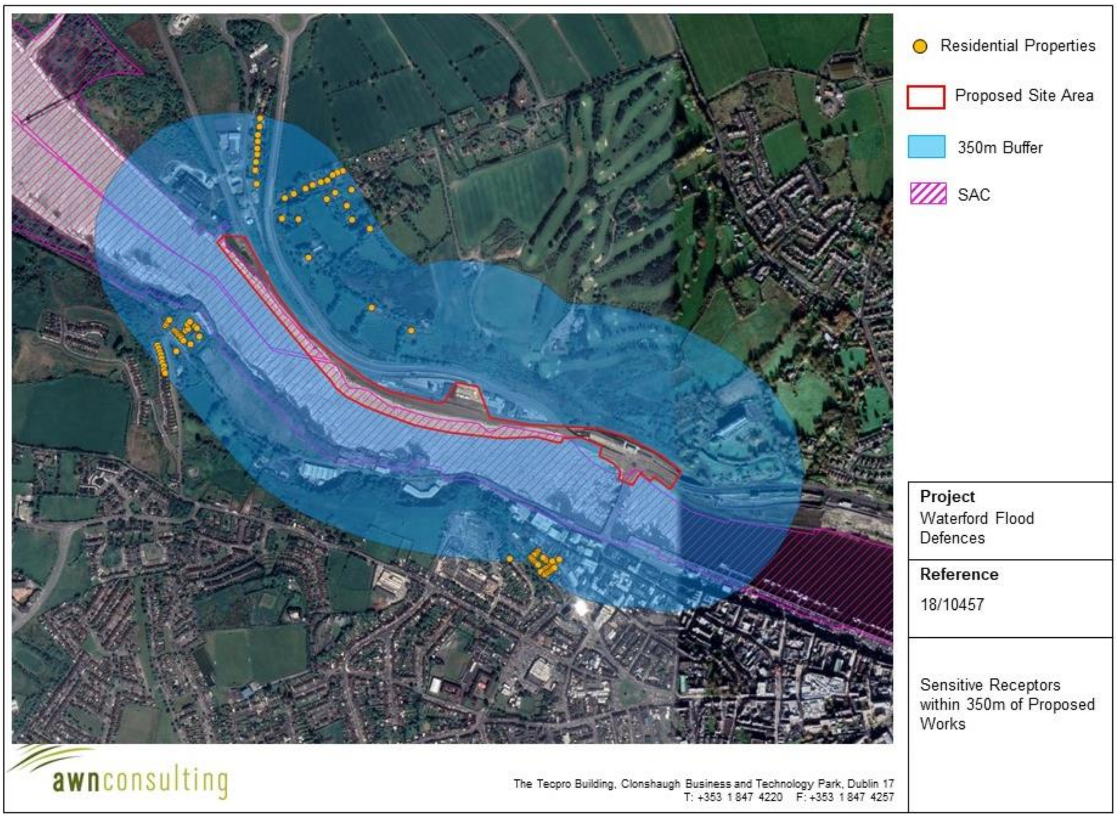


Figure 13.2 Sensitive Receptors within 350m of Proposed Works

13.4 Description of Potential Impacts

13.4.1 Construction Phase

13.4.1.1 Air Quality

The greatest potential impact on air quality during the construction phase of the proposed development is from construction dust emissions and the potential for nuisance dust. While construction dust tends to be deposited within 350m of a construction site, the majority of the deposition occurs within the first 50m. The extent of any dust generation depends on the nature of the dust (soils, peat, sands, gravels, silts etc.) and the nature of the construction activity. In addition, the potential for dust dispersion and deposition depends on local meteorological factors such as rainfall, wind speed and wind direction. As per Section 13.3.4, local meteorological conditions are favourable to dust suppression the majority of the time.

In order to determine the level of dust mitigation required during the proposed works, the potential dust emission magnitude for each dust generating activity needs to be taken into account, in conjunction with the previously established sensitivity of the area (see Section 13.3.4). The primary activities involved in the proposed flood defences development which have the potential to generate dust include: construction of trenching, construction of flood barriers, remediation of existing quay wall and construction of sheet pile defence wall.

The majority of these works are over relatively small areas and will result in very localised emissions of dust which is unlikely to travel to the sensitive receptors located within 110 - 350m of the works area. The most significant works with dust generation potential are those that involve excavations, filling and piling. Other works are likely to have very minor dust emissions due to their small scale. Worst-case assumptions have been used as part of this assessment. As such, the dust mitigation measures proposed are those associated with a worst-case assessment and actual levels of dust which may arise from the proposed construction activities may be lower than estimated. The major dust generating activites have been divided into three categories as detailed below to reflect their different potential impacts.

Piling and Demolition Activities

In order to determine the level of dust mitigation required during the proposed piling and minor demolition works, the potential dust emission magnitude needs to be taken into account, along with the already established sensitivity of the area. The dust emission magnitude of the IAQM assessment criteria for demolition activities can be classified as small, medium and large as described below, this criteria has been adopted for the piling activities associated with the proposed flood defence works.

Large: Total Building Volume > 50,000m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities > 20m above ground level;

Medium: Total building volume 20,000m^3 – 50,000m^3, potentially dusty construction material, demolition activities 10-20m above ground level; and

Small: Total building volume < 20,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.

Sheet piling will be installed for the proposed flood defence walls on both the land and river sides. Approximately 540m of walls will be installed on the riverside with approximately 190m installed on the landside. The demolition of c.540m of existing quay wall to 800m below ground will be required to faiclitate draiange works. Addtionally, the demolition of minor localised sections of existing masonry quay wall (max width 2m) will also be required in order to connect the section of in-river sheet piles to the adjacent flood walls. A further complete demolition of c.25m of the existing quay wall will be required to construct a pumping station at Ch.390 (see Figure 4.18 in Volume 3 of this EIAR).

The dust emission magnitude for the proposed piling and minor demolition works can be considered small as a worst-case as works will not take place above 10m and steel sheet piling will be used. Combining this with the previously established sensitivtiy of the area (see Section 13.3.4) results in an overall low risk of temporary dust soiling and human health impacts and a medium risk of temporary ecological impacts as a result of the proposed activites (see Table 13.7).

Table 13.7 Risk of Dust Impacts – Piling & Demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Earthworks

Earthworks primarily involve excavating material, loading and unloading of materials, tipping and stockpiling activities. Activities such as levelling the site and landscaping works are also considered under this category. The dust emission magnitude from earthworks can be classified as small, medium or large based on the definitions from the IAQM guidance as transcribed below:

Large: Total site area > 10,000m^2, potentially dusty soil type (e.g. clay which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds > 8m in height, total material moved >100,000 tonnes;

Medium: Total site area 2,500m^2 – 10,000m^2, moderately dusty soil type (e.g. silt), 5 - 10 heavy earth moving vehicles active at any one time, formation of bunds 4 – 8m in height, total material moved 20,000 – 100,000 tonnes;

Small: Total site area < 2,500m^2, soil type with large grain size (e.g. sand), < 5 heavy earth moving vehicles active at any one time, formation of bunds < 4 m in height, total material moved < 20,000 tonnes, earthworks during wetter months.

As part of the construction stage for the proposed flood defence measures, there will be the requirement for removal of some materials and the import of material for fill. It is expected that there will be 4,570m^3 of material required for fill, 1,400 tonnes of steel sheet piles, 1,500 m^3 of pre-cast concrete cladding material and 1,309m of pipes for drainage works. Approximately of 2,400m^3 of waste will be generated from demolision and excavation works which cannot be resued on site, and will be transported to an approriate licensed waste facility. According the the IAQM guidance as a worst-case the potentially dusty materials involved in excavation and infill works could be considered small in scale as the quantities are significantly less than 20,000 tonnes. Dust emissions are not predicted from the steel sheet piles.

The sensitivity of the area, as determined in Section 13.3.1.3, is combined with the dust emission magnitude for each dust generating activity to define the risk of dust impacts in the absence of mitigation. As outlined in Table 13.8, this results in an overall negligible risk of temporary dust soiling impacts, a negligible risk of temporary dust related human health impacts and a low risk of dust related ecological impacts as a result of the proposed earthworks activities.

Table 13.8 Risk of Dust Impacts – Earthworks

Sensitivity of Area	Dust Emission Magnitude		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Trackout

Factors which determine the dust emission magnitude are vehicle size, vehicle speed, number of vehicles, road surface material and duration of movement. Dust emission magnitude from trackout can be classified as small, medium or large based on the definitions from the IAQM guidance as transcribed below:

Large: > 50 HGV (> 3.5 t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length > 100m;

Medium: 10 - 50 HGV (> 3.5 t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 - 100m;

Small: < 10 HGV (> 3.5 t) outward movements in any one day, surface material with low potential for dust release, unpaved road length < 50m.

The construction programme for the construciton phase of proposed development is 30 - 35 weeks. The dust emission magnitude for the proposed trackout can be classified as medium as worst-case as on average there will be between 26 and 32 outward HGV movements per day over approx. 7 weeks of the construction programme. Traffic movements for the remainder of the construction programme range between 4 and 20 HGV movements per day.

The sensitivity of the area is combined with the dust emission magnitude for each dust generating activity to define the risk of dust impacts in the absence of mitigation. As outlined in Table 13.9, this results in an overall low risk of temporary dust soiling impacts, a low risk of dust related human health impacts and a medium risk of dust related ecological impacts as a result of the proposed trackout activities.

Table 13.9 Risk of Dust Impacts – Trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Summary of Dust Emission Risk

The risk of dust impacts as a result of the proposed development are summarised in Table 13.10 for each activity. The magnitude of risk determined is used to prescribe the level of site specific mitigation required for each activity in order to prevent significant impacts occurring.

Overall, in order to ensure that no dust nuisance occurs during the construction activities for the proposed development, a range of dust mitigation measures associated with a **medium risk** of dust impacts must be implemented. In the absence of mitigation, there is the potential for *negative, temporary, slight* impacts to air quality.

Table 13.10 Summary of Dust Impact Risk used to Define Site-Specific Mitigation

Potential Impact	Dust Emission Risk		
	Piling & Demolition	**Earthworks**	**Trackout**
Dust Soiling	Negligible Risk	Negligible Risk	Low Risk
Human Health Impacts	Negligible Risk	Negligible Risk	Low Risk
Ecological Impacts	Medium Risk	Low Risk	Medium Risk

13.4.1.2 Climate

There is the potential for a number of greenhouse gas emissions to atmosphere during the construction of the development. Construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions. The Institute of Air Quality Management document '*Guidance on the Assessment of Dust from Demolition and Construction'* states that site traffic and plant is unlikely to make a significant impact on climate. Therefore, the potential impact on climate is considered to be *imperceptible* and *short-term*.

13.4.1.3 Human Health

Dust emissions from the construction phase of the proposed development have the potential to impact on human health through the release of PM_{10} and $PM_{2.5}$ emissions. As per Table 13.5, the surrounding area is of low sensitivity to potential human health impacts as a result of construction dust emissions. In addition, it was found that there is an overall low risk of significant human health impacts from dust emissions in the absence of mitigation. Therefore, in the absence of mitigation there is the potential for *negative, imperceptible, , short-term* impacts to human health as a result of the proposed development.

13.4.2 Operational Phase

Due to the nature of the proposed development, there will be no emissions to atmosphere during the operational phase. Therefore, there is no potential for impacts to air quality or climate as a result of the proposed development. The operational phase is considered *neutral* in terms of air quality and climate.

Climate change has the potential to alter weather patterns in future years leading to increased rainfall and a greater potential for flooding events. The proposed development will facilitate in mitigating flooding impacts on critical infrastructure within Waterford City which will be beneficial to the area.

13.5 Mitigation & Monitoring Measures

13.5.1 Construction Phase

The proactive control of fugitive dust will ensure the prevention of significant emissions. The key aspects of controlling dust are listed below. These measures will be incorporated into the overall Construction Environmental Management Plan (CEMP) prepared in respect of the proposed development.

In summary, the measures which will be implemented will include:

- Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic.
- Any road that has the potential to give rise to fugitive dust will be regularly watered, as appropriate, during dry and/or windy conditions.
- Vehicles exiting the site shall make use of a wheel wash facility where appropriate, prior to entering onto public roads.
- Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates.
- Public roads outside the site will be regularly inspected for cleanliness and cleaned as necessary.
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.
- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.
- During any demolition processes, water suppression should be used, preferably with a hand-held spray. Only the use of cutting, grinding or sawing equipment fitted or used in conjunction with a suitable dust suppression technique such as water sprays/local extraction should be used.
- Drop heights from conveyors, loading shovels, hoppers and other loading equipment should be minimised, if necessary fine water sprays should be employed.

At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

13.5.2 Operational Phase

As there are no predicted impacts to air quality or climate during the operational stage, there are no mitigation measures proposed.

13.6 Residual Impacts

13.6.1 Construction Phase

13.6.1.1 Air Quality

Once the dust minimisation measures outlined in Section 13.5.1 are implemented, the impact of the proposed development in terms of dust soiling will be negative, *temporary, localised,* and *imperceptible* at nearby receptors.

13.6.1.2 Climate

According to the IAQM guidance site traffic, plant and machinery are unlikely to have a significant impact on climate. Therefore, the predicted impact is neutral, temporary and imperceptible.

13.6.1.3 Human Health

Best practice mitigation measures are proposed for the construction phase of the proposed development which will focus on the pro-active control of dust to minimise generation of emissions at source. The mitigation measures that will be put in place during construction of the proposed development will ensure that the impact of the development complies with all EU ambient air quality legislative limit values which are based on the protection of human health (see Table 13.1). Therefore, the impact of construction of the proposed development is likely to be *neutral, temporary, localised,* and *imperceptible* with respect to human health.

13.6.2 Operational Phase

There are no predicted impacts to air quality or climate as a result of the operational phase of the proposed development.

13.7 Difficulties Encountered

There were no difficulties encountered when compiling this assessment.

13.8 References

Department of the Environment, Heritage and Local Government (2004) Quarries and Ancillary Activities, Guidelines for Planning Authorities

Environmental Protection Agency (2019) GHG Emissions Projections Report - Ireland's Greenhouse Gas Emissions Projections 2018 - 2040

Environmental Protection Agency (2020a) Air Quality Monitoring Report 2019 (& previous annual reports)

Environmental Protection Agency (2020b) Ireland's Provisional Greenhouse Gas Emissions 1990 – 2019

Environmental Protection Agency (2021) EPA website Available at: http://www.epa.ie/whatwedo/monitoring/air/

German VDI (2002) Technical Guidelines on Air Quality Control – TA Luft

Government of Ireland (2015) Climate Action and Low Carbon Development Act

Government of Ireland (2019) Draft Scheme of the Climate Action (Amendment) Bill 2019

Government of Ireland (2019) Climate Action Plan 2019

Government of Ireland (2021) Climate Action and Low Carbon Development (Amendment) Bill 2021

Institute of Air Quality Management (IAQM) (2014) Guidance on the Assessment of Dust from Demolition and Construction Version 1.1

Met Éireann (2021) Met Eireann website: https://www.met.ie/

Transport Infrastructure Ireland (2011) Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes

UK Highways Agency (2019a) UK Design Manual for Roads and Bridges (DMRB), Volume 11, Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 LA 105 Air quality

World Health Organisation (2006) Air Quality Guidelines - Global Update 2005 (and previous Air Quality Guideline Reports 1999 & 2000)

Chapter 14
Archaeology and Cultural Heritage

Chapter 14 Archaeology and Cultural Heritage

14.1 Introduction

This chapter examines the potential impact on the archaeological and cultural heritage resource of the proposed flood defence scheme immediately north of the River Suir at Waterford City (Plate 14.1).

This study determines, as far as reasonably possible from existing records, the nature of the archaeological resource within the proposed development area using appropriate methods of study. In order to provide an appropriate archaeological context, the wider vicinity was also examined. Desk-based assessment is defined as a programme of study of the historic environment within a specified area or site that addresses agreed research and/or conservation objectives. It consists of an analysis of existing written, graphic, photographic and electronic information in order to identify the likely heritage assets, their interests and significance and the character of the study area, including appropriate consideration of the settings of heritage assets (CIfA 2014). This leads to the following:

- Determining the presence of known archaeological heritage sites that may be affected by the proposed development;
- Assessment of the likelihood of finding previously unrecorded archaeological remains during the construction programme; and
- Suggested mitigation measures based upon the results of the above research.

The assessment involved detailed interrogation of the archaeological and historical background of the development area. This included information from the Record of Monuments and Places of County Waterford, the County and City Development Plans, the topographical files of the National Museum of Ireland and cartographic and documentary records. Aerial photographs of the assessment area held by Ordnance Survey Ireland were also consulted. A field inspection was carried out during March 2021 in an attempt to identify any known cultural heritage sites and previously unrecorded features, structures and portable finds within the study area.

An impact assessment and a mitigation strategy have been prepared. The impact assessment is undertaken to outline potential adverse impacts that the proposed development may have on the cultural heritage resource, while the mitigation strategy is designed to avoid or reduce such adverse impacts.

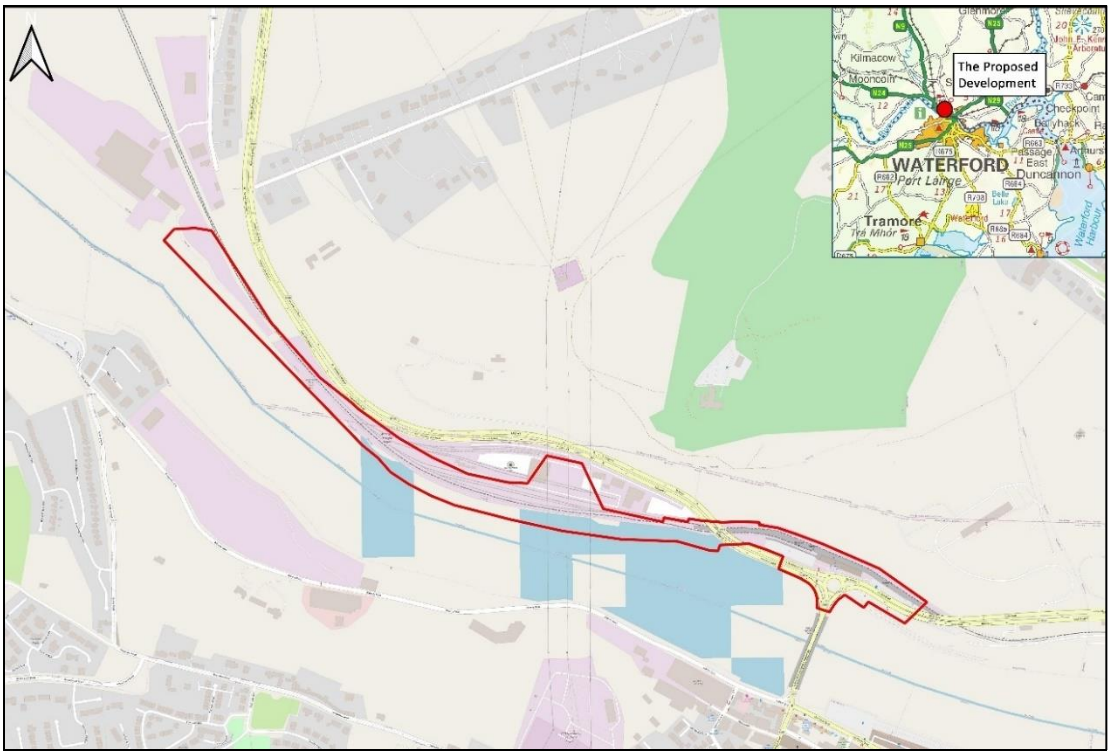


Plate 14.1 Location of the Proposed Development

14.1.1 Definitions

In order to assess, distil and present the findings of this assessment, the following definitions apply. 'Cultural Heritage' where used generically, is an over-arching term applied to describe any combination of archaeological and cultural heritage features, where –

- the term '*archaeological heritage*' is applied to objects, monuments, buildings or landscapes of an (assumed) age typically older than AD 1700 (and recorded as archaeological sites within the Record of Monuments and Places);
- the term '*cultural heritage*', where used specifically, is applied to other (often less tangible) aspects of the landscape such as historical events, folklore memories and cultural associations. This designation can also accompany an archaeological or architectural designation.

As assessment of the potential architectural heritage impacts is presented in Chapter 15 Archaeological Heritage of this EIAR.

14.1.2 Statutory Instruments and Guidance

In the first instance, the scope of the EIAR has been determined with regard to the statutory instruments and regulations relating to EIAR and related guidance from the European Union, the Government and the EPA. These include the following:-

14.1.2.1 EU Directives / Legislation

- The EU Directives on Environmental Impact Assessment (85/337/EEC as amended by 97/11/EC, 2003/35/EC, 2009/31/EC (codified in 2011/92/EU) and 2014/52/EU)
- The Planning and Development Act, 2000 (as amended)
- The Planning and Development Regulations, 2001 (as amended)
- National Monuments Acts, 1930-2014;

- The Planning and Development (Strategic Infrastructure) Bill, 2006;
- Heritage Act, 1995;
- Frameworks and Principles for the Protection of the Archaeological Heritage, 1999, (formerly) Department of Arts, Heritage, Gaeltacht and Islands;
- Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act, 2000 and the Local Government (Planning and Development) Act 2000;

14.1.2.2 EIA and related Guidance

- EPA, 2002, *Guidelines on the Information to be contained in Environmental Impact Statements*
- EPA, 2003, *Advice Notes on Current Practice in the preparation of Environmental Impact Statements*
- EPA, 2015, *Advice Notes for preparing Environmental Impact Statements* (Draft)
- EPA, 2017, *Guidelines on the Information to be contained in Environmental Impact Assessment Reports* (Draft)
- European Commission, 2017, *Environmental Impact Assessment of Projects - Guidance on the preparation of the Environmental Impact Assessment Report*
- DHPCLG, 2018, *Circular* PL05/2018 – *Transposition into Planning Law of Directive 2014/52/EU amending Directive 2011/92/EU on the effects of certain public and private projects on the environment (the EIA Directive) and Revised Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment.*
- DHPCLG, 2018, *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment.*
- DEHLG, 2003, *Environmental Impact Assessment (EIA) Guidance for Consent Authorities regarding Sub-threshold Development.*

The scope of the study is also informed by various other sources of relevance to the proper planning and sustainable development of the site.

14.1.3 Terminology

In accordance with the EPA Guidelines on the Information to be contained in Environmental Impact Statements (2002) and Advice Notes on Current Practice in the preparation of Environmental Impact Statements (2003), the descriptions in Table 14.1 are used in this EIAR to describe the effects on the environment.

These descriptions take account of updated Guidelines and Advice Notes prepared by the EPA in response to the 2014 EIA Directive, namely: - Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (2017) and Draft Advice Notes for preparing Environmental Impact Statements (2015): -

Table 14.1 Description of Effects

The quality of the effects is defined as:-	
Positive effects	A change which improves the quality of the environment (e.g. by increasing species diversity; or the improving reproductive capacity of an ecosystem, or removing nuisances or improving amenities).
Negative effects	A change which reduces the quality of the environment (e.g. lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health *or* property or by causing nuisance).
Neutral effects	A change which does not affect the quality of the environment.
The significance of the effects is described as:-	
Imperceptible	An effect capable of measurement but without significant consequences.
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound effects	An effect which obliterates sensitive characteristics.
The magnitude of the effect is, where appropriate, indicated as:-	
Extent	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
Duration	Describe the period of time over which the effect will occur. (See further detail below)
Frequency	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)
Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
The probability of the effect is, where appropriate, indicated as:-	
Likely Effects	The effects that can reasonably be expected to occur as a result of the planned project if all mitigation measures are properly implemented.
Unlikely Effects	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
The duration of the effect is, where appropriate, indicated as:-	
Momentary Effects	Effects lasting from seconds to minutes
Brief Effects	Effects lasting less than a day
Temporary Effects	Effects lasting for less than a year
Short-term Effects	Effects lasting one to seven years.
Medium-term Effects	Effects lasting seven to fifteen years.
Long-term Effects	Effects lasting fifteen to sixty years.

The quality of the effects is defined as:-	
Permanent Effects	Effects lasting over sixty years.
Reversible Effects	Effects that can be undone, for example through remediation or restoration
The type of effect is described, where appropriate, as:-	
Cumulative Effects	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.
Do-nothing Effects	The environment as it would be in the future should the subject project not be carried out.
Indeterminable Effects	When the full consequences of a change in the environment cannot be described.
Irreversible Effects	When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.
Residual Effects	The degree of environmental change that will occur *after* the proposed mitigation measures have taken effect.
Worst-case Effects	The impacts arising from a development in the case where mitigation measures substantially fail.
Synergistic Effects	Where the resultant effect is of greater significance than the sum of its constituents, (e.g. combination of SOx and NOx to produce smog).
Indirect Effects	Impacts on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
Secondary Effects	Effects that arise as a consequence of a project (a new waste water treatment plant will reduce the yield of mussels in a nearby estuary).

14.1.4 Consultation

Following the initial research, a number of statutory and voluntary bodies were consulted to gain further insight into the cultural background of the baseline environment, receiving environment and study area, as follows:

- Department of Housing, Local Government and Heritage – the Heritage Service, National Monuments and Historic Properties Section: Record of Monuments and Places; Sites and Monuments Record; Shipwreck Inventory, Monuments in State Care Database; Preservation Orders and Register of Historic Monuments;
- National Museum of Ireland, Irish Antiquities Division: topographical files of Ireland;
- Waterford City and County Council: Planning Section; and
- Historical and Ordnance Survey Maps.

14.1.5 Methodology

Research for this chapter was undertaken in two phases. The first phase comprised a paper survey of all available archaeological, historical and cartographic sources. The second phase involved a field inspection of the site.

14.1.6 Paper Survey

The following databases were reviewed as part of the paper survey to determine any existing records relating to the development site:

- Record of Monuments and Places for Counties Waterford and Kilkenny;
- Sites and Monuments Record for Counties Waterford and Kilkenny;
- National Monuments in State Care Database;
- Preservation Orders List;
- Register of Historic Monuments;
- Shipwreck Inventory of Ireland;
- Topographical files of the National Museum of Ireland;
- Cartographic and written sources relating to the study area;
- Waterford City Development Plan 2013–2019 (as extended);
- Kilkenny County Development Plan 2014-2020;
- Aerial photographs; and
- Excavations Bulletin (1970–2020);

Record of Monuments and Places (RMP) is a list of archaeological sites known to the National Monuments Service, which are afforded legal protection under Section 12 of the 1994 National Monuments Act and are published as a record.

Sites and Monuments Record (SMR) holds documentary evidence and field inspections of all known archaeological sites and monuments. Some information is also held about archaeological sites and monuments whose precise location is not known e.g. only a site type and townland are recorded. These are known to the National Monuments Section as 'un-located sites' and cannot be afforded legal protection due to lack of locational information. As a result, these are omitted from the Record of Monuments and Places. SMR sites, which also includes records of previous archaeological investigations, are listed on a website maintained by the Department of Housing, Local Government and Heritage (DoHLGH) – www.archaeology.ie.

National Monuments in State Care Database is a list of all the National Monuments in State guardianship or ownership. Each is assigned a National Monument number whether in guardianship or ownership and has a brief description of the remains of each Monument.

The Minister for the Department of Housing, Local Government and Heritage (DoHLGH) may acquire national monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister.

Preservation Orders List contains information on Preservation Orders and/or Temporary Preservation Orders, which have been assigned to a site or sites. Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Register of Historic Monuments was established under Section 5 of the 1987 National Monuments Act which requires the Minister to establish and maintain such a record. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places.

Shipwreck Inventory of Ireland contains information gathered from a broad range of cartographic, archaeological and documentary sources, and each entry in the Inventory gives information on the ship's name, type of vessel, port of origin, owner's name, cargo, date of loss and other relevant information where available.

The topographical files of the National Museum of Ireland are the national archive of all known finds recorded by the National Museum. This archive relates primarily to artefacts but also includes references to monuments and unique records of previous excavations. The find spots of artefacts are important sources of information on the discovery of sites of archaeological significance.

Cartographic sources are important in tracing land use development within the development area as well as providing important topographical information on areas of archaeological potential and the development of buildings. Cartographic analysis of all relevant maps has been made to identify any topographical anomalies or structures that no longer remain within the landscape. The following sources have been reviewed:

- William Petty's Down Survey, Map of the Barony of Ida Igrin Ibercon, c. 1655;
- William Richards and Bernard Scale's Plan of the City and Suburbs of Waterford, 1764;
- Nicholas Sinnott's Map of Waterford, 1830;
- Patrick Leahy's Map of the city of Waterford and its environs..., 1834; and
- Ordnance Survey Mapping 1839-1953.

Documentary sources were consulted to gain background information on the archaeological and cultural heritage landscape of the proposed development area.

Development Plans contain a catalogue of all the Protected Structures and archaeological and architectural sites within the counties of Waterford and Kilkenny. The Waterford City and County Development Plan 2013–2019 (as extended) and the Kilkenny County Development Plan 2014-2020 were consulted to obtain information on cultural heritage sites in and within the immediate vicinity of the proposed development area.

Aerial photographic coverage is an important source of information regarding the precise location of sites and their extent. It also provides initial information on the terrain and its likely potential for archaeology. A number of sources were consulted including aerial photographs held by the Ordnance Survey, Google Earth and Bing Maps.

Excavations Bulletin is a summary publication that has been produced every year since 1970. The hard copy publication summarises every archaeological excavation that has taken place in Ireland during that year up until 2010 and since 1987 has been edited by Isabel Bennett. This information is vital when examining the archaeological content of any area, which may not have been recorded under the SMR and RMP files.

This information is also available within an online database (www.excavations.ie) that covers the years from 1970–2020.

14.1.7 Field Inspection

Field inspection is necessary to determine the extent and nature of archaeological and historical remains, and can also lead to the identification of previously unrecorded or suspected sites and portable finds through topographical observation and local information.

The archaeological field inspection was carried out on the 15th of March 2021. Access to the landward side of the development (adjacent to the River Suir) was not possible due to the presence of a live railway track. As such, that section of the inspection was carried out from a boat on the River Suir. The remaining landward sections of the development were inspected on foot. The field inspection entailed -

- Walking the proposed development area and its immediate environs.
- Noting and recording the terrain type and land usage.
- Noting and recording the presence of features of archaeological or historical significance.
- Verifying the extent and condition of any recorded sites.
- Visually investigating any suspect landscape anomalies to determine the possibility of their being anthropogenic in origin.

14.2 Description of the Receiving Environment

14.2.1 Archaeological and Historical Background

The proposed development is located along the northern edge of the River Suir, in the townlands of Newrath, County Kilkenny and Mountmisery, County Waterford. A small section of Newrath is also located within County Waterford, due to a slight change in the county boundary at the end of the 19th century. There are no recorded monuments within the site boundary of the proposed development. There are five sites proposed for inclusion in the next revision of the RMP within 200m of the proposed development, including a mound (WA009-017003), two standing stones (WA009-017001/2) and two *fulachtaí fia* (KK046-006004/5) (Plate 14.2). It should be noted that archaeological monitoring of vegetation clearance and of site investigations was carried out at the site of the mound (WA009-017003) and two standing stones (WA009-017001/2) in 2019 as part of a rock stabilisation project. No evidence of any of the sites was identified during the course of these works (Licence 19E0027, Bennett 2019:465).

The zone of archaeological potential associated with the historic settlement of Waterford City, which is a recorded monument, is located c. 260m south of the proposed development.

Whilst the Shipwreck Inventory provides a record of wrecking incidents since 1750, it is not a comprehensive record for earlier events, and therefore the medieval and prehistoric periods are not represented in this archive. Numerous shipwrecks are listed for the coastal water surrounding the Port of Waterford. However, none are listed for the specific area under assessment.

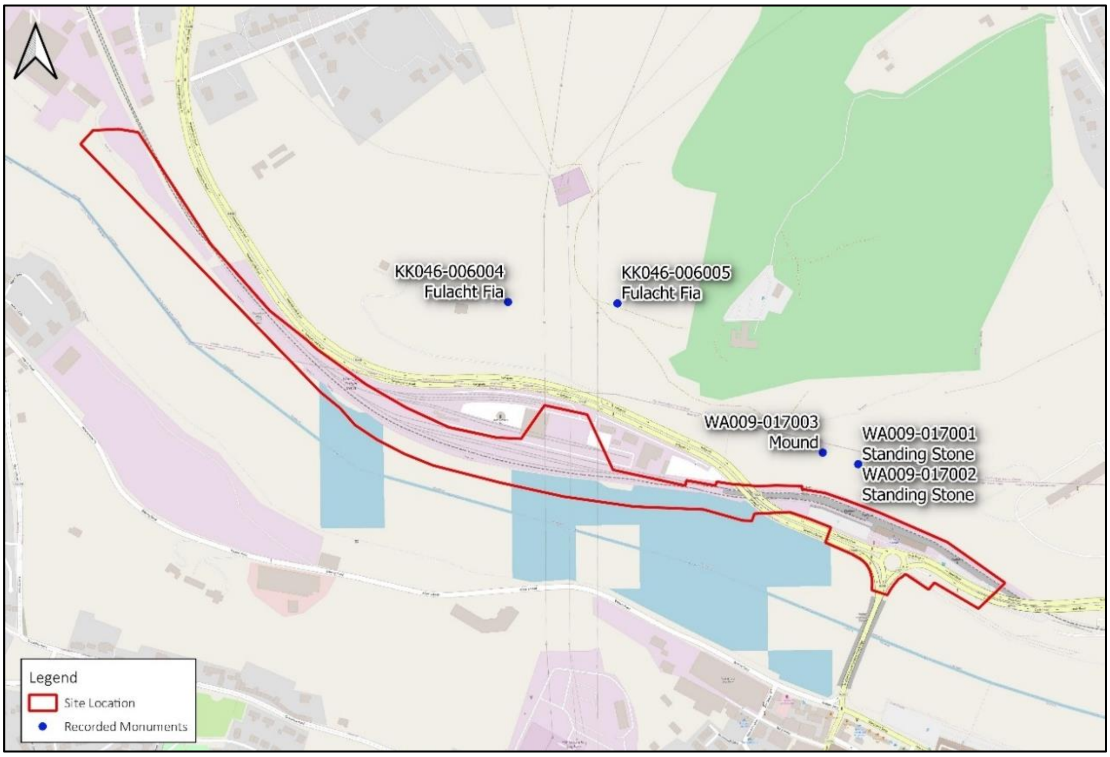


Plate 14.2 Archaeological sites within 200m of the proposed development

14.2.1.1 Prehistoric Period (6000 BC – AD 400)

Although recent discoveries may push back the date of human activity by a number of millennia (Dowd and Carden 2016), the Mesolithic period is the earliest time for which there is clear and widespread evidence of prehistoric activity in Ireland (6000-4000 BC). During this period people hunted, foraged and gathered food and appear to have had a mobile lifestyle. Evidence of settlement during this period is rare, although Mesolithic deposits are typically found within riverine and coastal areas. The first evidence of human occupation in the Waterford area dates to the Mesolithic Period, as seen by the large quantities of Late Mesolithic implements, around 5000 BC, found during the Bally Lough project (Zvelebil et al. 1996). The River Suir would have been an excellent resource for people to utilise in terms of food, water and transport during the prehistoric period.

During the Neolithic period (4000–2500 BC) communities became less mobile and their economy became based on the rearing of stock and cereal cultivation. This transition was accompanied by major social change. Agriculture demanded an altering of the physical landscape. Forests were cleared and field boundaries constructed. There was a greater concern for territory, which contributed to the construction of large communal burial monuments called megalithic tombs, which are characteristic of the period. A number of Neolithic tombs are located in the vicinity of Waterford City, such as the portal tomb (WA017-016) located at Ballindud, c. 4.2km to the south and a megalithic structure (WA018-004), located at Ballygunnertemple, c. 5.1km to the southeast. An excavation c. 550m to the west of the proposed development discovered a pit containing a polished stone axehead of Neolithic date (Bennett 2003:1039).

The Bronze Age in Ireland (2500–800 BC) was marked by the use and production of metal for the first time. As with the transition from Mesolithic to Neolithic, the transition into the early Bronze Age was accompanied by changes in society. The megalithic tomb tradition gradually diminished and was replaced by a focus on the individual in mortuary practice, with subterranean cist or pit burials that were either in isolation or in small cemeteries becoming common. These burials contained inhumed or cremated remains and were often, but not always, accompanied by a pottery vessel. Settlement traces from the Bronze Age are plentiful in the area surrounding Waterford City. There are two standing stones (WA009-017001/2) of possible Bronze Age origin recorded c. 60m north of the eastern section of the proposed development (see Plate 14.2). Although these sites were recorded by the NMS in 1998, a subsequent visit in 2010 found no evidence of the features, and recent archaeological monitoring at the site failed to identify any trace of the monuments (Licence 19E0027, Bennett 2019:465). A bronze axehead recorded in the National Museum was found in 1836 in 'the suburbs of Waterford'.

The most common Bronze Age site within the archaeological record is the burnt mound or *fulacht fia*. The term fulacht or *fulacht fia* is found in early Irish literature from at least the 9th century AD and refers to open air cooking places. Thousands of *fulachta fia* have been recorded in the country making them the most common prehistoric monument in Ireland (Waddell 1998). Although they may have functioned as cooking sites in some cases, many date to the Bronze Age indicating that they significantly predate the cooking sites referred to in early Irish literature (Brindley & Lanting 1990). There are a large number of recorded burnt mounds and *fulachta fia* located within the landscape surrounding Waterford city, two of which are located within the study area of the proposed development (KK046-006004/5) as illustrated in Plate 14.2.

There is increasing evidence for Iron Age (800 BC–AD 500) settlement and activity in recent years as a result of development-led excavations as well as projects such as LIARI (Late Iron Age and Roman Ireland). Yet this period is distinguished from the rather rich material remains of preceding Bronze Age and subsequent early medieval period by a relative paucity of evidence for material culture in Ireland. The Iron Age had traditionally been associated with the arrival of the Celts and the Celtic language in Ireland. The Celts were an Indo-European group who are thought to have originated probably in east-central Europe in the 2nd millennium BC. They were among the earliest to develop an Iron Age culture, as has been found at Hallstatt, Austria (c. 700 BC).

The available evidence suggests that large defensive structures and earthworks known as promontory or hill forts were characteristic of the period. The former is a banked and ditched structure located above a steep cliff or bluff and often found in coastal areas. The hill fort or hill top enclosures are very interesting in that they are frequently multi-period in date. As a result, their dating is problematic but there appears to be some consensus that their peak use and greatest extents are dated to the Iron Age (Raftery 1994). There is no recorded evidence of Iron Age activity in the vicinity of the proposed development.

14.2.1.2 Early Medieval Period (AD 500–1169)

The foundation of Waterford as a city dates to the Viking Age when the city stretched along the waterfront between Barronstrand Street and The Mall. The earliest date for the city itself is generally accepted as c. AD 912-33. Waterford began as a defended Viking longphort or ship-fortress and became Ireland's second city after Dublin. The original name, *Vedrarfjordr* is an Old Norse name likely meaning 'windy fiord'. Its great parchment book (1361–1649) represents the earliest use of the English language in Ireland for official purposes and demonstrates the importance of the city as the regionally pre-eminent port in the medieval period. The town developed from an early fort at Reginald's Tower, along the ridge of high ground which eventually became High Street and Peter Street. It was laid out in a regular, chequered street pattern. Excavations at the western limit of the early town at Bakehouse Lane indicate the earliest fortifications comprised an earthen bank, constructed from the spoil of a deep moat-like ditch topped by a wooden palisade. Later during the 12th century, just before the Anglo-Norman invasion, the bank was fortified further by a stone wall. Material dated from underneath this bank gave an approximate date of between AD 898 and 920 (Scully, unpublished).

The proposed development is located along the northern bank of the river, 675m to the northwest of the Viking settlement.

14.2.1.3 Medieval Period (AD 1169–1600)

In 1170, Waterford City was captured by Anglo-Norman forces led by Richard de Clare, known as 'Strongbow', and Dermot McMurrough, King of Leinster. King Henry II landed there the following year and received the submissions of the kings of Desmond and Thomond (Bradley & Halpin 1992). Waterford was retained by the Crown as a royal city and under this royal patronage it developed into one of the most important and prosperous towns in medieval Ireland. Waterford continued to thrive and prosper and between 1224 and 1246 three murage grants were given to Waterford to increase the walled area of the city and to accommodate the growing population which had reached the height of its power by the early 14th century under the reign of King Edward I (McEneaney 2001, 23). Following the arrival of the Normans the city expanded westwards, presenting a longer frontage to the river.

During the 13th and 14th centuries, Waterford and New Ross accounted for more than half of all Irish trade (*ibid*.). Trade rivalry between these two towns continued from the 13th to the 16th century. Waterford was involved in the trading of wine with Bordeaux, including acting as an entrepot, such as in 1300 when 3000 hogsheads of wine were re-exported to supply King Edward I's army in Scotland (Barry 1995) as well as with towns such as Southampton, Chester and Bristol.

The medieval period was also characterised by the foundation of a large number of ecclesiastical sites throughout Ireland in the centuries following the introduction of Christianity in the 5th century AD. These early churches tended to be constructed of wood or post-and-wattle. Between the late 8th and 10th centuries, mortared stone churches gradually replaced the earlier structures. Many of the sites, some of which were monastic foundations, were originally defined by an enclosing wall or bank. In addition to the cathedral, there were seven parish churches in Waterford city. On the north bank of the River Suir is the site of the parish church of Kilculliheen (WA009-008), dating to 1151, located c. 1km to the southeast of the proposed development. This is likely to have been an Arroasian convent founded as a priory of St Mary de Hogges (Dublin) by Dermot Mac Murrough, becoming an abbey in 1257.

14.2.1.4 Post-Medieval Period (Ad 1600–1900)

Waterford remained the second city in Ireland throughout the 16th century, due to a flourishing trade industry. This declined by the end of the century due to the curtailment of trade with Spain and the situation worsened during the religious and social upheavals of the 17th century. The city was later revived by a new quay construction in the early 18th century, which involved the demolition of waterfront fortifications and half-timbered houses in the area. This was undertaken during the mayoralty of David Lewis Esq.; Ryland states that '*the quay was greatly enlarged, by throwing down the town walls. He also threw down Baron-strand gate; filled the great ditch, which then joined that gate and the town wall; and made a communication between the old quay and the new. The present quay and several of the fine buildings on it, including the exchange, were commenced in his time'* (Ryland 1824, 178-9). By the mid-18th century, the south quays stretched along the full length of the city's river frontage, from Reginald's Tower and The Mall in the east, to the Graving Bank in the west, around the site of the present Grattan Quay.

The improved quay allowed for trade with North America as well as with England and the Continent. Up to the end of the 18th century the ferry across the river was also extremely important to Waterford, as there was no bridge over the River Suir. The closest bridging point on the river being Carrick-on-Suir, c. 30km upstream. The 300m width of the river presented a major problem in terms of bridge construction until the end of the 18th century when Lemuel Cox, designed and constructed a timber trestle bridge that was completed in January 1794 and survived more than a century until it was replaced by a ferro-concrete bridge in 1910. This, in turn, was replaced by the present bridge, the Edmund Rice Bridge. The bridge greatly improved communications with the northern hinterland of Waterford including the landscape containing the proposed development, which had been hitherto cut off from the bustling city to the south.

The period of economic depression that followed the Napoleonic wars led to a collapse of trade in some sectors. The city became industrialised with the development of steam power and the advent of railway, with as many as six lines into and out of the city. By the opening years of the 20th century the most significant change along the northern bank of the Suir was the arrival of the railway. Waterford had received its first railway connection in 1854 with the opening of a line to Kilkenny by the Waterford and Kilkenny Railway Company and another to Limerick by the Waterford and Limerick Railway Company. These lines terminated to the west of Waterford Bridge and the station on the present site opened in 1864. A siding was constructed to Ferrybank in 1883 to serve Hall's Flour Mills and in 1904 the main line was continued through Ferrybank and onward to New Ross, while a second line opened to Rosslare in 1906. Today, the active railway line to Limerick and Plunkett Station are located to the immediate north of the proposed flood defences, the purpose of which is to prevent flooding along the railway track.

14.2.1.5 Summary of Previous Archaeological Fieldwork

A review of the Excavations Bulletin (1970-2020) revealed no previous archaeological investigations have been carried out within the proposed development boundary to date.

Archaeological monitoring of vegetation clearance and of site investigations was carried out at the site of a mound (WA009-017003) and two standing stones (WA009-017001/2) recorded in 1998, as part of a rock stabilisation project. The site had been revisited by the National Monuments Service in 2010 and no evidence of the recorded monuments was located at that time. While monitoring encountered some small recumbent erratics, none of these correlated to the dimensions of the standing stones recorded earlier (Licence 19E0027, Bennett 2019:465).

Archaeological test trenching was undertaken c. 175m to the northeast of the proposed development for a large mixed-use development known as Waterford City Quays at the time of the works (Licence 09E0030). A total of 19 trenches were excavated but no archaeology was found (Bennett 2009:504).

In 2018 an underwater assessment was carried out within the River Suir, from the north quays to the immediate east of the proposed development and the existing Edmund Rice Bridge for the River Suir Sustainable Transport Bridge (O'Donoghue and McCarthy, 2018, Licence Refs: 18R0180, 18D0108). This section of the north quay is characterised by a 540m long concrete quay comprising concrete decking, supported on concrete piles. It is protected by fenders consisting of wooden vertical piles and horizonal braces. The quay is in a state of disrepair and in particular the wooden fenders are considerably degraded. Behind this concrete quay are the remains of an earlier stone quay wall extending east for c. 480m from the bridge. The stone quay measures between 2.1m and 2.8m in height above the adjacent riverbed. It is constructed from coursed squared limestone blocks and contains multiple culverts and iron mooring rings. Some of the original timber fenders survive albeit in a very poor state of preservation. Multiple repairs and rebuilding phases are visible on the quay wall.

14.2.2 Cartographic Analysis

14.2.2.1 William Petty's Down Survey, Map of the Barony of Ida Igrin Ibercon c. 1655 (Plate 14.3)

The approximate study area for the proposed development is shown on Plate 14.3 by a red box, the northern bank of the River Suir, to the north of the City and Liberties of Waterford. No structures or features of archaeological potential are shown. A gibbet (KK046-007) recorded in the RMP to the north is marked on the boundary of Rathnew and Kilculliheen. Five houses and the parish church of Kilculliheen and abbey remains (WA009-008) are depicted to the east of the proposed development.

Plate 14.3 **Extract from Down Survey of c. 1655 showing the approximate location of the proposed development**

14.2.2.2 William Richards and Bernard Scale's Plan of the City and Suburbs of Waterford, 1764 (Plate 14.4)

This historic map depicts the city and suburbs of Waterford, including a narrow section of the northern bank within the margin. No bridge is shown crossing the River Suir although a ferry boat slip is marked on the south bank directly opposite Ferrybank. Very little of the northern bank is depicted, though a small settlement is shown at Mount Sion and Ferrybank to the east of the proposed development. The area of the proposed development, where it is shown, remains undeveloped and lies in open fields.

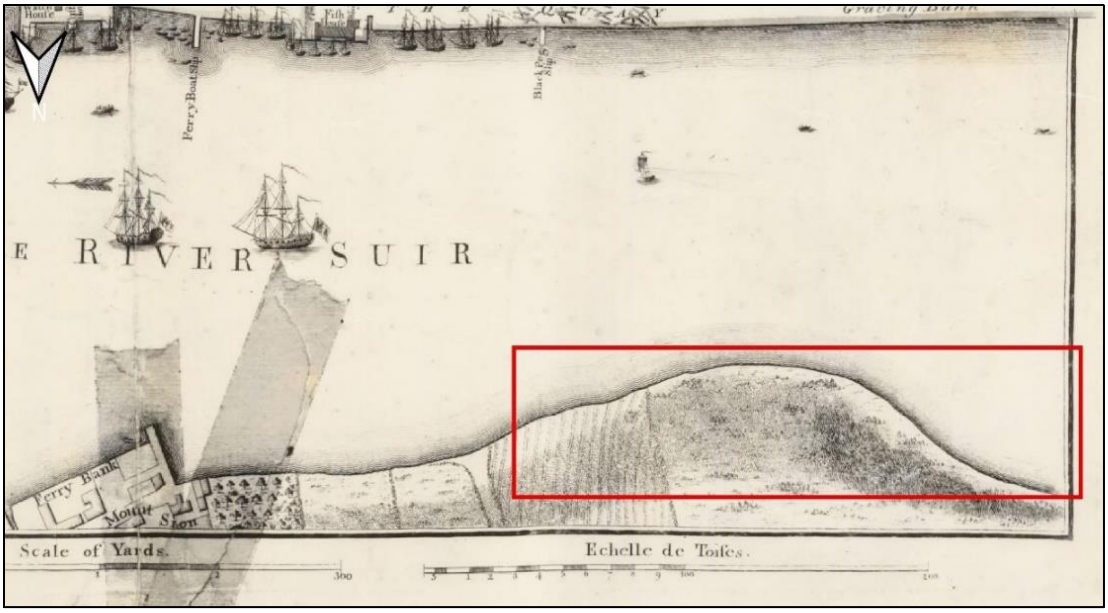


Plate 14.4 **Extract from Richards and Scale map of 1764 showing the approximate location of the proposed development**

14.2.2.3 Nicholas Sinnott's Map of Waterford, 1830 (Plate 14.5)

By this time, the wooden bridge has been constructed across the river in the approximate location of the current bridge. A road is now shown running west–east parallel with the river, along the route of the modern R711 and R448. To the north of the bridge a semi-circular scarped area appears to indicate a former quarry. The quayside to the east has been developed with numerous warehouses and storehouses indicated on the approach to Ferrybank. A number of structures are also indicated in the vicinity of the northern side of the bridge which would be within the proposed development boundary.

Plate 14.5 **Extract from Sinnott's map of 1830 showing the approximate location of the proposed development**

14.2.2.4 Patrick Leahy's Map of the city of Waterford and its environs..., 1834

There are no major changes to the area of the proposed development by this mapping, which was published only four years later.

14.2.2.5 First Edition Ordnance Survey Map, 1839-41, scale 1:10,560

The study area extends through the townlands of Mountmisery and Newrath. At this time the wooden bridge is shown with a Toll Gate marked on the northern bank of the River Suir. A group of structures are depicted in the immediate vicinity of the bridge's northern extent. The small demesne of Mountmisery Lodge is depicted to the immediate northeast of the proposed development. Newrath House is also shown with a short laneway leading to the main roadway.

The northern bank of the river within the proposed development does not follow the edge of the quays as present today, suggesting that the quay edge was not established until the construction of the railways and siding, which is first mapped in later OS mapping (Plates 14.7a/b below).

14.2.2.6 Ordnance Survey Map, 1871, scale 1:1,250 (Plate 14.6)

Only a small portion of the eastern part of the proposed development is depicted on this map. The wooden bridge across the Suir is depicted with a central draw bridge. On the northern bank, the Waterford and Limerick Railway Terminus has been established within the proposed development boundary, with the rail lines extending westwards. A number of terraced structures are shown lining the north of Dock Road and Terminus Street. The landscaped gardens of Knockane Villa (formerly Mountmisery Lodge) are shown to the northeast.

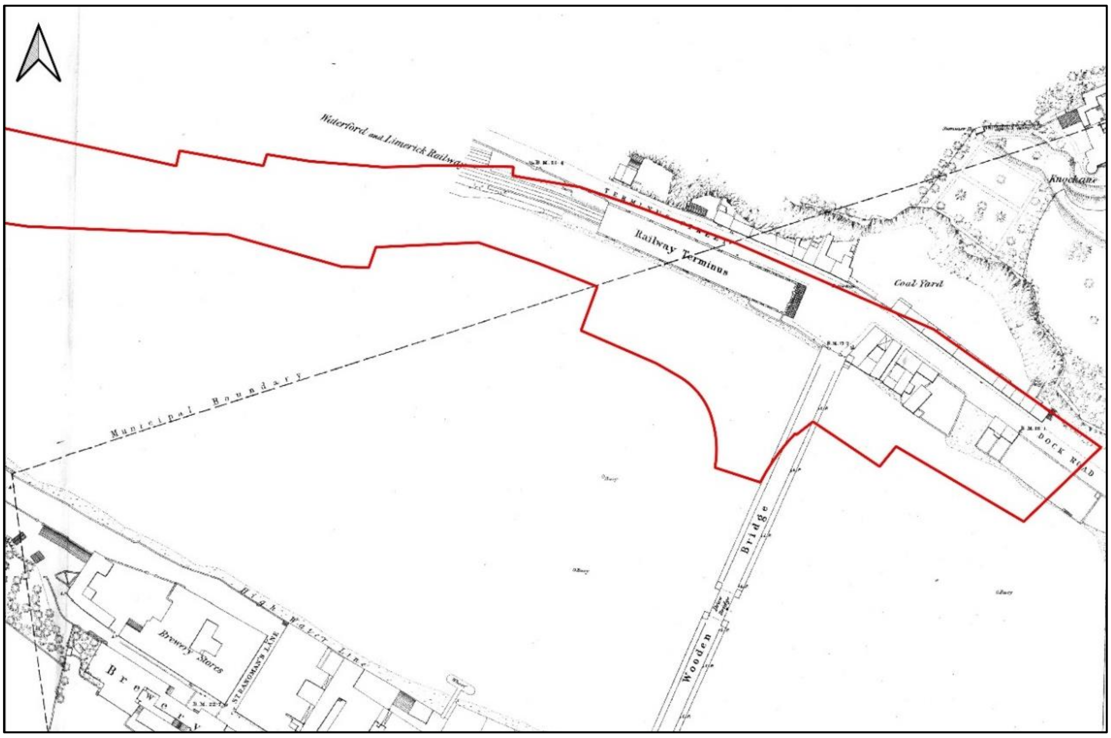


Plate 14.6 **Extract from OS map of 1871 showing the eastern section of the proposed development**

14.2.2.7 Ordnance Survey Map, 1903/1907, scale 1:2,500 (Plate 14.7a/b)

As noted above, by the time of this mapping, the railway to the north of the proposed development area has expanded significantly. Within the eastern section of the proposed development site, Plunkett Station is at this time known as 'Waterford North

Station' and is shown with a number of platforms to the north of the wooden bridge across the Suir. Ten landing stages are depicted along the river's edge to the west and a number of Goods Sheds, platforms and turn tables are shown to the west of the main station. Newrath House is depicted with two small laneways leading south and southwest to the main road. Knockane Villa (formerly Mountmisery Lodge) is also shown to the northeast. The Newrath Road appears to cross the railway via a bridge.

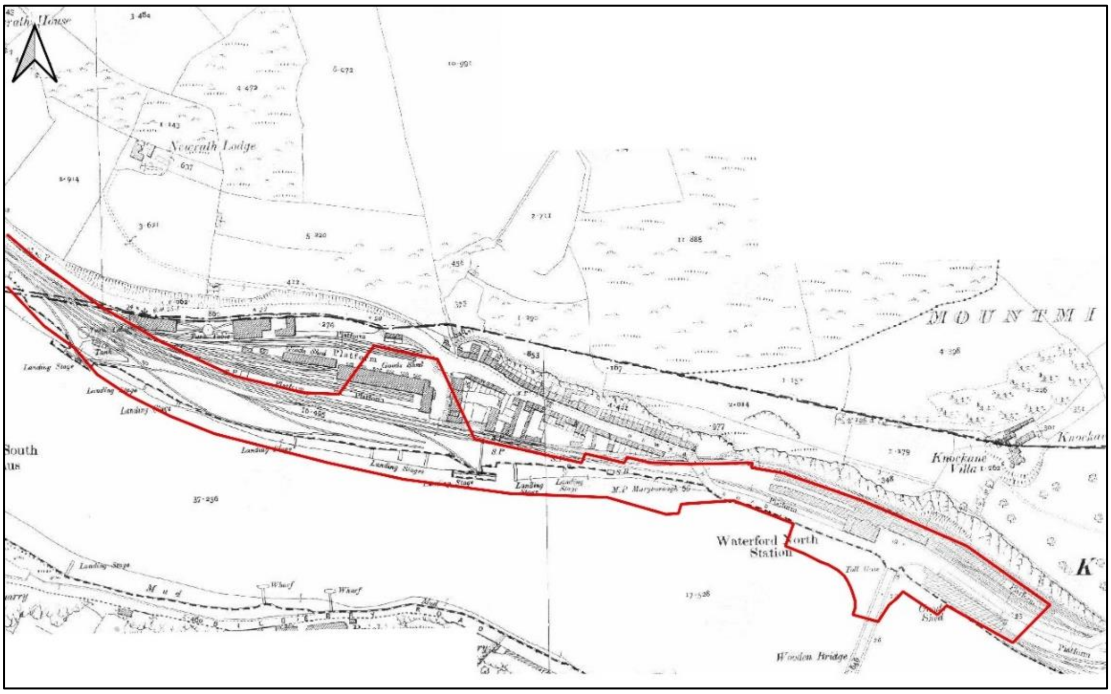


Plate 14.7a **Extract from OS map of 1903/7 showing the east of the proposed development**

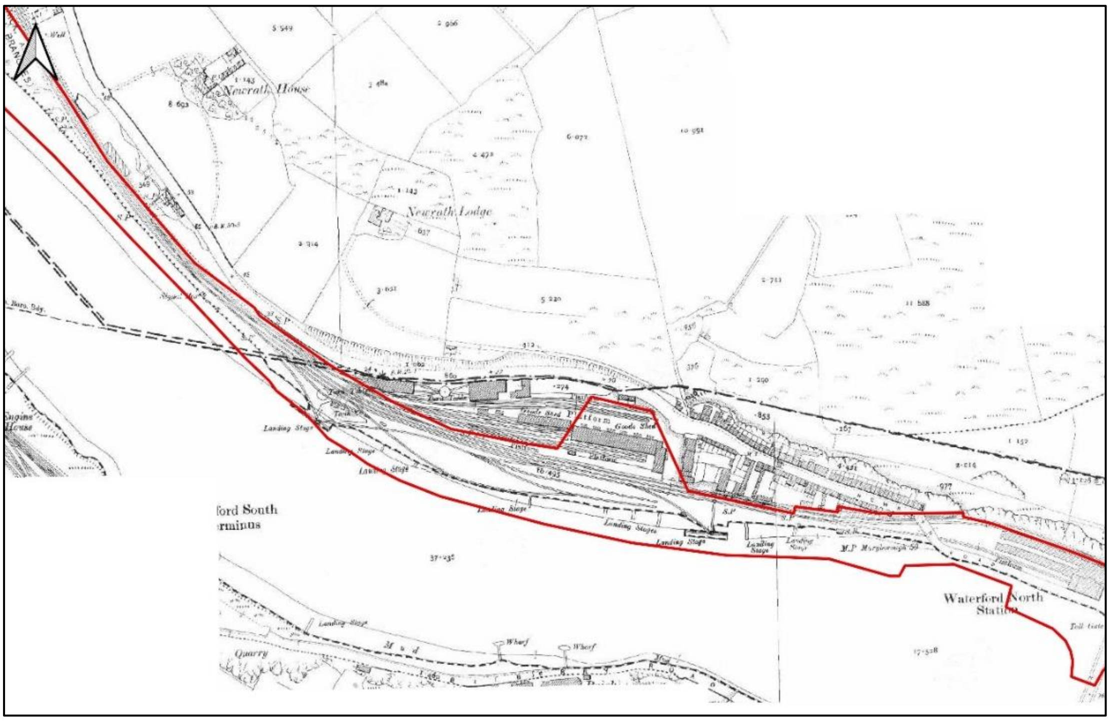


Plate 14.7b **Extract from OS map of 1903/7 showing the west of the proposed development**

14.2.2.8 Ordnance Survey Map, 1909, scale 1:1,250 (Plate 14.8)

Only a portion of the eastern part of the proposed development is shown on this mapping of 1909. 'Waterford North Station' is shown with a number of platforms. A signal box is shown for the first time. A number of slips, wharfs and landing stages are depicted extending into the River Suir from the north bank of the river. Knockane Villa (formerly Mountmisery Lodge) is again depicted to the northeast. There are no major changes to note within the mapping.

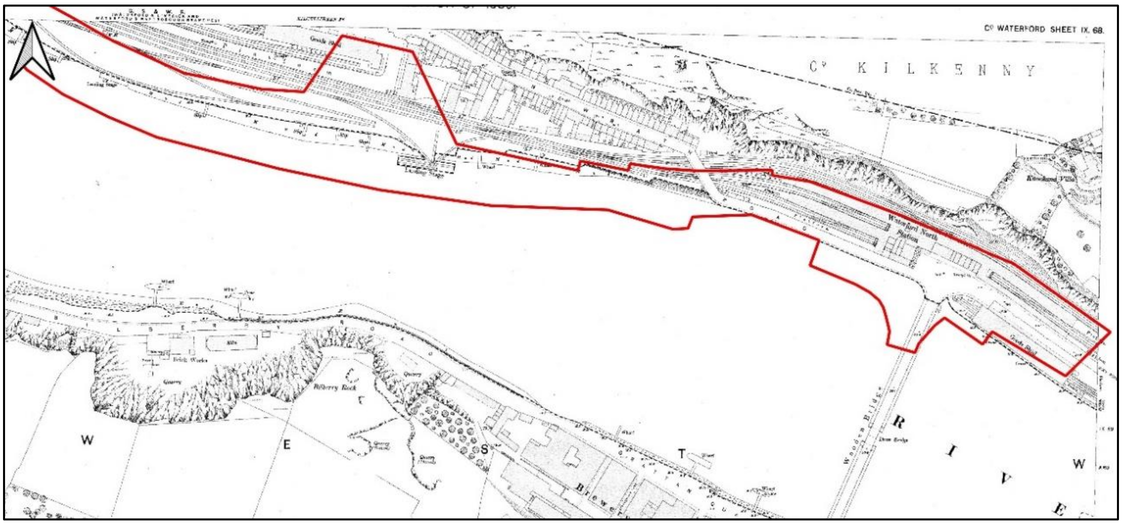


Plate 14.8 Extract from OS map of 1909 showing the eastern part of the proposed development

14.2.2.9 Third Edition Ordnance Survey Map, 1953, scale 1:10,560

There is little change to the railway structures within the proposed development boundary by the time of this map. To the west of the proposed development a Manure Works has been established. Only two of the landing stages formerly located within the proposed development site remain depicted within this mapping.

14.2.3 Development Plans

14.2.3.1 Archaeological Heritage

The Waterford City Development Plan (2013–2019- as extended) and the Kilkenny County Development Plan (2014-2020) recognise the statutory protection afforded to all recorded monuments under the National Monuments Legislation (1930–2014). The policies and objectives relating to archaeology are included in Appendix 14.2, whilst the sites themselves are described in Appendix 14.1.

There are no recorded monuments within the proposed development boundary . There are five archaeological sites proposed for inclusion in the next revision of the RMP within 200m of the development (Table 14.2). None of these sites are National Monuments in State Care or subject to a Preservation Order.

Table 14.2 Recorded Monuments within 200m of the proposed development

RMP/SMR No.	Location	Classification	Distance from development
WA009-017002	Mountmisery, Waterford	Standing stone	c. 60m north
WA009-017001	Mountmisery, Waterford	Standing stone	c. 60m north

RMP/SMR No.	Location	Classification	Distance from development
WA009-017003	Mountmisery, Waterford	Mound	c. 63m north
KK046-006004	Newrath, Kilkenny	*Fulacht fia*	c. 174m north
KK046-006005	Newrath, Kilkenny	*Fulacht fia*	c. 178m north

14.2.4 Aerial Photographic Analysis

Inspection of the aerial photographic coverage of the proposed development held by the Ordnance Survey (1995-2013), Google Earth (2008-2020) and Bing Maps (2021) did not reveal any previously unknown archaeological features due to the built-up nature of the site. The extensive railway features occupy a large portion of the proposed development and its immediate environs. The construction of the Newrath Link Road can be seen in the satellite imagery.

14.2.5 Topographical Files of National Museum of Ireland

Information on artefact finds from the study area in Counties Waterford and Kilkenny has been recorded by the National Museum of Ireland since the late 18th century. Location information relating to these finds is important in establishing prehistoric and historic activity in the study area.

A review of the Topographical Files held by the National Museum of Ireland revealed that no stray finds have been recorded within the proposed development or its immediate environs.

14.2.6 Cultural Heritage

The term 'cultural heritage' can be used as an over-arching term that can be applied to both archaeology and architectural; however, it also refers to more ephemeral aspects of the environment, which are often recorded in folk law or tradition or possibly date to a more recent period. There are no specific sites of cultural heritage significance within the study area of the proposed development area, however the archaeological sites discussed above, along with the later 19th century railway infrastructure are of cultural heritage significance. This is further added to by the townlands and placename analysis detailed below.

14.2.6.1 Townlands

The townland is an Irish land unit of considerable longevity as many of the units are likely to represent much earlier land divisions. However, the term townland was not used to denote a unit of land until the Civil Survey of 1654. It bears no relation to the modern word 'town' but like the Irish word *baile* refers to a place. It is possible that the word is derived from the Old English *tun land* and meant 'the land forming an estate or manor' (Culleton 1999, 174).

Prior to the Anglo-Norman invasion of Ireland, Ireland was made up of numerous small territories and kingdoms with frequent conflicts between these groups. Gaelic land ownership required a clear definition of the territories held by each group and a need for strong, permanent fences around their territories. It is possible that boundaries following ridge tops, streams or bog are more likely to be older in date than those composed of straight lines (*ibid.* 179).

The vast majority of townlands are referred to in the 17th century, when land documentation records begin. Many of the townlands are mapped within the Down Survey of the 1650s, so called as all measurements were carefully 'laid downe' on paper at a scale of forty perches to one inch. Therefore, most are in the context of pre-17th century landscape organisation (McErlean 1983, 315).

In the 19th century, some demesnes, deer parks or large farms were given townland status during the Ordnance Survey and some imprecise townland boundaries in areas such as bogs or lakes, were given more precise definition (*ibid.*). Larger tracks of land were divided into a number of townlands, and named Upper, Middle or Lower, as well as Beg and More (small and large) and north, east, south, and west (Culleton 1999, 179). By the time the first Ordnance Survey had been completed a total of 62,000 townlands were recorded in Ireland.

The proposed development is located within the townlands of Mountmisery, County Waterford and Newrath, County Kilkenny. The townland boundary within the proposed development boundary has long since been removed to facilitate the development of the railway. The county boundary between Kilkenny to the north and Waterford to the south also passes through the proposed development boundary; however, in this case, the boundary is not a physical boundary. It should be noted that the county boundary was slightly altered in the late 19th century, meaning that a small section of Newrath townland is now in County Waterford.

14.2.6.2 Toponomy of Placenames

Townland and topographic names are an invaluable source of information on topography, land ownership and land use within the landscape. They also provide information on history; archaeological monuments and folklore of an area. A place name may refer to a long-forgotten site and may indicate the possibility that the remains of certain sites may still survive below the ground surface. The Ordnance Survey surveyors wrote down townland names in the 1830's and 1840's, when the entire country was mapped for the first time. Some of the townland names in the study area are of Irish origin and through time have been anglicised. The main references used for the place name analysis are *Irish Local Names Explained* by P.W Joyce (1870) and www.logainm.ie. A description and possible explanation of each townland name in the environs of the proposed development are provided in the below table.

Table 14.3 Placename Analysis

Townlands	Derivation	Possible Meaning
Mountmisery	Unclear but may relate to the site of a gibbet on the townland boundary (KK046-007)	-
Newrath	An Ráth Nua	The new ringfort
Kilculliheen	Cill Choilchín	Church of Coilchín

14.2.7 Results of Field Inspection

The field inspection sought to assess the site, its previous and current land use, the topography and any additional information relevant to the report. Access to the landside of the proposed development was not possible due to the presence of live railway tracks. Due to current Covid-19 restrictions and the required health and safety for live railway track access, the inspection was carried out on a boat from the River Suir. The accessible sections of the development area were inspected on foot and photographic surveys compiled for ecological survey and geotechnical surveys in 2018 were also reviewed. Features identified during the field inspection are identified on Plate 14.12.

The proposed development will see the replacement of the existing northern quay wall along the bank of the River Suir. The existing Edmund Rice Bridge and section of the R448 are constructed within the river on concrete piles with a rear concrete wall (Plates 14.9). As the north quay emerges from beneath the R448 it is visible as a partially covered section of random rubble masonry, with supporting timber fenders, topped by a concrete parapet wall. At a projecting corner (indicated on Plate 14.9), the wall becomes more substantial, although the concrete parapet remains present.

Plate 14.9 Quay wall beneath the R448, facing north

The timber fenders are only present for a short distance and for c. 58m, the quay wall remains partially obscured behind silt and is formed by roughly coursed limestone masonry topped with a concrete wall (Plate 14.10). As indicated on Plate 14.10, the wall formation changes to a more roughly coursed construction with narrower stones, which continues for c. 102m. The historic mapping dating to 1903/7, shows two landing stages along this section of quay, although no remains of such features were noted during the field inspection. The walling along this section remains denuded and has been affected by the insertion of an outfall (Plate 14.11).

Approximately 160m west of the R448 are the remains of an abutment, which once formed part of a larger landing stage marked on the 1903/7 OS map (Plates 14.12 ro14.13). The abutment has been formed by coursed blocks of limestone masonry and is capped with concrete and a modern metal railing. The face of the abutment has been heavily patched with concrete and has been subject to subsidence and is gradually collapsing. There are no obvious remains of the landing stage associated with the abutment remaining.

Plate 14.10 Quay wall to the west of the R448, facing north

Plate 14.11 Quay wall to the west of Plate 14.10, showing outfall and denuded wall, facing north

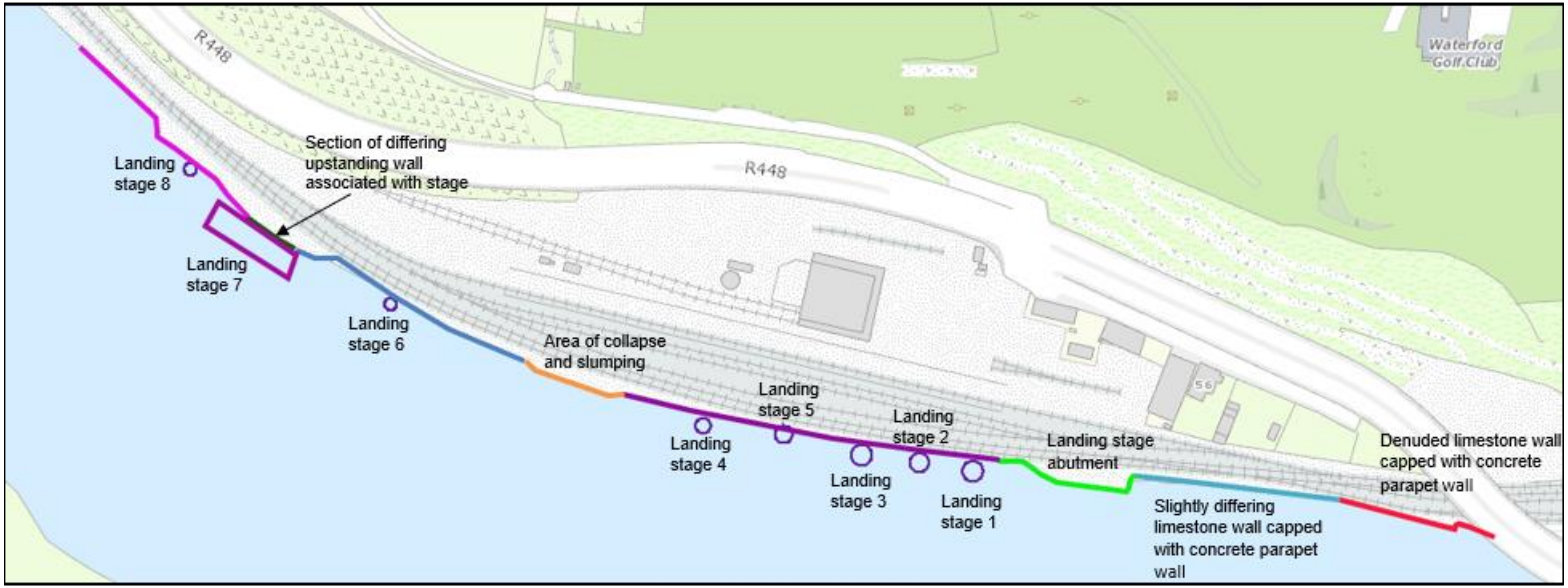


Plate 14.12 Features identified during field inspection

Plate 14.13 Eastern section of landing stage, facing north

Plate 14.14 Western section of landing stage, facing north

The section of quay wall running 180m west from the remains of the landing stage is of roughly coursed limestone masonry topped by concrete and a modern metal fence that bounds the railway lines. The remains of five landing stages were noted within the river silts, immediately adjacent to the quay wall. These are formed by denuded vertical timber piles that likely once supported horizontal timbers and a platform in order to be able to unload cargo from boats to the trains. Four of the stages are marked within the 1903/07 mapping (1-4, Plates 14.15 to Plate 14.17), whereas the fifth is likely to represent a similar feature and is formed by four upright and adjacent piles, parallel but not immediately adjacent to the quay wall.

At the western end of this section of quay wall are a number of surviving timber fenders shown in Plate 14.18 and after this point the wall has been subject to collapse for a short distance. A denuded section of wall continues west after the collapse, which has slumped down considerably, towards the water level (Plate 14.19).

Plate 14.15 Landing stage 1, facing north

Plate 14.16 Landing stage 2, facing north

Plate 14.17 Landing stage 3, facing north

Plate 14.18 **Timber fenders along quay wall and area of adjacent collapse, facing north-northeast**

Plate 14.19 **Slumping quay wall, facing north-northeast and adjacent fenders**

After the area of collapse, there is a stretch of quay wall measuring c. 127m in length, which comprises roughly coursed limestone blocks, capped with a concrete parapet wall. The historic mapping shows two landing stages along with section of the quay and the remains of one were noted in the inspection (landing stage 6), which is formed by four denuded vertical wooden piles (Plate 14.20). To the immediate west of this section of walling is the remains of a substantial timber landing stage (7), formed by 18 bays of vertical wooden piles, with some horizontal bracing pieces still in-situ. The stage measures c. 45m WNW-ESE by 14m NNE-SSW (Plate 14.21- to Plate 14.22) and is marked on the 1903/07 OS map.

To the rear of the landing stage the quay wall differs and includes a taller section of walling on top of the quay wall measuring 27m in length. It possesses some low, partially blocked opes (architectural term for openings) and is constructed from masonry but in poor condition. The purpose of the wall, which is visible in Plate 14.21 to Plate 14.22, is unclear but it may have formed part a boundary prevented access to the railway infrastructure to the north (marked on the 1903/07 mapping).

Plate 14.20 Landing stage 6, facing north-northeast

Plate 14.21 Eastern section of landing stage 7, facing north-northeast

Plate 14.22 Western section of landing stage 7, facing north-northeast

Plate 14.23 Landing stage 8, facing north-northeast

To the northwest of landing stage 7 is the remains of another probable stage, formed by four denuded vertical timber piles (Plate 14.23). The quay wall continues along the edge of the river for 120m before extending beyond the edge of the proposed development. The wall is characterised by roughly coursed limestone masonry but is not capped by concrete or a modern parapet.

The proposed main compound area is located to the northwest of the main site of the development (quay wall replacement), refer to Figure 4.21 in Volume 3 of this EIAR. It is currently formed by a level area of hard standing, in between the railway tracks to the east, an inlet to the northwest and the river bank to the west. The compound contains a section of the early 20th century iron railway bridge, the remainder of which crosses the river c. 700m to the northwest (Plate 14.24) and is listed as a protected structure (RPS WA731015).

Plate 14.24 Section of iron railway bridge within the compound area, facing north

Plate 14.25 Inlet and modern structure to the north of the compound area, facing northeast

The eastern section of the proposed development area is formed by the existing road network and the car park associated with the existing railway station. The construction of the modern roads and railway station has removed any former structures or archaeological features in the area. The area to the north of the proposed flood defences is formed by live railway tracks. Whilst the railway tracks survive, none of the post medieval structures associated with the railway are present today with much of the area characterised with modern industrial buildings.

14.2.8 Summary of the Receiving Environment

The proposed Flood Defences West is located along the northern bank and within the foreshore of the River Suir, to the west of the Edmund Rice Bridge, within the townlands of Newrath, County Kilkenny and Mountmisery, County Waterford. Due to a slight realignment of the county boundary, a small section of Newrath is also included in County Waterford. There are no recorded monuments within the proposed development boundary. There are five sites proposed for inclusion in the next revision of the RMP within 200m of the proposed development, including a mound (WA009-017003), two standing stones (WA009-017001/2) and two *fulachta fia* (KK046-006004/5).

A review of the Excavations Bulletin (1970-2020) revealed no previous archaeological investigations have been carried out within the proposed development boundary. Previous archaeological investigations in the vicinity of the mound (WA009-017003) and two standing stones (WA009-017001/2) as part of rock stabilisation works in 2019, failed to identify any evidence of the monuments recorded in 1998. An underwater survey along the quays to the east of the development area revealed the former north quay walls hidden by later modern concrete piles. The structure is masonry built but in poor condition.

Cartographic sources depict the proposed development area as occupied by the railway lines and associated infrastructure from the mid-19th century onwards. The development of the railway is clearly visible in the historic mapping. The current quay wall within the development area is directly associated with the railway and is contemporary with the construction of the expanded railway infrastructure during the late 19th century. It is likely that the quay wall was constructed in order to facilitate the stability of the railway tracks and also the loading and unloading of cargo from shipping.

A review of the Topographical Files held by the National Museum of Ireland revealed that no stray finds have been recorded within the proposed development boundary or its immediate environs.

A field inspection of the development area along the river was carried out from the River Suir, due to the fact that there was no access from the live railway tracks to the immediate north of the quay wall. The eastern section of the development area (including the car park associated with the existing train station) was inspected on foot. A total of eight post medieval landing stages were identified in varying states of preservation along the northern bank of the River Suir. These timber structures facilitated the transfer of goods from shipping to the railway. A further masonry abutment was identified, that was built into the quay wall and once formed part of a landing stage, the timber elements of which have disappeared. The largest landing stage is located at the northern end of the proposed development and comprises 18 bays of timber piles covering an area measuring 45m in length, which extend into the river by 14m.

The quay wall is extant, for the most part, along the length of the northern bank of the river, with some timber fenders still in-situ. One area of collapse and slumping was noted, although this section may be more recent in terms of a construction date. The remaining wall comprises roughly coursed limestone masonry that survives in moderate condition, although sections have covered over by river silts. Portions of the wall are either capped with concrete or a concrete parapet wall. At the site of the largest landing stage, a taller section of stone wall (27m in length) is located on top of the quay wall and although in poor condition, perhaps once formed part of the landing stage and railway infrastructure. Whilst the riverbank has been impacted by railway infrastructure, the overall archaeological potential of the landscape is considered to be high, due to the presence of a major watercourse. Large rivers have been utilised from prehistory onwards as a resource for food and transport and were often used for ritual deposition during the prehistoric periods.

The proposed main construction compound at the western site boundary of the proposed Flood Defences West, currently contains a section of the iron railway bridge, the remaining sections of which are in-situ across the river, c. 700m to the northwest. The main construction compound area is covered with hard standing and occupies rough ground in between the river and the railway tracks.

The eastern section of the development area is characterised by the car park associated with the existing train station. The car park is formed by an area of level, tarmacked surface. No archaeological features were noted within this area, due to the level of modern development that has occurred.

14.3 Description of Potential Impacts

14.3.1 Archaeology

No direct or indirect impacts will occur on the recorded archaeological resource, either during the construction or operation of the proposed development.

For the purposes of this assessment, the existing quay wall and riverine features are included in the archaeological impact assessment, as detailed below.

The proposed development will require the demolition and removal of the uppermost part of the existing quay wall (typically concrete capping/parapet wall and some masonry blocks) and existing handrails. The quay wall is not a recorded monument or a protected structure. The top of the wall extends up to 1.3m above ground level between Ch.355 and Ch.425, while from Ch.425 to Ch.900 it is approximately at level with the existing ground. The wall will be demolished to approximately 800mm below the existing ground level from Ch.355 to Ch.900. Approximately 25m of the quay wall will be demolished above and below ground (between approx. Ch.375 and Ch.400) to facilitate the construction of an underground pumping station at Ch.380. A small section of the quay wall (up to 3m) at Ch.900 will also be demolished to connect the landside and the riverside sections of the new sheet pile wall. The remainder of the wall will then be covered in, by the installation of the sheet piles and the backfilling of material between the riverside sheet piles and the existing wall, as part of the proposed development. The wall will not be demolished where sheet piles are positioned on landside after Ch.900 (up to Ch. 1090). Here, the sheet pile wall will be installed behind the quay wall. The location of the proposed sheet pile flood defence wall in shown in Figure 4.1 to 4.6 in Volume 3 of this EIAR.

The demolition of sections of the quay wall, including the landing stage abutment, but not including the wall associated with landing stage 7, will result in a *direct, negative, significant,* impact on the archaeological resource. No direct impacts are predicted upon the remains of the timber landing stages that have been identified as part of this assessment.

As part of the development, two existing outfalls will be replaced (at Ch.470 and Ch.490) and a new outfall will also be constructed at Ch. 390. The location of the works is shown on Figure 4.12 to 4.17 in Volume 3. The new and upgraded outfalls will extend approx. 6m into the riverbed and groundworks will be required to demolish 2 no. existing outfall structures and erect the new outfalls. The areas required for works will be defined by a temporary cofferdam for the duration of the new constructions. No specific features were identified in the area of the outfalls, although the historic mapping does indicate two landing stages along this section of the quay. No remains of these were identified during the field inspection. It is possible that that ground disturbances associated with the construction of the outfalls may have a *direct, negative,* impact on archaeological features or deposits that have the potential to survive behind the riverbed. Impacts, prior to the application of mitigation, may range from negative, *moderate to very significant* in scale.

It remains possible that ground disturbances associated with the proposed development may have a *direct, negative,* impact on archaeological features or deposits that have the potential to survive behind the quay walls proposed for demolition or during any other associated ground works. Impacts, prior to the application of mitigation, may range from *negative, moderate to very significant* in scale.

The eastern section of the proposed development area is characterised by the existing train station and modern car park. Excavations associated with drainage and services will be required in this area as part of the development. Although the area has been disturbed, it remains possible that that ground disturbances associated with the proposed development may have a *direct, negative,* impact on archaeological features or deposits that have the potential to survive below the existing ground level. Impacts, prior to the application of mitigation, may range from *negative, moderate to very significant* in scale.

14.3.2 Cultural Heritage

In addition to the above, it is possible that works associated with the proposed main construction compound may result in a *direct, negative* impact on the section of iron railway bridge that currently occupies the site.

14.4 Mitigation & Monitoring Measures

14.4.1 Archaeology

In order to ameliorate any negative impacts upon the archaeological resource, a full intertidal and wade/dive survey will be carried out along the sections of the existing quay wall to be directly impacted by the works and at the location of the upgraded and proposed outfalls. The survey will include a photogrammetry survey of the wall to be demolished (from Ch.350 to Ch.900), along with the mapping and recording of the former landing stages. All timber landing stages will be avoided during the course of works. The survey will also include a metal detecting survey and all works will be carried out by a suitably qualified underwater archaeologist, under licence to the National Monuments Service of the DoHLGH.

All ground disturbances associated with the works along the River Suir will be monitored by a suitably qualified underwater archaeologist. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).

All ground disturbances associated with excavations within the car park associated with the existing train station will be monitored by a suitably qualified archaeologist. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).

14.4.2 Cultural Heritage

The section of the iron railway bridge that currently occupies the works compound will be left in-situ and undisturbed by contractors.

14.5 Residual Impacts

Following the implementation of the above mitigation measures, there will be no residual impacts upon the archaeological and cultural heritage resource.

14.6 Difficulties Encountered

No access to the landward side of the proposed scheme was possible during field inspections and as such the quay wall was inspected from a boat in the River Suir. It should be noted that photographs from an ecological survey and geotechnical survey, carried out in 2018, were also reviewed in order to supplement the field inspection.

14.7 References

Barry, T. 1995 in Howard B Clarke (ed.), Irish Cities, 204-217.

Bennett, I. (ed.) 1987–2010 Excavations: Summary Accounts of Archaeological Excavations in Ireland. Bray. Wordwell.

Bradley, J. & Halpin, A. 1992 The topographical development of Scandinavian and Anglo-Norman Waterford. In W. Nolan and T. P. Power (eds), Waterford: History and Society, 105-129.

Chartered Institute for Archaeologists 2014a Standards & Guidance for Field Evaluation.

Chartered Institute for Archaeologists 2014b Standards & Guidance for Archaeological Excavation.

Chartered Institute for Archaeologists 2014c Standards & Guidance for an Archaeological Watching Brief (Monitoring).

Culleton E. (ed.) 1999 Treasures of The Landscape; Townland Names by An Tathair Seamas S. De Vaal Dublin: Trinity College.

Department of Arts, Heritage, Gaeltacht and the Islands. 1999a Framework and Principles for the Protection of the Archaeological Heritage. Dublin. Government Publications Office.

Department of Arts, Heritage, Gaeltacht and the Islands. 1999b Policy and Guidelines on Archaeological Excavation. Dublin. Government Publications Office.

Dowd, M. and Carden, R. 2016 First evidence of a Late Upper Palaeolithic human presence in Ireland. Quaternary Science Reviews: 158-163.

Environmental Protection Agency. 2015 Draft Advice Notes on Current Practice (in the preparation of Environmental Impact Statements). Dublin. Government Publications Office.

Environmental Protection Agency. 2017 Draft Guidelines on the Information to be Contained in Environmental Impact Statements. Dublin. Government Publications Office.

Kilkenny County Development Plan 2014-2020

Lewis, S. 1837 (online edition) Topographical Dictionary of Ireland.

MacCotter, P. 2008. Medieval Ireland: Territorial, Political and Economic Divisions. Four Courts Press, Dublin

McEneaney, E., 2001 Discover Waterford. O'Brien Press.

McErlean, T. 1983 "The Irish townland system of landscape organisation". In Reeves-Smyth, Terence; Hamond, Fred (eds) Landscape Archaeology in Ireland BAR British Series 116. pp. 315–39

National Monuments Service, Department of Housing, Local Government and Heritage, Counties Waterford and Kilkenny.

National Museum of Ireland. Topographical Files, Counties Waterford and Kilkenny.

Raftery, B. 1994 Pagan Celtic Ireland. London: Thames and Hudson

Ryland, R.H. 1824 The History, Topography and Antiquities of the County and City of Waterford. London (reprint).

Scully, Ó. (unpublished a) Preliminary report on the excavations and monitoring at the Theatre Royal and Deanery Gardens Waterford, C348, E4019.

Smith, C. 1746 State of the County and City of Waterford: Being a Natural, Civil, Ecclesiastical, Historical and Topographical Description thereof. Reprinted 1969, Mercier Press, Cork.

Waterford City Development Plan, 2013-2019 (as extended).

Waddell, J. 1998 The Prehistoric Archaeology of Ireland. Galway. Galway University Press.

Zvelebil, M., Macklin, M.G., Passmore, D.G. & Ramsden, P. 1996 Alluvial archaeology in the Barrow Valley, Southeast Ireland: The Riverford Culture re-visited. The Journal of Irish Archaeology: 13-40.

Cartographic Sources

William Petty, Down Survey, Map of the Barony of Ida Igrin Ibercon, c. 1655

William Richards and Bernard Scale, Plan of the City and Suburbs of Waterford, 1764

Nicholas Sinnott, Map of Waterford, 1830

Patrick Leahy, Map of the city of Waterford and its environs..., 1834

Ordnance Survey Mapping 1839-1953

Electronic Sources

www.excavations.ie – Summary of archaeological excavation from 1970–2020.

www.archaeology.ie –DoHLGH website listing all SMR/RMP sites.

www.heritagemaps.ie – The Heritage Council web-based spatial data viewer which focuses on the built, cultural and natural heritage.

www.googleearth.com – Satellite imagery of the proposed development area.

www.bingmaps.com – Satellite imagery of the proposed development area.

www.booksulster.com/library/plnm/placenamesC.php - Contains the text from Irish Local Names Explained by P.W Joyce (1870).

Appendix 14.1
SMR/RMP Sites Within the Surrounding Area

APPENDIX 14.1
SMR/RMP Sites Within The Surrounding Area

SMR No.	WA009-017001
RMP Status	Scheduled for inclusion in the next revision of the RMP
Townland	Mountmisery
Parish	Kilculliheen
Barony	Kilculliheen
I.T.M.	660165/613203
Classification	Standing stone
Dist. From Development	c. 60m north
Description	Situated on a scrub-covered, SW-facing slope, on top of a S-facing cliff which overlooks the River Suir and Waterford City. Two conglomerate stones, placed 20m apart, form an alignment-oriented ENE-WSW. The W stone has a diamond-shaped cross-section (dims. 0.6m x 0.35m; H 1.2m) and is oriented E-W. The E stone has a square cross-section (dims. 0.6m x 0.45m; H 1.45m). A mound (WA009-017003-) is 30m to W. Although recorded in 1998, it was not present in 2010.
Reference	www.archaeology.ie/ SMR file

SMR No.	WA009-017002
RMP Status	Scheduled for inclusion in the next revision of the RMP
Townland	Mountmisery
Parish	Kilculliheen
Barony	Kilculliheen
I.T.M.	660165/613203
Classification	Standing stone
Dist. From Development	c. 60m north
Description	Situated on a scrub-covered, SW-facing slope, on top of a S-facing cliff which overlooks the River Suir and Waterford City. Two conglomerate stones, placed 20m apart, form an alignment-oriented ENE-WSW. The W stone has a diamond-shaped cross-section (dims. 0.6m x 0.35m; H 1.2m) and is oriented E-W. The E stone has a square cross-section (dims. 0.6m x 0.45m; H 1.45m). A mound (WA009-017003-) is 30m to W. Although recorded in 1998, it was not present in 2010.
Reference	www.archaeology.ie/ SMR file

SMR No.	WA009-017003
RMP Status	Scheduled for inclusion in the next revision of the RMP
Townland	Mountmisery
Parish	Kilculliheen
Barony	Kilculliheen
I.T.M.	660112/613221
Classification	Mound

Dist. From Development	c. 63m north
Description	Situated on a steep scrub-covered, SW-facing slope, on top of a S-facing cliff which overlooks the River Suir and Waterford City. Circular grass- and fern-covered, flat-topped mound (dims. at top 6.5m N-S; 6m E-W: dims. at base 9.5m N-S; 8.8m E-W: H 0.2m at N (upslope) to 1m at S). Stone pair (WA009-017002-) is 30m to E. Although recorded in 1998, it was not present in 2010.
Reference	www.archaeology.ie/ SMR file

SMR No.	KK046-006004
RMP Status	Scheduled for inclusion in the next revision of the RMP
Townland	Newrath
Parish	Kilculliheen
Barony	Kilculliheen
I.T.M.	659651,613441
Classification	*Fulacht fia*
Dist. From Development	c. 174m north
Description	No information available
Reference	www.archaeology.ie/ SMR file

SMR No.	KK046-006005
RMP Status	Scheduled for inclusion in the next revision of the RMP
Townland	Newrath
Parish	Kilculliheen
Barony	Kilculliheen
I.T.M.	659811,613440
Classification	*Fulacht fia*
Dist. From Development	c. 178m north
Description	No information available
Reference	www.archaeology.ie/ SMR file

Appendix 14.2
Legislation Protecting the Archaeological Resource

APPENDIX 14.2
Legislation Protecting the Archaeological Resource

Protection of Cultural Heritage

The cultural heritage in Ireland is safeguarded through national and international policy designed to secure the protection of the cultural heritage resource to the fullest possible extent (Department of Arts, Heritage, Gaeltacht and the Islands 1999, 35). This is undertaken in accordance with the provisions of the *European Convention on the Protection of the Archaeological Heritage* (Valletta Convention), ratified by Ireland in 1997.

The Archaeological Resource

The *National Monuments Act 1930 to 2014* and relevant provisions of the *National Cultural Institutions Act 1997* are the primary means of ensuring the satisfactory protection of archaeological remains, which includes all man-made structures of whatever form or date except buildings habitually used for ecclesiastical purposes. A National Monument is described as 'a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto' (National Monuments Act 1930 Section 2). A number of mechanisms under the National Monuments Act are applied to secure the protection of archaeological monuments. These include the Register of Historic Monuments, the Record of Monuments and Places, and the placing of Preservation Orders and Temporary Preservation Orders on endangered sites.

Ownership and Guardianship of National Monuments

The Minister may acquire national monuments by agreement or by compulsory order. The state or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister.

Register of Historic Monuments

Section 5 of the 1987 Act requires the Minister to establish and maintain a Register of Historic Monuments. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. Any interference with sites recorded on the register is illegal without the permission of the Minister. Two months' notice in writing is required prior to any work being undertaken on or in the vicinity of a registered monument. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places.

Preservation Orders and Temporary Preservation Orders

Sites deemed to be in danger of injury or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister.

Record of Monuments and Places

Section 12(1) of the 1994 Act requires the Minister for Arts, Heritage, Gaeltacht and the Islands (now the Minister for the Department of Housing, Local Government and Heritage) to establish and maintain a record of monuments and places where the Minister believes that such monuments exist. The record comprises a list of monuments and relevant places and a map/s showing each monument and relevant place in respect of each county in the state. All sites recorded on the Record of Monuments and Places receive statutory protection under the National Monuments Act 1994. All recorded monuments on the proposed development site are represented on the accompanying maps.

Section 12(3) of the 1994 Act provides that 'where the owner or occupier (other than the Minister for Arts, Heritage, Gaeltacht and the Islands) of a monument or place included in the Record, or any other person, proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such a monument or place, he or she shall give notice in writing to the Minister of Arts, Heritage, Gaeltacht and the Islands to carry out work and shall not, except in case of urgent necessity and with the consent of the Minister, commence the work until two months after giving of notice'.

Under the National Monuments (Amendment) Act 2004, anyone who demolishes or in any way interferes with a recorded site is liable to a fine not exceeding €3,000 or imprisonment for up to 6 months. On summary conviction and on conviction of indictment, a fine not exceeding €10,000 or imprisonment for up to 5 years is the penalty. In addition, they are liable for costs for the repair of the damage caused.

In addition to this, under the *European Communities (Environmental Impact Assessment) Regulations 1989,* Environmental Impact Statements (EIS) are required for various classes and sizes of development project to assess the impact the proposed development will have on the existing environment, which includes the cultural, archaeological and built heritage resources. These document's recommendations are typically incorporated into the conditions under which the proposed development must proceed, and thus offer an additional layer of protection for monuments which have not been listed on the RMP.

The Planning and Development Act 2000

Under planning legislation, each local authority is obliged to draw up a Development Plan setting out their aims and policies with regard to the growth of the area over a five-year period. They cover a range of issues including archaeology and built heritage, setting out their policies and objectives with regard to the protection and enhancement of both. These policies can vary from county to county. The Planning and Development Act 2000 recognises that proper planning and sustainable development includes the protection of the archaeological heritage. Conditions relating to archaeology may be attached to individual planning permissions.

Waterford City Development Plan 2013 - 2019

The Development Plan contains the following policies with regard to the archaeological resource:

POL 10.1.1: To protect and enhance archaeological monuments and their settings including city walls, embankments and ditches, gates, bastions or ancillary fortifications, church sites and associated graveyards and other monuments.

POL 10.1.3: To protect the archaeological heritage of the City as a source and instrument for historical and scientific study.

POL 10.1.4: To facilitate appropriate guidance in relation to the protection of the archaeological heritage of the City.

POL 10.1.5: To promote pre-planning consultations in relation to the archaeological heritage with the Planning Authority and with the National Monuments Service, Department of Arts, Heritage & the Gaeltacht.

POL 10.1.7: To promote the use of the archaeological heritage of the City as an educational, cultural and tourism resource and to promote public access and awareness of this rich archaeological heritage.

It is an objective of Waterford City Development Plan:

OBJ 10.1.1: To secure the preservation (in-situ or by record) of all sites and features of historical and archaeological interest.

OBJ 10.1.2: To preserve the integrity of existing archaeological monuments in their settings including the integrity of city defences and to ensure that development in the vicinity of a site of archaeological interest does not unduly affect the character of the archaeological site or its setting by reason of its location, scale, bulk or detailing.

OBJ 10.1.3: In securing such preservation, and with regard to proposed development and/or works within or in the vicinity of archaeological monuments in Local Authority or State ownership or guardianship (i.e. National Monuments) to consult and to have regard to the advice and recommendations of the National Monuments Service, the Department of Arts, Heritage & the Gaeltacht, authorization/Ministerial Consent may be required to proceed under Section 14 of the National Monuments Acts.

OBJ 10.1.4: To seek to retain the existing street layout, including laneways, historic building lines and traditional plot widths where these derive from medieval or earlier origins.

OBJ 10.1.5: When considering development in the vicinity of upstanding archaeological/historical monuments, to aim to achieve a satisfactory buffer area between the development and the monument in order to ensure the preservation and enhancement of the amenity associated with the presence of upstanding monuments within the historic urban pattern.

OBJ 10.1.6: In considering development in the vicinity of all upstanding monuments, including city defences, or development that may have implications for archaeological heritage, the Planning Authority will require the preparation and submission of an archaeological assessment report detailing the potential impact of the development on the archaeological heritage including upstanding, buried structures and deposits. The report will also include a visual impact assessment to ensure adequate consideration of any potential visual impact the proposed development may have on any upstanding remains.

OBJ 10.1.7: To promote the incorporation of or reference to significant archaeological finds in a development, where appropriate, through layout, displays, signage, plaques, information panels or use of historic place names.

OBJ 10.1.8: To provide guidance for developers, based on the experience of the archaeological environment in Waterford, and guidelines on development issued by the National Monuments Service, Department of Arts, Heritage & the Gaeltacht and the Department of the Environment, Community and Local Government, in order to ensure that the degree of commitment to a development in terms of finance and programme, may be planned in relation to Waterford City Development Plan 2013 - 2019 the degree of uncertainty concerning the archaeology and the stages in its clarification and resolution.

Kilkenny County Development Plan 2014 - 2020

The Development Plan contains the following policies with regard to the archaeological resource:

- Endeavour to preserve in situ all archaeological monuments, whether on land or underwater, listed in the Record of Monuments and Places (RMP), and any newly discovered archaeological sites, features, or objects by requiring that archaeological remains are identified and fully considered at the very earliest stages of the development process and that schemes are designed to avoid impacting on the archaeological heritage.
- To require archaeological assessment, surveys, test excavation and/or monitoring for planning applications in areas of archaeological importance if a development proposal is likely to impact upon in-situ archaeological monuments, their setting and archaeological remains.
- Ensure that development within the vicinity of a Recorded Monument is sited and designed appropriately so that it does not seriously detract from the setting of the feature or its zone of archaeological potential. Where upstanding remains of a Recorded Monument exist a visual impact assessment may be required to fully determine the effect of any proposed development.
- Require the retention of surviving medieval plots and street patterns and to facilitate the recording of evidence of ancient boundaries, layouts etc. in the course of development.
- Safeguard the importance of significant archaeological or historic landscapes from developments that would unduly sever or disrupt the relationship, connectivity and/or inter-visibility between sites.

Appendix 14.3
Impact Assessment and the Cultural Heritage Resource

APPENDIX 14.3
Impact Assessment And The Cultural Heritage Resource

Potential Impacts on Archaeological and Historical Remains

Impacts are defined as 'the degree of change in an environment resulting from a development' (Environmental Protection Agency 2003: 31). They are described as profound, significant or slight impacts on archaeological remains. They may be negative, positive or neutral, direct, indirect or cumulative, temporary or permanent.

Impacts can be identified from detailed information about a project, the nature of the area affected and the range of archaeological and historical resources potentially affected. Development can affect the archaeological and historical resource of a given landscape in a number of ways.

- Permanent and temporary land-take, associated structures, landscape mounding, and their construction may result in damage to or loss of archaeological remains and deposits, or physical loss to the setting of historic monuments and to the physical coherence of the landscape.
- Archaeological sites can be affected adversely in a number of ways: disturbance by excavation, topsoil stripping and the passage of heavy machinery; disturbance by vehicles working in unsuitable conditions; or burial of sites, limiting accessibility for future archaeological investigation.
- Hydrological changes in groundwater or surface water levels can result from construction activities such as de-watering and spoil disposal, or longer-term changes in drainage patterns. These may desiccate archaeological remains and associated deposits.
- Visual impacts on the historic landscape sometimes arise from construction traffic and facilities, built earthworks and structures, landscape mounding and planting, noise, fences and associated works. These features can impinge directly on historic monuments and historic landscape elements as well as their visual amenity value.
- Landscape measures such as tree planting can damage sub-surface archaeological features, due to topsoil stripping and through the root action of trees and shrubs as they grow.
- Ground consolidation by construction activities or the weight of permanent embankments can cause damage to buried archaeological remains, especially in colluviums or peat deposits.
- Disruption due to construction also offers in general the potential for adversely affecting archaeological remains. This can include machinery, site offices, and service trenches.

Although not widely appreciated, positive impacts can accrue from developments. These can include positive resource management policies, improved maintenance and access to archaeological monuments, and the increased level of knowledge of a site or historic landscape as a result of archaeological assessment and fieldwork.

Predicted Impacts

The severity of a given level of land-take or visual intrusion varies with the type of monument, site or landscape features and its existing environment. Severity of impact can be judged taking the following into account:

- The proportion of the feature affected and how far physical characteristics fundamental to the understanding of the feature would be lost;

- Consideration of the type, date, survival/condition, fragility/vulnerability, rarity, potential and amenity value of the feature affected;
- Assessment of the levels of noise, visual and hydrological impacts, either in general or site-specific terms, as may be provided by other specialists.

Appendix 14.4
Mitigation Measures and the Cultural Heritage Resource

APPENDIX 14.4
Mitigation Measures And The Cultural Heritage Resource

Potential Mitigation Strategies for Cultural Heritage Remains

Mitigation is defined as features of the design or other measures of the proposed development that can be adopted to avoid, prevent, reduce or offset negative effects.

The best opportunities for avoiding damage to archaeological remains or intrusion on their setting and amenity arise when the site options for the development are being considered. Damage to the archaeological resource immediately adjacent to developments may be prevented by the selection of appropriate construction methods. Reducing adverse effects can be achieved by good design, for example by screening historic buildings or upstanding archaeological monuments or by burying archaeological sites undisturbed rather than destroying them. Offsetting adverse effects is probably best illustrated by the full investigation and recording of archaeological sites that cannot be preserved in situ.

Definition of Mitigation Strategies

Archaeological Resource

The ideal mitigation for all archaeological sites is preservation in situ. This is not always a practical solution, however. Therefore, a series of recommendations are offered to provide ameliorative measures where avoidance and preservation in situ are not possible.

Archaeological Test Trenching can be defined as 'a limited programme of intrusive fieldwork which determines the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area or site on land, inter-tidal zone or underwater. If such archaeological remains are present field evaluation defines their character, extent, quality and preservation, and enables an assessment of their worth in a local, regional, national or international context as appropriate' (CIfA 2014a).

Full Archaeological Excavation can be defined as 'a programme of controlled, intrusive fieldwork with defined research objectives which examines, records and interprets archaeological deposits, features and structures and, as appropriate, retrieves artefacts, ecofacts and other remains within a specified area or site on land, inter-tidal zone or underwater. The records made and objects gathered during fieldwork are studied and the results of that study published in detail appropriate to the project design' (CIfA 2014b).

Archaeological Monitoring can be defined as 'a formal programme of observation and investigation conducted during any operation carried out for non-archaeological reasons. This will be within a specified area or site on land, inter-tidal zone or underwater, where there is a possibility that archaeological deposits may be disturbed or destroyed. The programme will result in the preparation of a report and ordered archive' (CIfA 2014c).

Underwater Archaeological Assessment consists of a programme of works carried out by a specialist underwater archaeologist, which can involve wade surveys, metal detection surveys and the excavation of test pits within the sea or riverbed. These assessments are able to access and assess the potential of an underwater environment to a much higher degree than terrestrial based assessments.

Chapter 15
Architectural Heritage

Chapter 15 Architectural Heritage

15.1 Introduction

This chapter examines the potential impact on the architectural heritage resource of the proposed flood defence development immediately north of the River Suir at Waterford City (Plate 15.1).

The assessment involved detailed interrogation of the architectural heritage background of the development area. This included information from the County and City Development Plans, the National Inventory of Architectural Heritage and cartographic and documentary records. A field inspection was carried out during March 2021 in an attempt to identify any known architectural heritage sites and previously unrecorded structures of significance within the study area.

An impact assessment and a mitigation strategy have been prepared. The impact assessment is undertaken to outline potential adverse impacts that the proposed development may have on the architectural heritage resource, while the mitigation strategy is designed to avoid or reduce such adverse impacts.

Plate 15.1 Proposed Development Location

15.1.1 Statutory Instruments and Guidance

In the first instance, the scope of the EIAR has been determined with regard to the statutory instruments and regulations relating to EIA and related guidance from the European Union, the Government and the EPA. These include the following:-

15.1.1.1 EU Directives / Legislation

- The EU Directives on Environmental Impact Assessment (85/337/EEC as amended by 97/11/EC, 2003/35/EC, 2009/31/EC (codified in 2011/92/EU) and 2014/52/EU)
- The Planning and Development Act, 2000 (as amended)

- The Planning and Development Regulations, 2001 (as amended)
- The Planning and Development (Strategic Infrastructure) Bill, 2006;
- Heritage Act, 1995;
- Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act, 2000 and the Local Government (Planning and Development) Act 2000;

15.1.1.2 EIA and related Guidance

- EPA, 2002, *Guidelines on the Information to be contained in Environmental Impact Statements*
- EPA, 2003, *Advice Notes on Current Practice in the preparation of Environmental Impact Statements*
- EPA, 2015, *Advice Notes for preparing Environmental Impact Statements* (Draft)
- EPA, 2017, *Guidelines on the Information to be contained in Environmental Impact Assessment Reports* (Draft)
- European Commission, 2017, *Environmental Impact Assessment of Projects - Guidance on the preparation of the Environmental Impact Assessment Report*
- DHPCLG, 2018, *Circular* PL05/2018 – *Transposition into Planning Law of Directive 2014/52/EU amending Directive 2011/92/EU on the effects of certain public and private projects on the environment (the EIA Directive) and Revised Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment.*
- DHPCLG, 2018, *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment.*
- DEHLG, 2003, *Environmental Impact Assessment (EIA) Guidance for Consent Authorities regarding Sub-threshold Development.*

The scope of the study is also informed by various other sources of relevance to the proper planning and sustainable development of the site.

15.1.2 Terminology

In accordance with the EPA Guidelines on the Information to be contained in Environmental Impact Statements (2002) and Advice Notes on Current Practice in the preparation of Environmental Impact Statements (2003), the descriptions in Table 15.1 are used in this EIAR to describe the effects on the environment.

These descriptions take account of updated Guidelines and Advice Notes prepared by the EPA in response to the 2014 EIA Directive, namely: - Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (2017) and Draft Advice Notes for preparing Environmental Impact Statements (2015): -

Table 15.1 Description of Effects

The quality of the effects is defined as:-	
Positive effects	A change which improves the quality of the environment (e.g. by increasing species diversity; or the improving reproductive capacity of an ecosystem, or removing nuisances or improving amenities).
Negative effects	A change which reduces the quality of the environment (e.g. lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health *or* property or by causing nuisance).

Neutral effects	A change which does not affect the quality of the environment.
The significance of the effects is described as:-	
Imperceptible	An effect capable of measurement but without significant consequences.
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging trends.
Significant effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound effects	An effect which obliterates sensitive characteristics.
The magnitude of the effect is, where appropriate, indicated as:-	
Extent	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
Duration	Describe the period of time over which the effect will occur. (See further detail below)
Frequency	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)
Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
The probability of the effect is, where appropriate, indicated as:-	
Likely Effects	The effects that can reasonably be expected to occur as a result of the planned project if all mitigation measures are properly implemented.
Unlikely Effects	The effects that can reasonably be expected not to occur
The duration of the effect is, where appropriate, indicated as:-	
Momentary Effects	Effects lasting from seconds to minutes
Brief Effects	Effects lasting less than a day
Temporary Effects	Effects lasting for less than one year
Short-term Effects	Effects lasting one to seven years.
Medium-term Effects	Effects lasting seven to fifteen years.
Long-term Effects	Effects lasting fifteen to sixty years.
Permanent Effects	Effects lasting over sixty years.
Reversible Effects	Effects that can be undone, for example through remediation or
The type of effect is described, where appropriate, as:-	
Cumulative Effects	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.
Do-nothing Effects	The environment as it would be in the future should the subject project not be carried out.
Indeterminable Effects	When the full consequences of a change in the environment cannot be described.

Irreversible Effects	When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.
Residual Effects	The degree of environmental change that will occur *after* the proposed mitigation measures have taken effect.
Worst-case Effects	The impacts arising from a development in the case where mitigation measures substantially fail.
Synergistic Effects	Where the resultant effect is of greater significance than the sum of its constituents, (e.g. combination of SOx and NOx to produce smog).
Indirect Effects	Impacts on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
Secondary Effects	Effects that arise as a consequence of a project (a new waste water treatment plant will reduce the yield of mussels in a nearby estuary).

15.2 Methodology

Research for this chapter was undertaken in two phases. The first phase comprised a paper survey of all available architectural, historical and cartographic sources. The second phase involved a field inspection of the site.

15.2.1 Paper Survey

The following sources were reviewed as part of the paper survey:

- Cartographic and written sources relating to the study area;
- Waterford City Development Plan 2013–2019 (as extended);
- Kilkenny County Development Plan 2014-2020;
- National Inventory of Architectural Heritage.

Cartographic sources are important in tracing land use development within the development area as well as providing important topographical information on the development of buildings. Cartographic analysis of all relevant maps has been made to identify any structures that no longer remain within the landscape. The following sources have been reviewed:

- William Petty's Down Survey, Map of the Barony of Ida Igrin Ibercon, c. 1655;
- William Richards and Bernard Scale's Plan of the City and Suburbs of Waterford, 1764;
- Nicholas Sinnott's Map of Waterford, 1830;
- Patrick Leahy's Map of the city of Waterford and its environs..., 1834; and
- Ordnance Survey Mapping 1839-1953

Documentary sources were consulted to gain background information on the architectural heritage landscape of the proposed development area.

Development Plans contain a catalogue of all the Protected Structures and architectural sites within the counties of Waterford and Kilkenny. The Waterford City and County Development Plan (2013–2019, as extended) and the Kilkenny County Development Plan (2014-2020) were consulted to obtain information on architectural heritage sites in and within the immediate vicinity of the proposed development area. This included a review of additions and deletions from the RPS that was ratified by Waterford City and County Council in 2018.

The National Inventory of Architectural Heritage (NIAH) was established in 1990 to fulfil Ireland's obligation under the Granada Convention, through the establishment and maintenance of a central record, documenting and evaluating the architecture of Ireland (NIAH Handbook 2005,2). As inclusion in the inventory does not provide statutory protection, the survey information is used in conjunction with the Architectural Heritage Protection Guidelines for Planning Authorities to advise local authorities on compilation of a Record of Protected Structures as required by the Planning and Development Act, 2000. The NIAH has also carried out a desk-based survey of all designed landscapes within the country and this was examined in relation to any demesnes within the study area.

15.2.2 Field Inspection

Field inspection is necessary to determine the extent and nature of architectural and historical remains and can also lead to the identification of previously unrecorded structures of architectural merit.

The architectural field inspection, undertaken on the 15th of March 2021. Access to the landward side of the development (adjacent to the River Suir) was not possible due to the presence of a live railway track. As such, that section of the inspection was carried out from a boat on the River Suir. The remaining landward sections of the development were inspected on foot. The field inspection entailed -

- Walking the proposed development area and its immediate environs.
- Noting and recording the presence of features of historical or architectural significance.
- Verifying the extent and condition of any recorded structures.

15.3 Description of Receiving Environment

15.3.1 Architectural Background

The proposed development is located along the northern edge of the River Suir, in the townlands of Newrath, County Kilkenny and Mountmisery, County Waterford. Due to a slight change in the county boundary in the late 19th century, a small section of Newrath is now located in County Waterford. There are four built heritage sites within the boundary of the proposed development, three of which relate to the historic railway and the bridge across the River Suir, which is only partially within the development area (Plate 15.2a/b). There are two additional built heritage sites within a 200m radius of the proposed development.

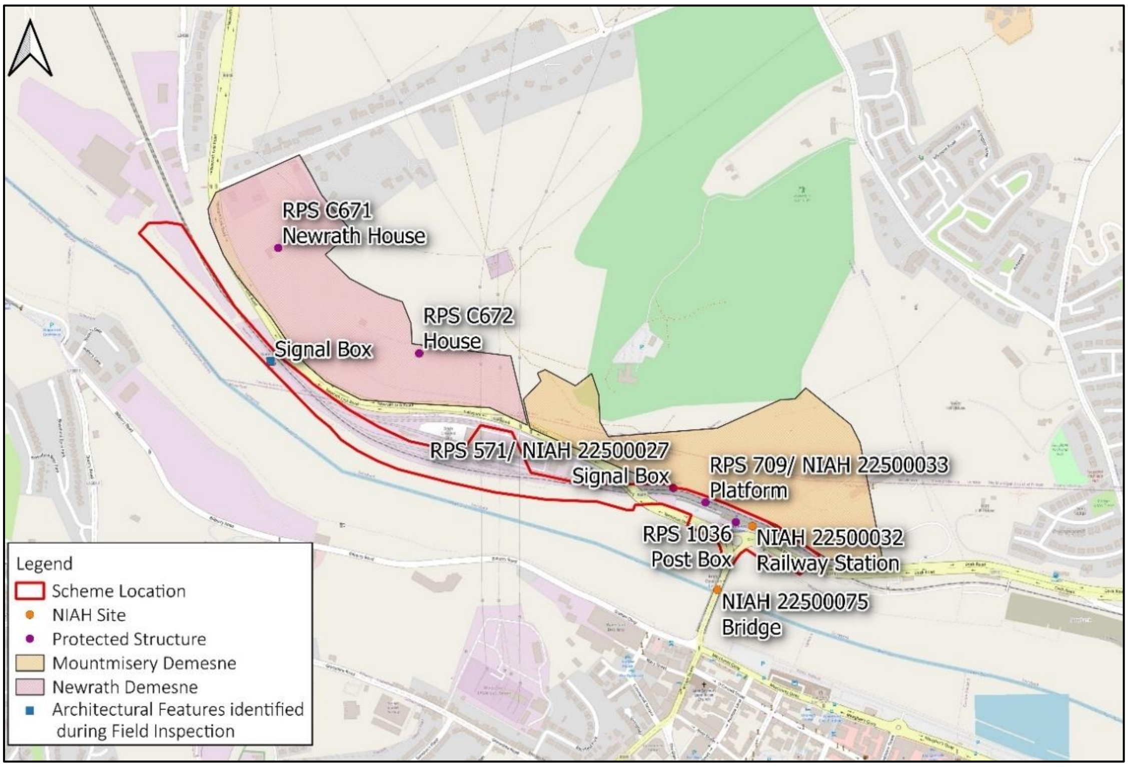


Plate 15.2a Architectural heritage sites within 200m of the proposed development

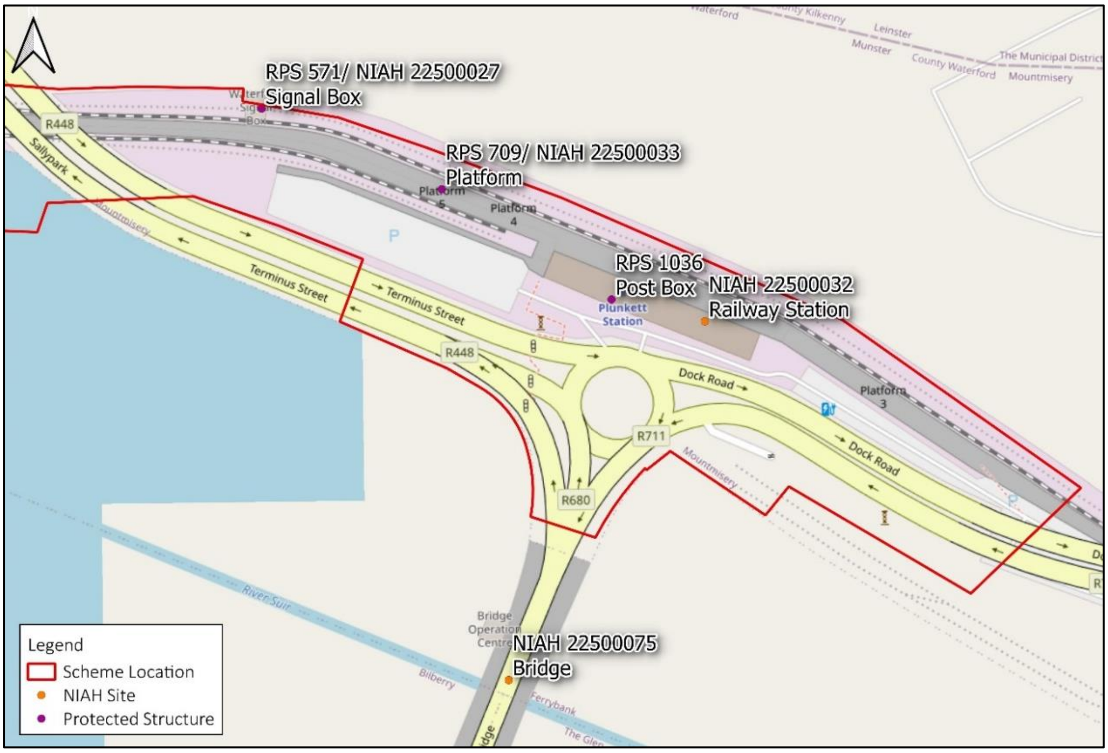


Plate 15.2b Architectural heritage sites within the Plunkett Station Complex

A detailed historical background is given in Chapter 14 Archaeological and Cultural Heritage of this EIAR. Specific information on the historic structures in and within the study area is provided below.

Edmund Rice Bridge (NIAH 22500075)

This structure was formerly listed within the RPS but was deleted from the record by Waterford City and County Council in 2018. During the late 18th century, an American engineer, Lemuel Cox, was working in Ireland and specialised in the construction of timber bridges of significant length. Whilst he was in Ireland, he built long bridges at Wexford, Ferrycarrig, New Ross, and Mountgarret (near New Ross). In 1793 he was engaged to bridge the Suir at Waterford and he selected a site at the western end of the town, where the river was only 250m wide. His timber trestle bridge was completed in January 1794 and survived more than a century until it was replaced by a ferro-concrete bridge in 1910. This, in turn, was replaced by the present bridge, the Edmund Rice Bridge (NIAH 22500075) built in 1986. During the post-medieval period the bridge greatly improved communications with the northern hinterland of Waterford, including the landscape containing the proposed development, which had been hitherto cut off from the bustling city to the south. Today the Edmund Rice Bridge remains an important element of the city. The NIAH describes it as possessing regional significance and it comprises a nine-span concrete road bridge with pair of pre-cast concrete oblong piers at the centre with a single-bay, single-storey, flat-roofed control tower at its western end. It possesses a central lifting ramp to allow tall ships to pass beneath the structure (Plate 15.3).

Plate 15.3 Edmund Rice Bridge (NIAH 22500075), facing west

Railway Infrastructure

By the opening years of the 20th century the most significant change along the northern bank of the Suir was the arrival of the railway. Waterford had received its first railway connection in 1854 with the opening of a line to Kilkenny by the Waterford and Kilkenny Railway Company and another to Limerick by the Waterford and Limerick Railway Company. These lines terminated to the west of Waterford Bridge and the station on the present site opened in 1864. A siding was constructed to Ferrybank in 1883 to serve Hall's Flour Mills and in 1904 the main line was continued through Ferrybank and onward to New Ross, while a second line opened to Rosslare in 1906.

Plunkett Station, located within the extents of the proposed development boundary (NIAH 22500032) dates to 1908 and was originally built as a wing of the railway station, the main section of which has been replaced (Plate 15.4). The cast-iron platform canopy (RPS 709, NIAH 22500033) dates from the same period (Plate 15.5). The signal box (RPS 571, NIAH 22500027, which is elevated and spans the railway line, dates to c. 1930, and while it has been subject to some renovation retains its original character (Plate 15.6). A cast iron, freestanding post box is recorded adjacent to the station entrance, which is also listed within the RPS as 1036.

Country Houses

During the mid-late 18th century there was a dramatic rise in the establishment of large residential houses around the country. The large country house was only a small part of the overall estate of a large landowner and provided a base to manage often large areas of land that could be located nationwide. Lands associated with the large houses were generally styled to create a parkland (or demesne) landscape – to be able to view a large house within a natural setting. Although the creation of a parkland landscape involved working with nature, rather than against it, considerable constructional effort went into their creation. Earth was moved, field boundaries disappeared, streams were diverted to form lakes and quite often roads were completely diverted to avoid travelling anywhere near the main house or across the estate. It was popular to situate such houses near large rivers for picturesque views and activities such as boating and fishing. The post-medieval suburbs of Waterford City were particularly attractive for the establishment of demesnes and large houses along the River Suir. The study area of the proposed development contains two country houses, Newrath House (RPS C671) located 145m to the northeast of the proposed development and Newrath Lodge (RPS C672), located 191m to the northeast. Newrath House is earlier than Newrath Lodge and is marked on the first edition OS map (1839) with a demesne located to the northeast of what is now the R448. Newrath Lodge was constructed in the second part of the 19th century within what was part of the demesne associated with Newrath House.

Plate 15.4 Railway Station (NIAH 22500032), facing northwest

Plate 15.5 Platform canopy (RPS 709, NIAH 22500033), facing northwest

Plate 15.6 Signal box (RPS 571), facing west

15.3.2 Cartographic Analysis

15.3.2.1 William Petty's Down Survey, Map of the Barony of Ida Igrin Ibercon c. 1655

The study area is shown on the bank of the River Suir, to the north of the City and Liberties of Waterford. The area of the proposed development is located to the north of the River Suir, in open space with no structures shown.

15.3.2.2 William Richards and Bernard Scale's Plan of the City and Suburbs of Waterford, 1764

This historic map depicts the city and suburbs of Waterford, including a narrow section of the northern bank within the margin. No bridge is shown crossing the River Suir although a ferry boat slip is marked on the south bank directly opposite Ferrybank. Very little of the northern bank is depicted, though a small settlement is shown at Mount

Sion and Ferrybank to the east of the proposed development. The area of the proposed development, where it is shown, remains undeveloped and lies in open fields.

15.3.2.3 Nicholas Sinnott's Map of Waterford, 1830 (Plate 15.7)

By this time of this map, the wooden bridge that was constructed at the end of the 18th century is shown across the river. A road is now shown running west–east parallel with the river, along the route of the modern R711 and R448. To the north of the bridge a semi-circular scarped area appears to indicate a former quarry. The quayside to the east has been developed with numerous warehouses and storehouses indicated on the approach to Ferrybank. A number of structures are also indicated in the vicinity of the northern side of the bridge which would be within the proposed development boundary.

Plate 15.7 Extract from Sinnott's map of 1830 showing the approximate location of the proposed development

15.3.2.4 Patrick Leahy's Map of the city of Waterford and its environs..., 1834

There are no major changes to the area of the proposed development by this mapping, which was published only four years later.

15.3.2.5 First Edition Ordnance Survey Map, 1839-41, scale 1:10,560

The study area extends through the townlands of Mountmisery and Newrath. At this time the wooden bridge is shown with a Toll Gate marked on the northern bank of the River Suir. A group of structures are depicted in the immediate vicinity of the bridge's northern extent. A small demesne associated with Mountmisery Lodge is depicted to the immediate northeast of the proposed development. Newrath House (RPS C671) is also marked and is located within a demesne located to the north of what is now the R448.

15.3.2.6 Ordnance Survey Map, 1871, scale 1:1,250 (Plate 15.8)

Only a small portion of the eastern section of the proposed development is depicted on this map. The wooden bridge is depicted with a central draw bridge. On the northern bank, the Waterford and Limerick Railway Terminus has been established within the proposed development boundary, with the rail lines extending westwards. A number of terraced structures are shown lining the north of Dock Road and Terminus Street. The landscaped gardens of Knockane Villa (formerly Mountmisery Lodge) are shown to the northeast.

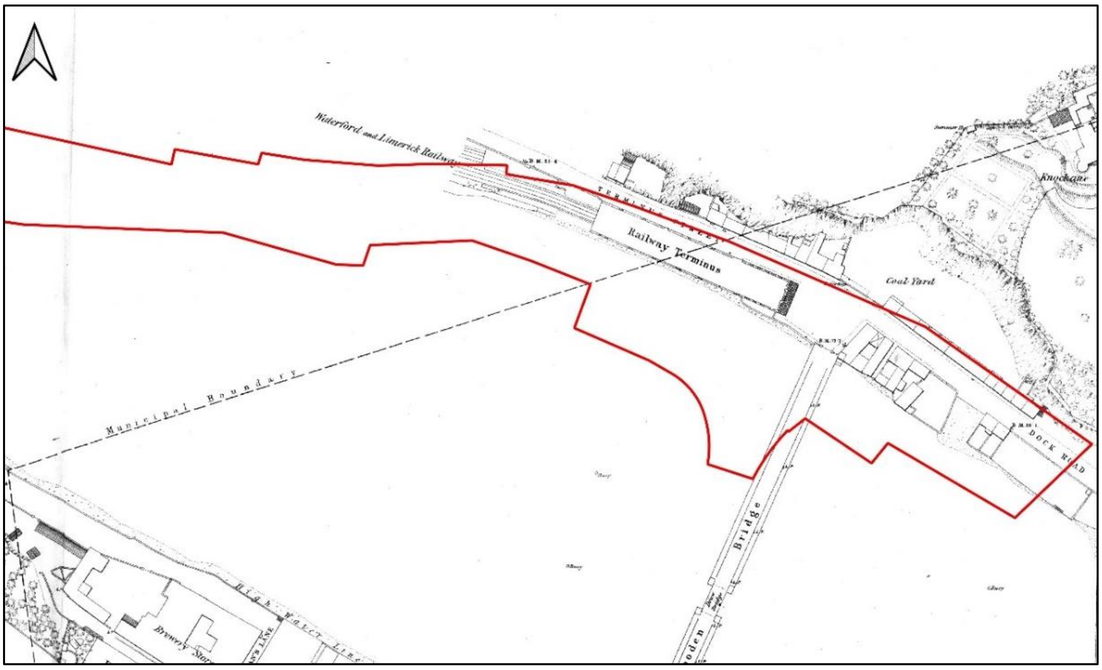


Plate 15.8 **Extract from OS map of 1871 showing the east of the proposed development**

15.3.2.7 Ordnance Survey Map, 1903/1907, scale 1:2,500 (Plate 15.9a/b)

The railway has expanded significantly by this time. Plunkett Station is at this time known as 'Waterford North Station' and is shown with a number of platforms. A number of landing stages are depicted along the river's edge. To the west of the main station a number of Goods Sheds, platforms and turn tables are shown. Newrath House is depicted with two small laneways leading south and southwest to the main road. Knockane Villa (formerly Mountmisery Lodge) is also shown to the northeast. The Newrath Road appears to cross the railway via a bridge. A large number of terraced structures are marked to the north of the development, in between the two areas of railway infrastructure.

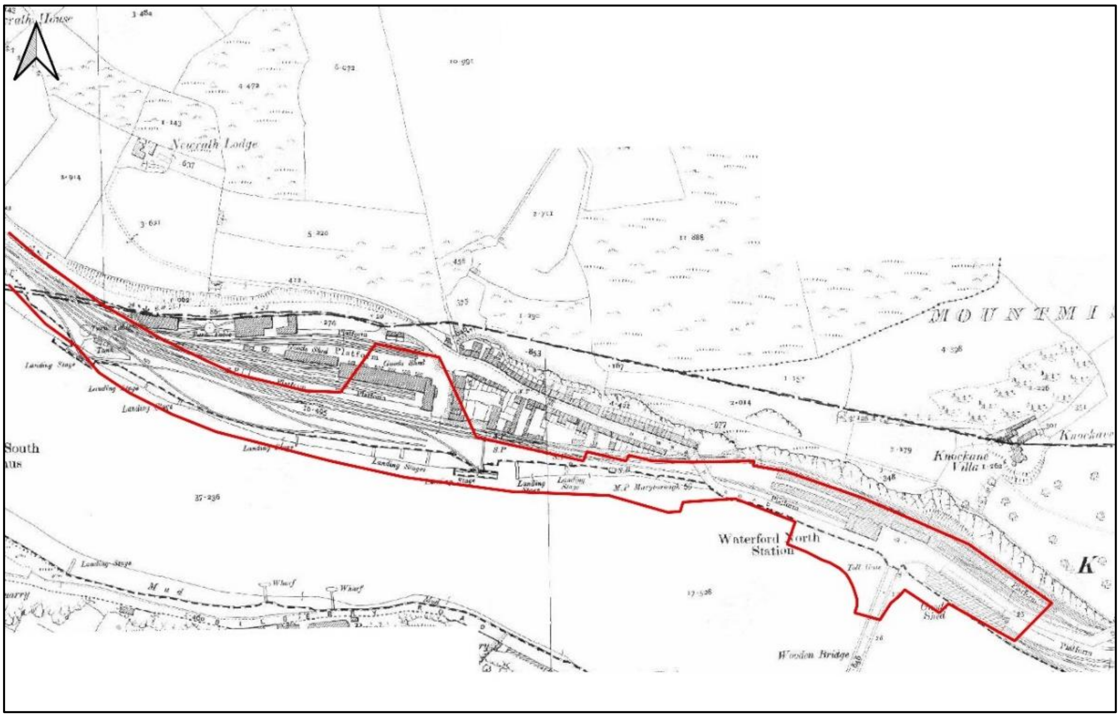


Plate 15.9a **Extract from OS map of 1903/7 showing the east of the proposed development**

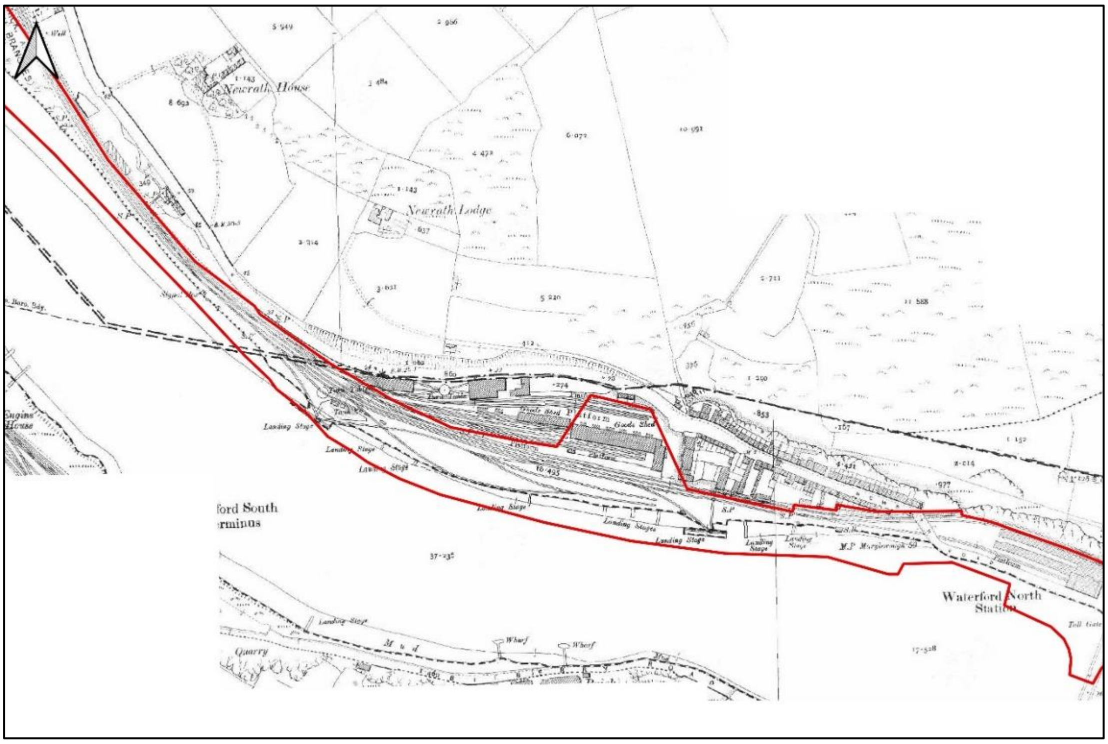


Plate 15.9b **Extract from OS map of 1903/7 showing the central part of the proposed development**

15.3.2.8 Ordnance Survey Map, 1909, scale 1:1,250 (Plate 15.10)

Only a portion of the proposed development is shown on this mapping of 1909. 'Waterford North Station' is shown with a number of platforms. The signal box (RPS 571/NIAH 22500027) is shown for the first time. A number of slips, wharfs and landing stages are depicted extending into the River Suir from the north bank of the river. Knockane Villa (formerly Mountmisery Lodge) is again depicted to the northeast.

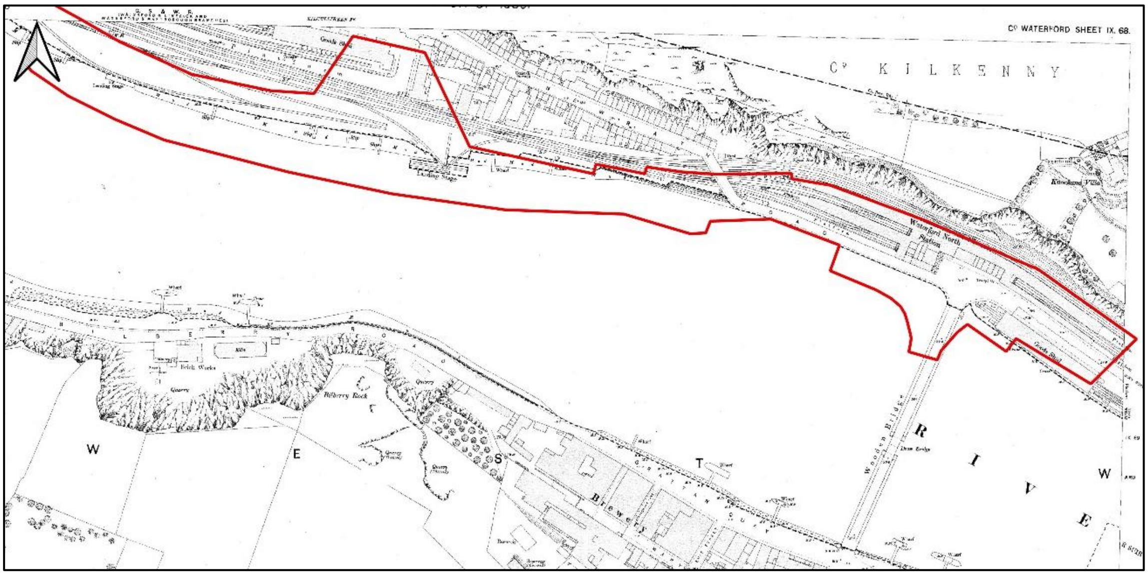


Plate 15.10 **Extract from OS map of 1909 showing the east of the proposed development**

15.3.2.9 Third Edition Ordnance Survey Map, 1953, scale 1:10,560

There is little change to the railway structures within the proposed development boundary by the time of this map. To the west of the proposed development a Manure Works has been established.

15.3.3 Development Plan

15.3.3.1 Built Heritage

The Record of Protected Structures (RPS) for Waterford City is set down in the Waterford City Development Plan 2013-2019 (as extended) and the Kilkenny County Development Plan 2014-2020 details the Record of Protected Structures for County Kilkenny. These records include a number of structures within the proposed development boundary and a number of structures within 200m of the development. There are five protected structures in total, including two which are also listed in the NIAH Building Survey (Table 15.2, Plate 15.2, Appendix 15.1).

Table 15.2 **Protected Structures within 200m of the proposed development**

RPS No.	Location	Classification	Distance from proposed development
709*	Mountmisery, Waterford	Railway Station (platform)	Within development Boundary
571*	Mountmisery, Waterford	Signal Box	Within development Boundary
1036	Railway Station (Mountmisery, Waterford)	Post Box	Within development boundary
C671	Newrath, Kilkenny	Newrath House	c. 145m north
C672	Newrath, Kilkenny	House	c. 191m north

*also listed in the NIAH Survey

15.3.3.2 Architectural Conservation Areas

There are no Architectural Conservation Areas within the study area or its immediate environs.

15.3.4 National Inventory of Architectural Heritage

15.3.4.1 Building Survey

A review of the architectural survey was undertaken as part of this assessment which included buildings within 200m of the study area. There are four structures listed on the NIAH building survey, including two that are also protected structures (Table 15.3, Plate 15.2, Appendix 15.1).

Table 15.3 NIAH Sites within 200m of the proposed development

NIAH Ref.	Location	Classification	Distance from proposed development
22500032	Mountmisery, Waterford	Railway Station	Within development Boundary
22500027*	Mountmisery, Waterford	Signal Box	Within development Boundary
22500033*	Mountmisery, Waterford	Platform	Within development Boundary
22500075	Mountmisery, Waterford	Bridge	Partially within the development Boundary

*also recorded as protected structure

15.3.4.2 Garden Survey

There are no demesne landscapes listed on the NIAH Garden Survey within the study area. However, the modest former demesne of Mountmisery Lodge, later known as Knockane Villa, is located to the immediate northwest of the proposed development and a demesne associated with Newrath House is located immediately north and northeast of the proposed development.

The aerial photography shows that the outline of Mountmisery Lodge demesne remains visible although portions of the parkland is overgrown with scrub. The principal structure is no longer present and a large, former hotel, has been constructed to the east of where the main building was located. A large amount of the specimen planting has been retained in the landscape and it retains its main driveway from the R448 that borders the demesne to the south. Due to the widening of the R448, the entrance and demesne boundary wall have been replaced with modern structures.

Newrath House demesne has retained some greenfield elements and specimen planting but has been impacted by scattered modern residential development. The widening of the R448 along the south-western boundary has also impacted on the original demesne boundary.

15.3.5 Results of Field Inspection

The field inspection sought to assess the site, its previous and current land use, the topography and any additional information relevant to the report. Access to the landside of the proposed development was not possible due to the presence of live railway tracks. Due to current Covid-19 restrictions and the required health and safety for live railway track access, the inspection was carried out on a boat from the River

Suir. The accessible sections of the development area were inspected on foot and photographic surveys compiled for ecological survey and geotechnical surveys in 2018 were also reviewed. Structures identified during the field inspection are identified in Plate 15.2.

A detailed description of the quay wall along the northern bank of the River Suir and any other associated features, such as landing stages, is included in Chapter 14 Archaeological and Cultural Heritage of the EIAR in the context of riverine archaeological and cultural heritage. This information is not repeated here.

The development boundary includes the northern section of the Edmund Rice Bridge (NIAH 22500075) and Plunkett Railway Station (NIAH 22500032). These structures are present and maintained in good condition due to their ongoing use. With the exception of the railway platform canopy (RPS 709, NIAH 22500033), former station wing (NIAH 22500032) and signal box (RPS 571), no other items of railway infrastructure survive in the vicinity of the proposed development area at the eastern end of the development area, although a post box adjacent to the station is included in the RPS as 1036. The dearth of historic structures is due to the widening of the existing road network and the insertion of a roundabout at the junction of the Edmund Rice Bridge and the R448. A plaque adjacent to the station and roundabout notes that it was opened in 1998 by Minister Noel Dempsey.

Further to the west, no built remains associated with the railway infrastructure located to the north of the river survive today, with the exception of a section of masonry boundary wall. The whole area now contains modern industrial structures. Similarly, the extensive terraced housing marked between the two areas of railway infrastructure (within the historic maps) has also been removed, due to the realignment and widening of the R448.

One surviving element of railway infrastructure was noted to the northwest of the flood development extents and southeast of the proposed main construction compound. The structure is not listed in the NIAH or the RPS. This comprises a signal box immediately adjacent to the northern edge of the river (Plate 15.11). The building comprises two-storeys and retains its hipped slate roof and wooden cladding but is in poor condition.

No other structures of architectural heritage merit were noted in and within the vicinity of the proposed development. A section of the metal railway bridge is present in the proposed compound area, which has been removed from the in-situ structure c. 700m to the northeast, outside of the study area for the assessment. The in-situ bridge is listed within the RPS as WA731015. This has been noted within Chapter 14 Archaeological and Cultural Heritage.

Plate 15.11 Signal box to the northwest of the proposed development

15.3.6 Summary of the Receiving Environment

The proposed development is located along the northern bank of the River Suir, in the townlands of Newrath, County Kilkenny and Mountmisery, County Waterford. Due to a slight change in the county boundary in the late 19th century, a small section of Newrath townland is now located in County Waterford. There are five recorded built heritage sites within the boundary of the proposed development, four relating to the railway (the Railway Station, Signal Box, Platform and post box) with the fifth comprising the Edmund Rice Bridge across the River Suir, which is only partially within the development boundary. The bridge and the original wing to the station are listed in the NIAH only and are not listed within the RPS. There are two additional built heritage sites within a 200m radius of the proposed development. The modest former demesne of Mountmisery Lodge, later known as Knockane Villa, is also located to the immediate northeast of the development, with the demesne associated with Newrath House located to the north and northeast.

Cartographic sources depict the proposed development area as occupied by the railway lines and associated infrastructure from the mid-19th century. The development of the railway is clearly visible in the historic mapping. The Railway Station structure that remains within the proposed development (NIAH 22500032) dates to 1908 and was built as a wing of the original railway station, which has been replaced. The cast-iron platform canopy (RPS 709, NIAH 22500033) dates from the same time.

Although the study area was dominated by railway infrastructure during the early 20th century, a field inspection confirmed that a large portion of these features have been removed, with the exception of the recorded elements at the station site. In addition, much of the terraced housing that formerly occupied the area to the north of the river has also disappeared due to the expansion of the road network. One post medieval signal box was noted to the northwest of the proposed development, adjacent to northern bank of the river. The structure retains some original elements but is in overall poor condition.

The existing quay wall along the northern bank of the River Suir has been noted and described in detail within Chapter 14 Archaeological and Cultural Heritage of this EIAR, in the context of riverine archaeological and cultural heritage.

15.4 Description of Potential Impacts

It is proposed to erect glass flood barriers along the three roundabout arms, at the Edmund Rice Bridge roundabout, to the immediate north of the bridge and south of the railway station. Demountable flood barriers are also proposed on the R680 Edmund Rice Bridge for the section leading to the North Quays Strategic Development Zone (see Figure 4.1 to 4.6 of Volume 3 in this EIAR). Ground works associated with required drainage and the underground impermeable trench will also be carried out within the car park associated with the existing train station. The glass and the demountable flood barriers, and ground disturbances, which are proposed will not result in any negative direct or indirect impacts, either during construction or the operation of the development, on the bridge, station and post box. This is due to the developed nature of the existing suburban environment and the minimal changes proposed by the proposed development.

The post medieval signal box, which is located to the northwest of the proposed flood development works, will not be negatively impacted by the works, as no changes are proposed to the structure or its setting.

15.5 Mitigation & Monitoring Measures

No mitigation measures relating to the architectural heritage resource are required as either part of the construction or operation of the proposed development.

15.6 Residual Impacts

No residual impacts on predicted upon the architectural heritage resource.

15.7 Difficulties Encountered

No access to the landward side of the proposed scheme (along the river) was possible during field inspections and as such the northern bank of the river was inspected from a boat in the River Suir. It should be noted that photographs from an ecological survey and geotechnical survey, carried out in 2018, were also reviewed in order to supplement the field inspection.

15.8 References

Environmental Protection Agency. 2015 Draft Advice Notes on Current Practice (in the preparation of Environmental Impact Statements). Dublin. Government Publications Office.

Environmental Protection Agency. 2017 Draft Guidelines on the Information to be Contained in Environmental Impact Statements. Dublin. Government Publications Office.

Kilkenny County Development Plan 2014-2020

Ryland, R.H. 1824 The History, Topography and Antiquities of the County and City of Waterford. London (reprint).

Smith, C. 1746 State of the County and City of Waterford: Being a Natural, Civil, Ecclesiastical, Historical and Topographical Description thereof. Reprinted 1969, Mercier Press, Cork.

Waterford City Development Plan, 2013-2019 (as extended).

Cartographic Sources

William Petty, Down Survey, Map of the Barony of Ida Igrin Ibercon, c. 1655

William Richards and Bernard Scale, Plan of the City and Suburbs of Waterford, 1764

Nicholas Sinnott, Map of Waterford, 1830

Patrick Leahy, Map of the city of Waterford and its environs..., 1834
Ordnance Survey Mapping 1839-1953

Electronic Sources

www.heritagemaps.ie – The Heritage Council web-based spatial data viewer which focuses on the built, cultural and natural heritage.

www.googleearth.com – Satellite imagery of the proposed development area.

www.bingmaps.com – Satellite imagery of the proposed development area.

www.buildingsofireland.ie – Results of the NIAH Building and Garden Survey

Appendix 15.1
RPS/NIAH Sites within the Surrounding Area

APPENDIX 15.1
RPS/NIAH Sites within the Surrounding Area

RPS No.	571
NIAH Ref.	22500027
Townland	Mountmisery
Parish	Kilculliheen
Barony	Kilculliheen
I.T.M.	660089/613163
Classification	Signal Box, Plunkett Railway Station
Dist. From Development	Within proposed development
Description	**Description** Freestanding five-bay two-storey elevated signal box, c.1930, over railway line with two-bay two-storey side elevation to south. Extensively renovated, pre-1999, with support replaced. Hipped slate roof with clay ridge tiles and cast-iron rainwater goods on timber eaves. Painted timber-clad walls. Square-headed window openings with timber sills. Replacement uPVC casement windows, pre-1999. Square-headed door opening approached by flight of replacement iron steps, pre-1999, with replacement tongue-and-groove timber panelled door, pre-1999. Sited spanning railway line on replacement single-span steel frame, pre-1999, with lattice supports, steel pillars to south, and red brick Common bond pier to north. **Appraisal** The appearance of this signal box is not unlike many signal boxes built around the country during the development of the railway network in the nineteenth century. However, it is distinguished by its position, elevated spanning the railway line on a metal support, which is of technical significance. The signal box, despite renovations in the late twentieth century, retains most of its original form and some of its early character and, together with a portion of the original railway station building (22500032/WD-5632-16-32) and the platform canopy (22500033/WD-5632-16-33), is of significance as a reminder of the original railway station complex in Waterford City, much of which has subsequently been replaced.
Reference	www.buildingsofireland.ie/ Waterford City County Development Plan 2013-2019

RPS No.	N/a
NIAH Ref.	22500032
Townland	Mountmisery
Parish	Kilculliheen
Barony	Kilculliheen
I.T.M.	660247/613089
Classification	Railway Station
Dist. From Development	Within proposed development
Description	**Description**

	Detached fifteen-bay single-storey red brick building, opened 1908, retaining early aspect, and originally built as wing to railway station. Now in use as offices. Pitched slate roof with clay ridge tiles, cut-stone coping, and cast-iron rainwater goods on timber eaves. Red brick English bond walls with moulded red brick course to eaves. Square-headed window openings to front (south) elevation with cut-limestone flush sills, wrought iron sill guards and cut-limestone lintels having chamfered reveals. 6/9 timber casement windows. Square-headed door openings with cut-limestone lintels, timber panelled doors and overlights. Square-headed window openings to platform (north) elevation with timber sills, surrounds and continuous cornice over. 6/2 timber casement windows. Square-headed door openings with timber surrounds, continuous cornice over, timber panelled doors and overlights. Road fronted with concrete flagged footpath to front, and concrete flagged platform to north. **Appraisal** This building, built as a wing to the original railway station building on site, is an attractive composition of regular proportions that has been well maintained to present an early aspect. The building, together with the signal box (22500027/WD-5632-16-27) and platform canopy (22500033/WD-5632-16-33), is of significance as a reminder of the original railway station complex in Waterford City, the station building of which was subsequently replaced. The building retains many important salient features and materials to the exterior, and it is believed that some original fittings to the interior also survive intact. The building is an attractive feature of the streetscape of Dock Road, terminating the vista from Rice Bridge to the south.
Reference	www.buildingsofireland.ie/ Waterford City County Development Plan 2013-2019

RPS No.	709
NIAH Ref.	22500033
Townland	Mountmisery
Parish	Kilculliheen
Barony	Kilculliheen
I.T.M.	660232/613099
Classification	Platform, Plunkett Railway Station
Dist. From Development	Within proposed development
Description	**Description** Freestanding canopy, built 1908, over platform on cast-iron piers. Series of hipped felt roofs in timber frames on cast-iron beams and lattice girders with reeded Perspex skylights, and cast-iron rainwater goods on timber eaves having timber boarded apron. Series of paired cast-iron girder piers on cast-iron plinths having moulded necking. Sited sheltering concrete flagged platform. **Appraisal** This canopy, which extends almost the entire length of the railway station complex, is an attractive composition in early surviving cast-iron work. The construction of the canopy is of technical significance. The canopy, together with the signal box (22500027/WD-5632-16-27) and the surviving portion of the original railway station (22500032/WD-5632-16-32), is of significance as a reminder of the original railway station

	complex in Waterford City, much of which has subsequently been replaced.
Reference	www.buildingsofireland.ie/ Waterford City County Development Plan 2013-2019

RPS No.	1036
NIAH Ref.	N/a
Townland	Mountmisery
Parish	Kilculliheen
Barony	Kilculliheen
I.T.M.	660214/613096
Classification	Post Box
Dist. From Development	Within proposed development
Description	Free standing cylindrical cast iron post box adjacent to the modern entrance into Plunkett Station.
Reference	Waterford City County Development Plan 2013-2019

RPS No.	N/a
NIAH Ref.	22500075
Townland	Mountmisery
Parish	Kilculliheen
Barony	Kilculliheen
I.T.M.	660173/612953
Classification	Edmund Rice Bridge
Dist. From Development	Partially within the proposed development
Description	**Description** Nine-span concrete road bridge over river, built 1986, with pair of pre-cast concrete oblong piers to centre having single-bay single-storey flat-roofed control tower to west. Series of nine reinforced concrete spans (lifting spans to centre) on concrete cylindrical piers with hollow iron railings over to parapet. Flat concrete roof to control tower. Square-headed window openings with fixed-pane tapered aluminium windows. Sited spanning River Suir. **Appraisal** This bridge is an imposing feature on the approach into Waterford City and is of significance continuing the long-standing presence of a bridge on the same section of the River Suir, the earliest bridge having been built in the late eighteenth century. The construction of the bridge, including the lifting span to centre, is of considerable technical and civil engineering importance.
Reference	www.buildingsofireland.ie/ Waterford City County Development Plan 2013-2019

RPS No.	C671
NIAH Ref.	-
Townland	Newrath
Parish	Kilculliheen
Barony	Kilculliheen
I.T.M.	659302,613645
Classification	Newrath House
Dist. From Development	c. 145m north
Description	No description given.
Reference	www.buildingsofireland.ie/ Kilkenny County Development Plan 2014-2020

RPS No.	C672
NIAH Ref.	-
Townland	Newrath
Parish	Kilculliheen
Barony	Kilculliheen
I.T.M.	659582,613432
Classification	House
Dist. From Development	c. 191m north
Description	No description given.
Reference	www.buildingsofireland.ie/ Kilkenny County Development Plan 2014-2020

Appendix 15.2
Legislation Protecting the Architectural Resource

APPENDIX 15.2
Legislation Protecting The Architectural Resource

The main laws protecting the built heritage are the Architectural Heritage (National Inventory) and National Monuments (Miscellaneous Provisions) Act 1999 and the Local Government (Planning and Development) Acts 1963–1999, which has now been superseded by the Planning and Development Act, 2000. The Architectural Heritage Act requires the Minister to establish a survey to identify, record and assess the architectural heritage of the country. The background to this legislation derives from Article 2 of the 1985 Convention for the Protection of Architectural Heritage (Granada Convention). This states that:

> *For the purpose of precise identification of the monuments, groups of structures and sites to be protected, each member state will undertake to maintain inventories of that architectural heritage.*

The National Inventory of Architectural Heritage (NIAH) was established in 1990 to fulfil Ireland's obligation under the Granada Convention, through the establishment and maintenance of a central record, documenting and evaluating the architecture of Ireland (NIAH Handbook 2005:2). As inclusion in the inventory does not provide statutory protection, the survey information is used in conjunction with the Architectural Heritage Protection Guidelines for Planning Authorities to advise local authorities on compilation of a Record of Protected Structures as required by the Planning and Development Act, 2000.

Protection Under the Record of Protected Structures and County Development Plan

Structures of architectural, cultural, social, scientific, historical, technical or archaeological interest can be protected under the Planning and Development Act, 2000, where the conditions relating to the protection of the architectural heritage are set out in Part IV of the act. This act superseded the Local Government (Planning and Development) Act, 1999, and came into force on 1st January 2000.

The act provides for the inclusion of Protected Structures into the planning authorities' development plans and sets out statutory regulations regarding works affecting such structures. Under new legislation, no distinction is made between buildings formerly classified under development plans as List 1 and List 2. Such buildings are now all regarded as 'Protected Structures' and enjoy equal statutory protection. Under the act the entire structure is protected, including a structure's interior, exterior, attendant grounds and also any structures within the attendant grounds.

The act defines a Protected Structure as (a) a structure, or (b) a specified part of a structure which is included in a Record of Protected Structures (RPS), and, where that record so indicates, includes any specified feature which is in the attendant grounds of the structure, and which would not otherwise be included in this definition. Protection of the structure, or part thereof, includes conservation, preservation, and improvement compatible with maintaining its character and interest. Part IV of the act deals with architectural heritage, and Section 57 deals specifically with works affecting the character of Protected Structures or proposed Protected Structures and states that no works should materially affect the character of the structure or any element of the structure that contributes to its special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest. The act does not provide specific criteria for assigning a special interest to a structure. However, the National Inventory of Architectural Heritage (NIAH) offers guidelines to its field workers as to how to designate a building with a special interest, which are not mutually exclusive. This offers guidance by example rather than by definition:

Archaeological

It is to be noted that the NIAH is biased towards post-1700 structures. Structures that have archaeological features may be recorded, providing the archaeological features are incorporated within post-1700 elements. Industrial fabric is considered to have technical significance and should only be attributed archaeological significance if the structure has pre-1700 features.

Architectural

A structure may be considered of special architectural interest under the following criteria:

- Good quality or well executed architectural design.
- The work of a known and distinguished architect, engineer, designer, craftsman
- A structure that makes a positive contribution to a setting, such as a streetscape or rural setting.
- Modest or vernacular structures may be considered to be of architectural interest, as they are part of the history of the built heritage of Ireland.
- Well-designed decorative features, externally and/or internally.

Historical

A structure may be considered of special historical interest under the following criteria:

- A significant historical event associated with the structure.
- An association with a significant historical figure.
- Has a known interesting and/or unusual change of use, e.g. a former workhouse now in use as a hotel.
- A memorial to a historical event.

Technical

A structure may be considered of special technical interest under the following criteria:

- Incorporates building materials of particular interest, i.e. the materials or the technology used for construction.
- It is the work of a known or distinguished engineer.
- Incorporates innovative engineering design, e.g. bridges, canals or mill weirs.
- A structure which has an architectural interest may also merit a technical interest due to the structural techniques used in its construction, e.g. a curvilinear glasshouse, early use of concrete, cast-iron prefabrication.
- Mechanical fixtures relating to a structure may be considered of technical significance.

Cultural

A structure may be considered of special cultural interest under the following criteria:

- An association with a known fictitious character or event, e.g. Sandycove Martello Tower, which featured in Ulysses.
- Other structure that illustrates the development of society, such as early schoolhouses, swimming baths or printworks.

Scientific

A structure may be considered of special scientific interest under the following criteria:

- A structure or place which is considered to be an extraordinary or pioneering scientific or technical achievement in the Irish context, e.g. Mizen Head Bridge, Birr Telescope.

Social

A structure may be considered of special social interest under the following criteria:

- A focal point of spiritual, political, national or other cultural sentiment to a group of people, e.g. a place of worship, a meeting point, assembly rooms.
- Developed or constructed by a community or organisation, e.g. the construction of the railways or the building of a church through the patronage of the local community.
- Illustrates a particular lifestyle, philosophy, or social condition of the past, e.g. the hierarchical accommodation in a country house, philanthropic housing, vernacular structures.

Artistic

A structure may be considered of special artistic interest under the following criteria:

- Work of a skilled craftsman or artist, e.g. plasterwork, wrought-iron work, carved elements or details, stained glass, stations of the cross.
- Well-designed mass-produced structures or elements may also be considered of artistic interest.

(From the NIAH Handbook 2003 & 2005 pages 15–20)

The Local Authority has the power to order conservation and restoration works to be undertaken by the owner of the protected structure if it considers the building to need repair. Similarly, an owner or developer must make a written request to the Local Authority to carry out any works on a protected structure and its environs, which will be reviewed within three months of application. Failure to do so may result in prosecution.

Waterford City Development Plan 2013–2019 (as extended);

The Development Plan contains the following policies with regard to the architectural resource:

POL 10.2.1: To promote the protection of the architectural heritage of the City through the identification of structures of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest, by the inclusion of such structures on the RPS and by taking such steps as are necessary to ensure the protection of those structures.

POL 10.2.2: To promote the sustainable reuse of protected structures for any such purpose compatible with the character of the structure. The Planning Authority may, where considered appropriate, relax use zoning and other site development restrictions and may grant exemption from or reduce the amounts of development contributions payable in order to secure the protection and conservation of protected structures. These restrictions may be relaxed and development contributions reduced or exempted where the protected structure will be rehabilitated to a high standard, where the special interest, character and setting of the building is protected and where the proposed use and development is consistent with conservation policies and the proper planning and sustainable development of the area. In such cases the proposed development shall be open for consideration notwithstanding the current zoning objective for the site and therefore shall be considered as not materially contravening the Development Plan.

POL 10.2.3: To protect the structures included on the Record of Protected Structures their curtilage and setting from any works that would result in the loss or damage to their special character.

It is an objective of Waterford City Development Plan:

OBJ 10.2.1: To review the Record of Protected Structures during the lifetime of the Development Plan to ensure all records are consistent with the criteria for inclusion on the RPS, by being of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest.

OBJ 10.2.2: To include all of the structures within the city which are, in the opinion of the planning authority, of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest, in the Record of Protected Structures (RPS) and to ensure the protection of all structures included in the RPS.

OBJ 10.2.3: To carry out an audit of all protected structures in the ownership of the City Council with a view to securing uses that are compatible with the character of the individual protected structure.

OBJ 10.2.4: To achieve the protection of the architectural heritage within the city by giving advice to owners of protected structures on appropriate measures or actions to take in regard to their property; by promoting best practice in the use of materials in repair and adaptation work, including referral to appropriate documents such as the 'Architectural Heritage Protection, Guidelines for Planning Authorities, 2004' issued by the Department of the Environment, Heritage and Local Government; and the use of skilled specialist practitioners in the conservation of protected structures.

OBJ 10.2.5: In considering development which may have a significant impact on the architectural heritage to require the preparation and submission of an architectural heritage impact assessment detailing the potential impact of the development on the architectural heritage. The report shall be compiled generally in accordance with the details set out in Appendix B of the Architectural Heritage Protection Guidelines for Planning Authorities, Department of the Environment, Heritage & Local Government, 2004.

OBJ 10.2.6: To issue declarations on request to owners or occupiers of protected structures detailing the type of works that it is considered would or would not materially affect the character of the structure or of any element of the structure which contributes to its special interest.

OBJ 10.2.7: To promote public awareness of the value of the protected structures within the city and the positive contribution protected structures make to the built environment, the distinctiveness and authenticity of the city and the tourism potential of the city and to develop specific measures to achieve such awareness.

OBJ 10.2.8: To identify and implement measures for promoting the character and distinctiveness of the historic city and improving its physical condition and presentation.

OBJ 10.2.9: To seek the retention and repair of shop and pub fronts of architectural interest.
Kilkenny County Development Plan.

The Development Plan contains the following policies with regard to the architectural resource:

- The Council will have regard to the Architectural Heritage Protection Guidelines when assessing proposals for development affecting a protected structure.
- To encourage the sympathetic retention, reuse and rehabilitation of protected structures and their setting.

- To have regard to the Architectural Heritage Protection Guidelines when assessing applications and proposals for development affecting structures included in the National Inventory of Architectural Heritage.
- To seek the protection and sustainable management of historic gardens, parklands and designed landscapes in the county, their setting and their visual amenity.
- To have regard to the Architectural Heritage Protection Guidelines, when assessing proposals for development affecting the character of an ACA
- To ensure the retention, repair rather than replacement and the regular maintenance of original/early features in buildings which contribute to the character of an ACA such as chimney stacks, roof coverings, roof profiles, external wall treatments, doors and windows, shopfronts and pubfronts and to ensure the use of appropriate materials and repair techniques when repairs are being carried out.
- To ensure that inappropriate materials such as windows, doors and rainwater goods constructed in aluminium or uPVC are not introduced to buildings within ACAs.
- To encourage high quality, contemporary design and materials where appropriate when new buildings are being introduced into an ACA and the retention of the historic scale and plot size.
- To ensure the preservation of the character of an ACA when assessing proposals for advertising
- To retain historic items of street furniture where they contribute to the character of the ACA and to protect historic items of street furniture and roadside items as appropriate.
- To ensure the conservation of historic shopfronts and pubfronts. Where replacement is necessary, to encourage the introduction of shopfronts and pubfronts of contemporary high-quality design and materials.
- To seek the retention of mature trees/significant planting (those in good condition) which contribute to the character of each ACA where appropriate.

Chapter 16
Material Assets and Land

Chapter 16 Material Assets and Land

16.1 Introduction

The Material Assets and Land chapter assesses the impact of the proposed development on material assets which are defined as physical resources in the environment, which may be either of human or natural origin such as built services, residential and commercial property, development land or maritime businesses within the study area. A development may also affect material assets if it involves any of the following:

- Acquisition of land; and
- Changes to existing services and infrastructure.

16.2 Methodology

16.2.1 Guidelines

The following EPA guidance and guideline documents have informed the assessment process:

- Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA, 2017);
- Draft Advice Notes for Preparing Environmental Impact Statements (EPA, 2015);
- Advice notes on Current Practice in the Preparation of Environmental Impact Statements (EPA, 2003); and
- Guidelines on the information to be contained in environmental impact statements (EPA, 2002).

16.2.2 Scope

This chapter will describe the receiving environment and determine the significance of the impact of the proposed development on:

- Land use and ownership – an examination of impacts on housing, severance, loss of rights of way or amenities, conflicts, or other changes likely to ultimately alter the character and use of the surroundings;
- Local economy, businesses, and community facilities – an assessment of the effect on the operation of local businesses and community at construction and operation phases of the proposed development.
- Transport Infrastructure; and,
- Existing services and utilities

16.2.3 Study Area

There is no official guidance on the appropriate geographical scope (i.e. study area) to apply in the assessment of impacts on material assets and land. Since this assessment considers the impacts on a variety of different aspects of the environment, the geographical scope of the assessment will be applied on a case-by-case basis for each of the headings of the assessment, using professional judgement.

16.2.4 Sources of Information

In order to complete this assessment, a baseline study of the existing material assets environment has been undertaken. The sources of information contained in Table 16.1 were consulted in the process of this assessment.

Table 16.1 Information Used in Assessment and Sources

Information	Source
Landowner Information	• Waterford City and County Council
Land Use	• Waterford City Development Plan 2013 – 2019 (as extended) • Draft Waterford City and County Development Plan 2022 - 2028 • Kilkenny City and County Development Plan 2021 - 2027 • Corine Landcover, (2018)
Mapping and project information	Roughan & O'Donovan

In addition to the sources listed above, aerial photography, OSI maps, Google Maps and a site layout plan of the existing area and proposed development have been reviewed.

The Material Assets and Land Chapter should be read in conjunction with the following chapters:

- Chapter 4 – Description of the Proposed Development;
- Chapter 5 – Traffic Analysis;
- Chapter 6 – Population and Human Health;
- Chapter 10 – Hydrology; and
- Chapter 12 – Noise and Vibration.

16.3 Description of Receiving Environment

16.3.1 Land Use and Ownership

Corine 2018 landcover data[1] was consulted to categorise the land use within the study area of the proposed development. The land use is classified as 'artificial surfaces' by Corine 2018 landcover data, consisting of industrial, commercial and transport units which corresponds to the land use patterns observed on desktop mapping tools such as aerial photography and Google Earth satellite maps. The land use adjacent to the proposed flood defences consists of the live railway infrastructure serviced by Plunkett Station and the Sallypark Industrial Estate which are under the ownership of Córas Iompair Éireann (CIÉ) and operated by Iarnród Éireann (IÉ). Waterford City and County Council has been in consultation with IÉ since the beginning of the proposed development to gain access into the site across the live railway line.

The River Suir bounds the proposed development to the south. Elements of the proposed development, such as riverside installation of sheet piles and drainage works will be carried out within the foreshore of the River Suir.

[1] EPA Maps. Source: https://gis.epa.ie/EPAMaps/

The proposed development is also located on lands not in the ownership of CIÉ or WCCC and mainly constitute existing road network, including section of the Rice Bridge roundabout and its approach roads: R680 Rice Bridge, R447 Terminus Street and R711 Dock Road.

Unregistered lands are also present within the site boundary of the proposed development as shown in Figures 16.1 – 16.6 in Volume 3 of this EIAR.

16.3.2 Local Economy and Businesses

Waterford City is recognised as a Gateway City in the South East of Ireland and is the largest economic centre in the South East. The economic activity of the city is dominated by the commercial, retail, industrial and tourism industries. Additionally, major sources of employment within the city include the Health Service Executive (HSE), government offices, the Department of Education and Waterford Institute of Technology (WIT).

Waterford City is the largest urban area in the South East of Ireland and is an important tourism centre with good transport linkages for both public and private transport. Waterford City is located within Ireland's Ancient East which is a Fáilte Ireland tourism initiative, see Plate 16.1. The aim of the initiative is to attract visitors to areas in Ireland which are renowned for historical features. It is expected that tourism will increase in Waterford City and County as a result of this investment and promotional drive.

Plate 16.1 Image Presenting Ireland's Ancient East. Source: www.irelandsancienteast.com

The closest commercial enterprises, the Swan Plastics Limited and the Paving Yard are located within the Sallypark Industrial Estate adjacent to the proposed development. Similarly, the area on the south bank of the River Suir, parallel to the proposed flood defences primarily contains commercial and industrial enterprises, such as the Waterford Distillery, Fastnet Shipping and Heritage Irish Crystal.

16.3.2.1 Community Facilities

In terms of community facilities, Waterford City offers a large selection of restaurants, cafes, hotels, bars and shops along with visitor attractions such as museums. These facilities have developed in the area over many years and provide important attractions to potential visitors. Additionally, a number of shopping centres of regional importance are located in close proximity to the study area including City Square Shopping Centre and George's Court Shopping Centre. The study area of the proposed development is located in an isolated area on the north quays of Waterford City, characterised by the historically heavy industrial usage, whereas the majority of the aforementioned community facilities are located on the south quays of the city.

16.3.3 Transport Infrastructure

The transport infrastructure within the extents of the Waterford north quays area is shown in Plate 16.2 and discussed below.

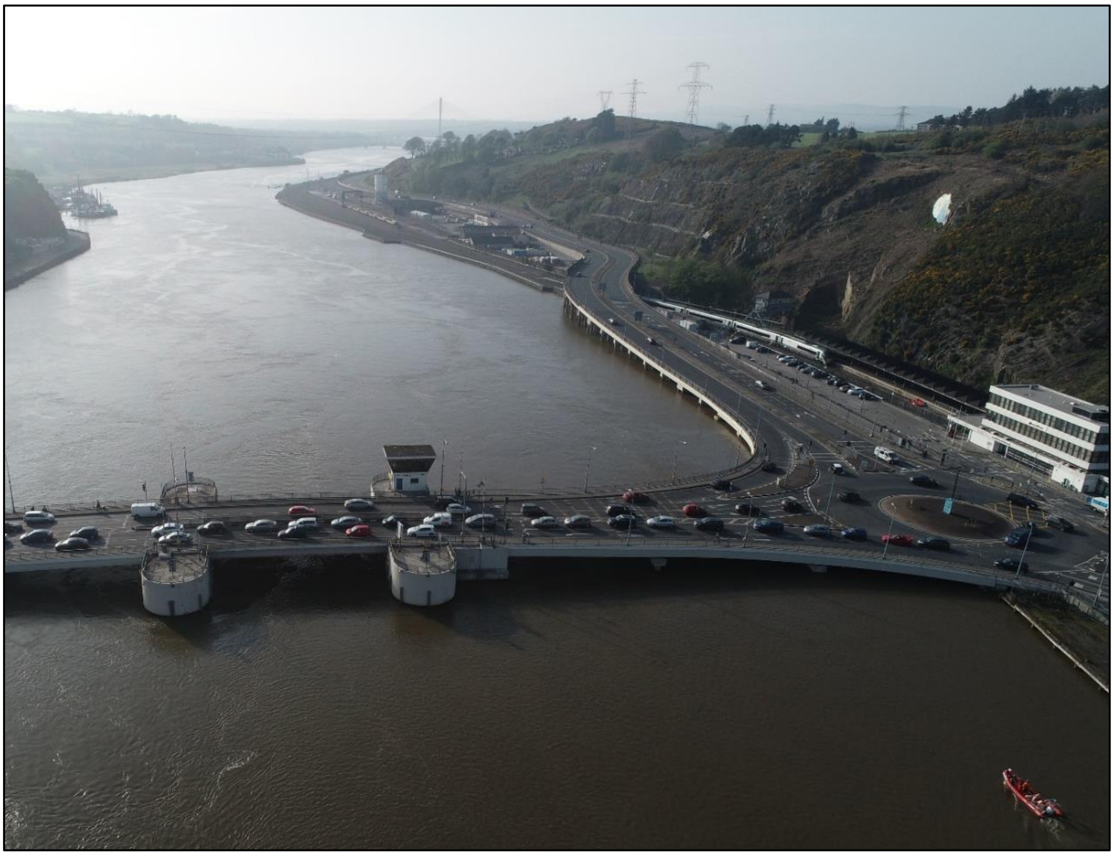


Plate 16.2 Transport Infrastructure within the north quays of Waterford City

Road Infrastructure

Waterford City is connected to major surrounding regions, towns and cities through the existing road network and through bus and train services. There is a high concentration of commuting traffic to, from and through Waterford City.

The road transport network within the study area consists of the R680 regional road which carries traffic across the River Suir via Rice Bridge to and from Waterford South Quays. The Rice Bridge roundabout (as shown in Plate 16.2) located on the north quays provides a connection to the regional road network and the wider area, for the city of Waterford. To the east of the roundabout, the R711 Dock Road serves the Ferrybank/Belview area before joining the N29. From the west of the roundabout, the R448 dual carriageway carries traffic to and from the city providing a connection to the N25. The R448 dual carriageway is located to the north of the proposed development.

Rail Infrastructure

The study area of the proposed development contains the Waterford Railway corridor serviced by Plunkett Station.

Presently, Plunkett Station serves as a significant interchange point for Intercity services from Dublin Heuston and from Limerick Junction, which provides onward connections to Cork, Limerick and Galway. Before the Covid-19 pandemic, seven train services operated each way between Waterford and Dublin from Monday to Saturday inclusive, while only four services were provided each way on Sundays. Only two train services operated each way between Waterford and Limerick Junction on Mondays to Saturdays inclusive.

Train timetables for both railway lines have been revised on 21st of March 2021 as a result of the Covid-19 pandemic and are subject to updates which are dependent on the level of restrictions. The most up to date timetables are included in Appendix 16.1.

Until 18th September 2010, there was one daily service provided each way between Waterford and Rosslare, however due to low passenger numbers and competition with the road network, the rail corridor was suspended (NTA, 2010). The rail service was replaced by bus services to provide connection to Waterford City from Rosslare. This railway corridor is currently out of service and maintained by Iarnród Éireann. Freight and engineering trains still operate fortnightly between the Waterford to Belview Port section of the rail corridor for deliveries.

The operation of the rail infrastructure in Waterford City has been impacted by recurring flood events. Over the past 15 years, flooding at and in the vicinity of Plunkett Station has been reported in news articles[2] and observed by the Iarnród Éireann (IÉ) Inspection Staff – the latest being in October of 2020 (see Plate 16.3 below). It has been found that large sections of the existing quay walls which separate the rail infrastructure from the River Suir are of inadequate height and are below the design flood level of +4.0mOD, rendering them ineffective at protecting IÉ lands and the associated rail infrastructure against flooding. The flood waters frequently enter into Iarnród Éireann (IÉ) property and affect the railway infrastructure.

[2] www.journal.ie published an article on the 17th of Oct. 2012 entitled 'Waterford train station is flooded… very flooded".

www.theirishindependant.ie published an article on the 11th of March 2008 entitled "Escaping in the eye of the storm" and describes that rail services at the existing Plunkett train station were affected due to flooding resulting in bus transfers to be put in place.

Plate 16.3 Flooding at the Plunkett Station in October 2020

River Navigation

The River Suir is a popular navigational channel for recreational and commercial vessels. On the south quays approximately 300m downstream of the proposed development is the location of Waterford City Marina (parallel to Meagher's Quay at the Clock Tower) that is owned and operated by Waterford City and County Council (WCCC). The marina contains both a pontoon, and a floating jetty.

The pontoon is 238m in length and is capable of berthing vessels on both the river side and the land side. The pontoon is used all year round and is busiest during the summer months. The floating jetty is designed to accommodate 40 vessels. The floating jetty is a popular berthing area as the River Suir is deep at this section and is not affected by silting. It is also popular as it is close to the city centre and has a number of adjacent facilities for boat owners including wifi, showers, toilets and laundry facilities.

Two commercial maritime companies are located on the south quays of the city, upstream of Rice Bridge; Fastnet Shipping Ltd. and South East Tug Services Ltd. Furthermore, during storms, fishing trawlers moor upriver, just below Rice Bridge on both the north and south wharfs.

16.3.4 Utilities

A Ground Penetrating Radar (GPR) survey was carried out in October 2018 between Ch.300 and Ch.1090 (see Figures 16.7 to 16.12 in Volume 3 of the EIAR for chainage references) which encompasses the lands adjacent to the existing quay wall and the river embankment where construction works are to take place. The aim of the survey was to determine the nature and condition of existing rail network services. Figures 16.7 to 16.12 in Volume 3 of the EIAR show the existing utilities within the site boundary of the proposed development based on the findings of the survey, and are outlined below:

Overhead Power Lines: There is a large concentration of overhead power lines spanning the River Suir from the Waterford 110kV Substation located on Waterford south quays. A section of the site boundary is located directly below these power lines.

Water Mains/Fire Mains: Two water main 25mm pipes, two hydrants and a sluice valve were found within the study area.

Underground power lines: One electrical line was found within the study area.

Eircom, UPC (Virgin), BT and other Comms: No evidence of the Eircom, BT, and UPC networks was found within the study area.

Gas, Oil and Fuel mains: Two oil pipes were found with the study area entering and exiting ground from a tank and the nearby signal cabin building at Ch.1150 (see Figure 16.7 – 16.12 for chainage reference points). No evidence of gas pipes was found within the study area.

Unknown Cables/Empty Ducks and Services: Multiple unknown cables were found within the study area, most of these were running along the railway track with some of them crossing the track. See Figures 16.7 – 16.12 in Volume 3 for their location.

16.3.5 Utilities within the Irish Rail Car Parking Area

It is proposed to construct a shallow underground impermeable trench (1m in width and up to 3m in depth) within the car parking areas of Waterford (Plunkett) Station as part of the proposed development to cut-off groundwater flows during high tide events from Ch.0.0 to Ch.300 (refer to Figure 4.2 in Volume 3 of this EIAR). The car parking areas likely contain a number of buried/underground IÉ utilities. They mainly consist of signalling electrical cables, the location of which will be confirmed at detailed design using GPR surveys. Drainage gullies have also been identified during site inspections which discharge directly to the River Suir through multiple outlets through the existing quay wall.

16.3.6 Existing Drainage

There are existing drainage networks within the site boundary of the proposed development which carry the upper catchment drainage and the local depot drainage to the River Suir. The existing drainage network has been described in Chapter 4 of this EIAR and is shown in Figures 16.7 to 16.12 in Volume 3 of this EIAR.

16.4 Description of Potential Impacts

16.4.1 Impact on Land Use and Ownership

The permanent footprint of the proposed development is largely located within the railway corridor which is in the ownership of Córas Iompair Éireann (CIÉ) and operated by Iarnród Éireann (IÉ), with whom the project team have been in consultation throughout the development of the project to agree consent to site access. CIÉ have consented to the proposed development and support the use of their lands for construction of the proposed flood protection measures.

The permanent footprint of the proposed development is also located within areas of the foreshore and on lands not in the ownership of either WCCC or CIÉ. These lands and areas of the foreshore will be obtained by WCCC through the Compulsory Purchase Order (CPO) process. WCCC or CIÉ will also pursue title to the unregistered lands within the permanent footprint of the proposed development for the purpose of this planning application.

A temporary works area for the proposed development is located within the foreshore. An application for Foreshore Licence consent will be made to the Marine Planning and Foreshore Section of the Department of Housing, Local Government and Heritage for the temporary works area.

During operation, the proposed development will have a positive impact on land use by protecting lands against potential flood events, thereby protecting existing material assets within the area.

16.4.2 Local Economy, Businesses and Community Facilities

Construction

The majority of construction works associated with the proposed development will be confined to the north banks of the River Suir which is dominated by the transport infrastructure and industrial land uses. It is not likely that the proposed development will significantly impact the local businesses and community facilities due to the isolated location of the proposed development site. Businesses located within the Sallypark industrial site may be subject to temporary indirect impacts during construction as a result of noise and vibration increases from activity of machinery and transport vehicles, see Chapter 12 Noise and Vibration of this EIAR for more details.

Overall, the local economy will benefit from the construction phase of the proposed development through purchases of materials for construction, and the expenditure of construction workers in the area.

The riverside sheet-pile wall installation works will be carried out from a barge positioned within the River Suir in the vicinity of the northern bank, and as such, the proposed riverside works are not likely to obstruct the navigational passage of commercial and recreational vessels during the construction phase. However, the construction works at the site may cause annoyance or nuisance to maritime recreational users of the River Suir over the duration of the construction phase, specifically during day-time piling activities which are estimated to occur intermittently throughout the day over approx 3 months, and have the potential to generate negative, moderate and temporary noise levels to commercial properties at Sallypark Industrial Site on the northern bank of the River Suir. Negative, not significant to slight and temporary noise impacts are predicted during daytime for properties at Grattan Quay on the southern bank of the River Suir (see Chapter 12 Noise and Vibration of this EIAR for more details). As such, the construction phase has the potential for *negative, slight to moderate, temporary* effects on maritime recreational users.

Operation

The proposed development will permanently reduce a small section of the River Suir channel through the installation of the riverside sheet piles in front of the existing quay wall. However, this change to the width of the river channel is very minor in nature, and will have a *neutral, permanent* impact on the maritime commercial and recreational activities within the River Suir.

The proposed development is likely to have *direct, significant, positive, long-term effects* on the economy of Waterford City by eliminating the costs associated with potential flood damage to existing built assets, particularly the rail infrastructure to the west of Plunkett Station and the road infrastructure, specifically Rice Bridge roundabout. The proposed Flood Defences West will also form a continuation of flood protection measures by connecting to the Flood Defences East, which was granted planning approval as part of the SDZ Transport Hub Part VIII planning application. The proposed development will thus, facilitate the development of infrastructure of Waterford City on the northern bank in a sustainable way, including the regeneration of the SDZ lands which aims to drive economic development in Waterford City.

16.4.3 Traffic Infrastructure

16.4.3.1 Rail Infrastructure

Construction

No construction works will take place on the rail line itself, temporary possession of the rail line during night-time works will be required in order to construct specific elements of the proposed flood defence measures such as the underground isolation structure at Ch.1090, c.50m of the landside sheet pile wall and the landside drainage works. This may have an impact on the scheduling of Iarnród Éireann engineering freight trains. However, all works will be carried out in consultation with IÉ, and no significant impacts are envisaged on the movement of freight trains. The construction of proposed flood protection measures will be carried out with no impact on the passenger rail services.

The construction of an impermeable trench within the car parking areas in front of Plunkett Station is likely to temporarily restrict the number of available parking spaces for users. The construction works will be carried out in a phased approach, whereby the eastern section of the car park will be open while the works to the western section are carried out and vice versa, ensuring that the car park remains open to the public throughout the construction phase.

Operation

The proposed development is likely to have *indirect, significant, positive, long-term effects* on the rail infrastructure during its operation phase by protecting the railway line against existing and future flood risk.

16.4.3.2 Road Infrastructure

Construction

The majority of construction works for the proposed development will be carried out within CIÉ lands and the foreshore and will have an imperceptible impact on the road infrastructure. Installation of flood defence glass parapets for the existing Rice Bridge roundabout are likely to result in diversions for pedestrians utilising the footpaths, with potential to have *negative, localised, temporary,* and *slight* impacts.

Operation

The proposed development is likely to have *indirect, significant, positive, long – term effects* on the transport infrastructure during its operation phase by protecting the Rice Bridge roundabout and associate road infrastructure against existing and future flood risk.

16.4.4 Utilities

Construction Phase

Utilities

While some diversions of utilities will be required during the construction phase of the proposed development, no interruptions to the associated services are anticipated as a result of the construction or operation of the proposed development. The construction of underground impermeable trench within the car parking area(s) in front of Plunkett Station will be carried out in agreement with IÉ to minimise any potential interruptions to IÉ utilities and insofar, the operation of the rail service. The construction of the proposed development is likely to have *negative, temporary, imperceptible* to *slight effects* on the existing IÉ utilities.

Drainage

There is potential for the build-up of excess silts in the existing drainage networks derived from construction runoff that could limit the network capacity. However, standard pollution control measures will be implemented along with the mitigation measures proposed as part of Chapter 7 Biodiversity and Chapter 10 Hydrology so as to manage contaminated runoff and ensure the existing drainage pathways are maintained during the construction phase. Refer to Chapter 10 Hydrology for details of pollution control measures to be used during the construction phase. The construction of the proposed development is likely to have *temporary imperceptible to neutral effects* on the existing drainage networks.

Operation Phase

Drainage

The proposed development will have a positive impact on the existing drainage network located within the site boundary by upgrading the existing infrastructure as follows:

- Where necessary, extending the drainage pipes to the new sheet pile wall;
- Upgrade the existing surface water outfalls by providing headwalls and erosion control measures to enable future maintenance;
- Provide sealed manhole covers on these existing drainage networks within the railway corridor.

Furthermore, the proposed development entails retrofitting existing and new surface water outfalls within the study area with non-return valves. This will limit tidal ingress during extreme coastal events and reduce coastal flood risk. The development will also require the implementation of surface water pumping stations to discharge surface water in the aforementioned extreme coastal events. This will increase the capacity of the existing surface water drainage network and significantly reduce the risk of flooding from surface water sources. The new pumping stations and pipe work will incur minor additional operational and maintenance costs. The proposed development is likely to have *permanent, significant positive effects* on the surface water drainage networks within the study area.

16.5 Mitigation Measures

16.5.1 Construction

During construction, the following mitigation measures are proposed for the Waterford Flood Defences West:

- Measures to control the production of dust will be put in place by the Contractor (refer to Chapter 13 Air Quality and Climate which presents a series of measures to control dust);
- Noise mitigation will be provided during construction of the development. Measures to mitigate noise impacts on sensitive receptors are detailed within Chapter 12 Noise and Vibration. The Contractor will work within stringent construction limits and guidelines to protect residential and commercial amenities.
- The upgrade works to the existing drainage system along the railway corridor west of Plunkett Station will be designed to ensure that the current drainage situation will not be impacted and there will be no increased risk of flooding as a consequence of the proposed development;
- Prior to any excavation works, a segment of the ground will be surveyed via a CAT scan and a shallow slit trench will be excavated in order to confirm the position of utilities.
- Any services that are interfered with as a result of the proposed development will be repaired / replaced without unreasonable delay.
- A site plan will be prepared showing the location of all surface water drainage lines and proposed discharge points to surface water. This will also include the location of all existing and proposed surface water protection measures, including best practice measures such as monitoring points, sediment traps, settling basins, interceptors etc.

All construction works will be temporary and will be carried out in line with best practice guidelines, thus minimising the impacts to the receiving communities. The Contractor will work within stringent construction limits and guidelines to protect surrounding amenities.

16.5.2 Operation

During operation, the impacts to material assets and land are likely to be positive and therefore, no mitigation measures are necessary.

16.6 Residual Impacts

The operation of the development will provide many significant positive impacts to the city. Specific significant positive impacts relating to the operational phase of the proposal include the following as outlined above in section 16.4:

- Protecting the existing rail and road infrastructure such as Plunkett Station and the Rice Bridge roundabout from existing and future flood risk.
- Upgrading the existing drainage network within the extents of the proposed development by increasing its capacity to account for extreme weather events induced by climate change.
- Eliminating costs associated with flood damage on built assets, particularly the rail infrastructure at, and to the west of Plunkett Station and the road infrastructure, specifically Rice Bridge roundabout.

There are no significant negative residual impacts predicted for Material Assets as a result of the proposed development. The impacts will remain as outlined in section 16.4.

16.7 Difficulties Encountered

No difficulties were encountered.

Appendix 16.1
Train Timetables

NO SERVICE: will operate between Limerick Jctn. and Waterford on Sundays and Public Holidays.		Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat
DUBLIN Heuston Ⓑ Ⓛ Ⓐ	Dep	..	..	08:00	..	..	..	13:15	..	..	..	17:00	..
Athy	Dep	..	..	..	..	..	..	13:56	..	..	..	..	..
Carlow	Dep	..	..	..	..	..	..	14:12	..	..	..	..	..
Muine Bheag	Dep	..	..	..	..	..	..	14:25	..	..	..	..	..
Kilkenny (MacDonagh)	Dep	..	..	..	..	..	..	14:47	..	..	..	..	..
Thomastown	Dep	..	..	..	..	..	..	14:59	..	..	..	..	..
WATERFORD (Plunkett)	Arr	..	..	..	..	..	..	15:30	..	..	..	..	..
WATERFORD (Plunkett)	Dep	07:20	..	..	..	..	..	..	16:25	..	..	..	..
Carrick-on-Suir	Dep	07:46	..	..	..	..	..	..	16:51	..	..	..	..
Clonmel	Dep	08:08	..	..	..	..	..	..	17:13	..	..	..	..
Cahir	Dep	08:27	..	..	..	..	..	..	17:32	..	..	..	..
Tipperary	Dep	08:49	..	..	..	..	..	..	17:54	..	..	..	..
LIMERICK JUNCTION	Arr	09:03	..	..	..	..	..	..	18:08	..	..	..	..
LIMERICK JUNCTION	Dep	..	09:18	09:32	09:37	..	..	..	..	18:15	18:23	18:27	..
LIMERICK (Colbert)	Arr	..	..	..	10:03	..	..	..	..	18:43	..	..	..
LIMERICK (Colbert)	Dep	..	..	..	..	12:30	14:20	..	..	..	..	..	19:50
Sixmilebridge	Dep	..	..	..	..	12:52	14:42	..	..	..	..	..	20:12
ENNIS	Arr	..	..	..	..	13:09	14:59	..	..	..	..	..	20:29
ENNIS	Dep	..	..	..	..	..	15:02	..	..	..	..	..	20:30
Gort	Dep	..	..	..	..	..	15:24	..	..	..	..	..	20:51
Ardrahan	Dep	..	..	..	..	..	15:33	..	..	..	..	..	21:00
Craughwell	Dep	..	..	..	..	..	15:41	..	..	..	..	..	21:09
Athenry	Dep	..	..	..	..	..	15:56	..	..	..	..	..	21:22
Oranmore	Dep	..	..	..	..	..	16:07	..	..	..	..	..	21:34
GALWAY (Ceannt)	Arr	..	..	..	..	..	16:15	..	..	..	..	..	21:42
Charleville	Dep	..	..	..	..	..	..	..	..	..	..	..	..
Mallow	Dep	..	..	10:07★	..	..	..	..	..	..	..	18:59★	..
CORK Kent Ⓟ Ⓣ	Arr	..	..	10:37	..	..	..	..	..	..	..	19:32	..
DUBLIN Heuston Ⓑ Ⓛ Ⓐ	Arr	..	10:47	..	..	..	..	..	..	..	20:04	..	..

Ⓑ Bus Link (Route 145) to/from Dublin City Centre
Ⓛ LUAS Tram Link to/from Dublin City Centre
Ⓐ Bus Link (Route 747) to Dublin Airport
Ⓟ Bus Link (Routes 226/226A) to Cork Airport.
Ⓣ Bus Link (Route 205) to U.C.C. and C.I.T.
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Baile Átha Cliath/Corcaigh/Gaillimh - Gabhal Luimnigh - Cluain Meala - Port Láirge/ Baile Átha Cliath - Luan go Satharn (gan saoire phoiblí san áireamh) - Bailí ó 21.03.2021 go bhfógrófar a mhalairt

Dublin/Cork/Galway - Limerick Jctn. - Clonmel - Waterford/Dublin - Monday to Saturday (excluding public holidays) - Valid from 21.03.2021 until further notice

Gabhal Luimnigh - Cluain Meala - Port Láirge - Luan go Satham (gan saoire phoiblí san áireamh)

Limerick Jctn. - Clonmel Waterford - Monday to Saturday (excluding public holidays)

NO SERVICE: will operate between Limerick Jctn. and Waterford on Sundays and Public Holidays.		Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat
DUBLIN Heuston Ⓑ Ⓛ Ⓐ	Dep	..	..	From	..	08:00	..	..	..	..	..	17:00	..
CORK Kent Ⓟ Ⓣ	Dep	..	08:00	Tralee	..	..	..	..	..	..	17:25	..	..
Mallow	Dep	..	08:21	08:43	..	..	..	..	..	..	17:46★	..	..
Charleville	Dep	..	..	08:58	..	..	..	..	..	..	..	..	..
GALWAY (Ceannt)	Dep	06:15	..	..	..	..	..	..	13:45	..	..	..	..
Oranmore	Dep	06:22	..	..	..	..	..	..	13:53	..	..	..	..
Athenry	Dep	06:37	..	..	..	..	..	..	14:08	..	..	..	..
Craughwell	Dep	06:47	..	..	..	..	..	..	14:17	..	..	..	..
Ardrahan	Dep	06:56	..	..	..	..	..	..	14:25	..	..	..	..
Gort	Dep	07:11	..	..	..	..	..	..	14:34	..	..	..	..
Ennis	Dep	07:40	..	..	..	..	..	..	15:01	..	..	..	..
Sixmilebridge	Dep	07:57	..	..	..	..	..	..	15:19	..	..	..	..
LIMERICK (Colbert)	Arr	08:20	..	..	..	..	..	..	15:42	..	..	..	..
LIMERICK (Colbert)	Dep	..	..	..	08:55	..	..	..	..	17:50	..	..	..
LIMERICK JUNCTION	Arr	..	..	09:18	09:23	09:32	..	..	..	18:22	18:23	18:27	..
LIMERICK JUNCTION	Dep	..	..	..	..	..	09:40	..	..	..	..	..	18:40
Tipperary	Dep	..	..	..	..	..	09:53	..	..	..	..	..	18:53
Cahir	Dep	..	..	..	..	..	10:16	..	..	..	..	..	19:16
Clonmel	Dep	..	..	..	..	..	10:34	..	..	..	..	..	19:34
Carrick-on-Suir	Dep	..	..	..	..	..	10:57	..	..	..	..	..	19:57
WATERFORD (Plunkett)	Arr	..	..	..	..	..	11:25	..	..	..	..	..	20:25
WATERFORD (Plunkett)	Dep	..	..	..	..	..	..	13:05	..	..	..	..	..
Thomastown	Dep	..	..	..	..	..	..	13:25	..	..	..	..	..
Kilkenny (MacDonagh)	Dep	..	..	..	..	..	..	13:45	..	..	..	..	..
Muine Bheag	Dep	..	..	..	..	..	..	14:00	..	..	..	..	..
Carlow	Dep	..	..	..	..	..	..	14:12	..	..	..	..	..
Athy	Dep	..	..	..	..	..	..	14:25	..	..	..	..	..
DUBLIN Heuston Ⓑ Ⓛ Ⓐ	Arr	..	..	10:47	10:59	..	..	15:21	..	..	20:04	..	..

Ⓑ Bus Link (Route 145) to/from Dublin City Centre
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Dublin - Waterford - Monday to Sunday (excluding public holidays) - Valid from 21.03.2021 until further notice

BÁC - Port Láirge - Luan go Domhnach (gan saoire phoiblí san áireamh)
Dublin – Waterford - Monday to Sunday (excluding public holidays)

		Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Fri Only	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Fri
DUBLIN Heuston Ⓑ Ⓛ Ⓐ	Dep	07:20	10:15	13:15	15:10	16:15	16:40	17:35	18:35	20:15
Park West & Cherry Orchard	Dep	..	..	..	..	..	..	..	..	20:22
Clondalkin Fonthill	Dep	..	..	..	..	..	..	..	..	20:26
Adamstown	Dep	..	..	..	..	..	..	..	..	20:31
Hazelhatch & Celbridge	Dep	..	..	..	..	..	16:53	..	..	20:36
Sallins & Naas	Dep	..	..	..	..	..	17:03	17:52	..	20:45
Newbridge	Dep	07:41	..	..	15:31	..	..	..	18:56	20:52
Kildare	Dep	07:51	10:43	..	15:42	..	17:20	18:09	19:07	21:02
Athy	Dep	08:09	10:59	13:56	15:58	17:13	17:40	18:25	19:23	21:17
CARLOW	Arr	08:22	11:11	14:09	16:10	17:25	17:53	18:38	19:36	21:31
Carlow	Dep	08:22	11:11	14:12	16:10	17:25	17:53	18:38	19:42	..
Muine Bheag	Dep	08:46	11:24	14:25	16:22	..	18:06	18:51	19:55	..
Kilkenny (MacDonagh)	Arr	09:03	11:42	14:43	16:40	..	18:24	19:08	20:13	..
Kilkenny (MacDonagh)	Dep	09:07	11:46	14:47	16:44	..	18:28	19:12	20:17	..
Thomastown	Dep	09:19	11:58	14:59	16:56	..	18:40	19:24	20:29	..
WATERFORD (Plunkett)	Arr	09:44	12:23	15:30	17:21	18:15	19:04	19:48	20:54	..

		Sun Only	Sun Only	Sun Only	Sun Only
DUBLIN Heuston Ⓑ Ⓛ Ⓐ	Dep	09:10	14:10	17:45	18:40
Park West & Cherry Orchard	Dep	..	..	..	..
Clondalkin Fonthill	Dep	..	..	..	..
Adamstown	Dep	..	..	..	..
Hazelhatch & Celbridge	Dep	..	..	..	..
Sallins & Naas	Dep	..	..	..	..
Newbridge	Dep	09:31	14:31	18:06	..
Kildare	Dep	09:42	14:42	18:17	19:09
Athy	Dep	09:58	14:58	18:33	19:29
CARLOW	Arr	10:11	15:11	18:46	19:42
Carlow	Dep	10:14	15:11	18:46	19:42
Muine Bheag	Dep	10:27	15:24	19:01	19:55
Kilkenny (MacDonagh)	Arr	10:45	15:42	19:20	20:13
Kilkenny (MacDonagh)	Dep	10:49	15:47	19:24	20:17
Thomastown	Dep	11:01	15:59	19:36	20:29
WATERFORD (Plunkett)	Arr	11:26	16:24	20:01	20:54

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Waterford - Dublin - Monday to Sunday (excluding public holidays) - Valid from 21.03.2021 until further notice

		Mon to Fri	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Mon to Sat	Fri & Sat Only	Mon to Sat	Mon to Fri
WATERFORD (Plunkett)	Dep	..	05:55	07:00	07:50	11:00	13:05	14:50	16:05	18:25	..
Thomastown	Dep	..	06:16	..	08:11	11:21	13:25	15:12	..	18:55	..
Kilkenny (MacDonagh)	Arr	..	06:31	..	08:26	11:37	13:41	15:26	..	19:11	..
Kilkenny (MacDonagh)	Dep	..	06:35	..	08:30	11:43	13:45	15:30	..	19:15	..
Muine Bheag	Dep	..	06:50	07:42	08:45	11:58	14:00	15:45	..	19:31	..
Carlow	Arr	..	07:02	07:55	08:58	12:10	14:12	15:57	17:00	19:43	..
CARLOW	Dep	06:30	07:03	07:55	08:58	12:11	14:12	16:10	17:00	19:43	21:36
Athy	Dep	06:41	07:15	08:09	09:11	12:24	14:25	16:22	17:13	19:56	21:47
Kildare	Dep	07:01	07:34	..	09:30	12:43	14:45	16:42	17:36	20:15	22:06
Newbridge	Dep	07:08	07:41	08:33	..	12:49	14:52	..	..	..	22:12
Sallins & Naas	Dep	07:16	..	..	..	..	..	..	..	..	22:20
Hazelhatch & Celbridge	Dep	07:27	..	..	..	..	..	..	..	..	22:31
Adamstown	Dep	07:31	..	..	..	..	..	..	..	..	22:35
Clondalkin Fonthill	Dep	..	..	..	..	..	..	..	..	..	22:40
Park West & Cherry Orchard	Dep	..	..	..	..	..	..	..	..	..	22:43
DUBLIN Heuston Ⓑ Ⓛ Ⓐ	Arr	07:44	08:07	09:00	10:00	13:16	15:21	17:12	18:05	20:45	22:52

		Sun Only	Sun Only	Sun Only	Sun Only
WATERFORD (Plunkett)	Dep	09:05	12:40	15:10	18:05
Thomastown	Dep	09:26	13:01	15:31	18:26
Kilkenny (MacDonagh)	Arr	09:41	13:16	15:46	18:41
Kilkenny (MacDonagh)	Dep	09:45	13:20	15:50	18:45
Muine Bheag	Dep	10:01	13:36	16:06	19:03
Carlow	Arr	10:13	13:48	16:18	19:15
CARLOW	Dep	10:15	13:48	16:18	19:15
Athy	Dep	10:29	14:01	16:31	19:30
Kildare	Dep	10:49	14:21	16:51	19:49
Newbridge	Dep	10:56	14:28	16:58	19:57
Sallins & Naas	Dep	..	..	..	..
Hazelhatch & Celbridge	Dep	..	..	..	..
Adamstown	Dep	..	..	..	..
Clondalkin Fonthill	Dep	..	..	..	..
Park West & Cherry Orchard	Dep	..	..	..	..
DUBLIN Heuston Ⓑ Ⓛ Ⓐ	Arr	11:22	14:54	17:24	20:24

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Chapter 17
Interactions and Cumulative Impacts

Chapter 17 Interactions and Cumulative Impacts

17.1 Introduction

In addition to the assessment of impacts on individual topics presented in the previous chapters of this Environmental Impact Assessment Report (EIAR) in respect of the proposed Flood Defences West (hereafter, the 'proposed development'), the interaction between these factors has also been considered. In addition, the cumulative impacts of the proposed development with those of previous developments and developments for which planning authorisation has been received as well as development objectives in the development plans for the areas through which the development is proposed, have been assessed and are described in this chapter.

17.2 Methodology

17.2.1 Legislation and Guidelines

Directive 2011/92/EU ('the EIA Directive'), as amended by Directive 2014/52/EU, requires that the EIAR considers the potential for significant cumulative impacts to arise as a result of (i) the interaction between the various impacts within a single project ('interactions', hereafter) and (ii) the interaction between all of the different existing and/or approved projects in the same area as the proposed project ('cumulative impacts', hereafter).

This Chapter has been prepared with due reference to the following guidance documents:

- Department of Housing, Planning and Local Government (DoHPLG) (2018). *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment*.
- EPA (2017). *Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.*
- EC (2017). Guidance on the preparation of the Environmental Impact Assessment Report
- EC (1999). *Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions*.

17.2.2 Interactions

The determination of interrelationships was facilitated through an iterative design process that included meetings between designers and specialists where strong interrelationships exist. In addition, the process was informed by consultation with statutory and non-statutory consultees including the National Parks and Wildlife Service (NPWS) and Inland Fisheries Ireland (IFI). Where potential exists for interaction between two or more environmental topics, the relevant specialists have taken these into account when making their assessment and where necessary, mitigation measures have been proposed.

17.2.3 Cumulative Impacts

The geographical boundary of 15km was selected for the assessment of cumulative impacts. This comprises a viable study area holding potential for feasible cumulative impacts whilst excluding those areas which are non-viable because of issues such as topography and distance. Significant projects known to WCCC that are not yet within the planning system but have the potential to interact with the proposed development are also considered.

Cumulative impacts are impacts that result from incremental changes caused by other past, present or reasonably foreseeable projects together with the proposed Waterford Flood Defences West. Cumulative impacts were assessed by looking at previous plans and projects, current plans and projects in planning and proposed future plans and projects within 15km of the proposed site location from 2010 to the present. There is too much uncertainty associated with development proposals beyond 5 years into the future and this EIAR can only be based on data that is readily available. This cumulative assessment has considered cumulative impacts that are:

(a) Likely;

(b) Significant; and

(c) Relating to a future event which is reasonably foreseeable.

The following data sources have been consulted to identify the plans and projects within the 15km boundary:

- Waterford City and County Council;
- Kilkenny County Council;
- Wexford County Council;
- EIA Portal;
- An Bord Pleanála website (planning searches);
- Web search for major infrastructure projects in Waterford City and County and Co. Kilkenny;
- Waterford City Development Plan 2013-2019 (as extended);
- Waterford County Development Plan 2011-2017 (as extended);
- Draft Kilkenny County Development Plan 2021-2027;
- North Quays SDZ Planning Scheme 2018; and
- Ferrybank Belview Local Area Plan 2009-2020 (including Amendment 1).

17.3 Interactions

Table 17.1 shows a matrix of interactions between different environmental topics which have been identified and addressed in this EIAR. Ticks are indicative of interactions.

Interactions are summarised by receptor in sections 17.3.1 – 17.3.10 below. The impacts and the mitigation provided has been considered by all environmental specialists to ensure all the interactions have been fully considered within this EIAR.

The corresponding mitigation measures, where required, are not detailed in this Chapter, and are outlined in the corresponding specialist chapter, or Chapter 19 'Mitigation Measures' of this EIAR.

Table 17.1 Interactions Matrix

Receptor / Activity	Traffic Analysis	Population and Human Health	Biodiversity	Soils and Geology	Hydrogeology	Hydrology	The Landscape	Noise and Vibration	Air Quality and Climate	Archaeological and Cultural Heritage	Architectural Heritage	Material Assets and Land
Traffic Analysis	■	✓	✓					✓	✓			
Population and Human Health	✓	■										
Biodiversity			■					✓				
Soils and Geology	✓	✓	✓	■	✓	✓	✓	✓	✓	✓		
Hydrogeology		✓			■	✓						✓
Hydrology		✓	✓	✓		■						✓
The Landscape		✓					■					
Noise and Vibration		✓	✓				✓	■				✓
Air Quality and Climate		✓	✓						■			✓
Archaeological and Cultural Heritage										■		
Architectural Heritage											■	
Material Assets and Land		✓			✓	✓						■

17.3.1 Traffic Analysis

Traffic will interact and / or interrelate with the following environmental topics:

- Population and Human Health
- Biodiversity
- Noise and Vibration
- Air Quality and Climate

Population and Human Health

During the construction phase, the haulage of materials to and from the site of the proposed development will interrelate with road users, adding to the potential noise and vibration, air quality and visual impacts. However, restricted haulage routes have been outlined as part of this EIAR (refer to Chapter 4 'Description of the Proposed

Development') to ensure that the population of Waterford City is not affected significantly by increased traffic volumes as a result of construction traffic.

Due to the nature of the proposed development, no traffic will be generated during the operational phase as a result of the proposed development.

Biodiversity

The impact of construction traffic including piling barges and machines required for sheet piling have been assessed in Chapter 7 'Biodiversity' of this EIAR for their impact on the biodiversity within the Lower River Suir Special Area of Conservation (SAC) and the surrounding European and nationally designated sites. No impacts on biodiversity are envisaged during the operation phase as the proposed development will not generate an increase in traffic volume.

Noise and Vibration

Noise and vibration levels will increase as a result of construction traffic. Mitigation measures, as well as compliance with measures outlined in the outline Construction Environmental Management Plan (CEMP) in Appendix 4.1 A of this EIAR, will be put in place during construction to reduce the short-term noise impacts of construction traffic. No impacts on noise and vibration are envisaged during the operation phase as the proposed development will not generate an increase in volume of traffic.

Air Quality and Climate

Air pollutant emissions will also increase during the construction phase as a result of construction traffic. Mitigation measures have been developed and are presented in Chapter 13 'Air Quality and Climate' of this EIAR to mitigate potential short-term air quality impacts from construction traffic.

17.3.2 Population and Human Health

Population and Human Health will interact and / or interrelate with the environmental topic of Traffic Analysis.

Traffic Analysis

The construction phase of the proposed development will increase traffic visiting the site as a result of the workforce. The impact of these traffic movements have been incorporated in the traffic assessment.

17.3.3 Biodiversity

Biodiversity will interact and / or interrelate with the following environmental topics:

- The Landscape

The Landscape

As part of the biodiversity mitigation measures, it is proposed to install cladding in the form of an eco-seawall to the section of riverside sheet pile walls that it is within the intertidal zone of the River Suir to enhance marine biodiversity. This mitigation measure will have a beneficial visual impact during the operation phase of the proposed development by reducing the area of the steel sheet piles visible during low tide.

17.3.4 Soils and Geology

Soils and Geology will interact and / or interrelate with the following environmental topics:

- Traffic Analysis
- Population and Human Health
- Biodiversity
- Hydrogeology
- Hydrology
- The Landscape
- Noise and Vibration
- Air Quality and Climate
- Archaeological and Cultural Heritage
- Material Assets and Land

Traffic Analysis

Construction traffic will arise from a number of construction elements such the earthworks stage of development; from the removal of waste material off site; and the importation of infill material which is primarily required to backfill the area between the front face of the existing quay wall and the back face of the new sheet pile flood defence wall. Traffic counts have been predicted for the earthworks stage of construction and have been assessed in Chapter 5 'Traffic Analysis' of this EIAR.

Population and Human Health

The construction stage will have the potential to have impacts on population and human health within the area due to earthworks, the transport of material to and from the site and the installation sheet piles. The impacts on population and human health have been assessed in the respective specialists' chapters and Chapter 6 'Population and Human Health' of this EIAR. These chapters have taken increases in noise and vibration, and air quality and climate impacts into account due to the movement of construction material.

Biodiversity

Earthworks during the construction phase have the potential to impact on the Lower River Suir Special Area of Conservation (SAC) through construction site runoff, the risk of release of contaminants from the ground, noise and vibration, and air quality impacts. A suite of best practice techniques, mitigation measures and guidelines have been outlined in Chapter 9 'Hydrogeology', Chapter 10 'Hydrology', Chapter 7 'Biodiversity' and the Environmental Operating Plan (EOP) presented in Appendix 4.1 of this EIAR to mitigate impacts on the European and nationally designated sites within the River Suir.

Hydrogeology

Sheet piling and localised excavations have the potential to temporarily reduce the overburden to the aquifer during construction, creating a pathway for pollution. These potential impacts have been assessed and mitigated for in Chapter 8 'Soils and Geology' and in Chapter 9 'Hydrogeology' of this EIAR.

Hydrology

During the construction phase there is the potential for sediment laden run-off from the site to enter the River Suir. As part of the outline Environmental Operating Plan (EOP) developed, an outline Incident Response Plan (IRP), an outline Construction Environmental Management Plan (CEMP) and an outline Construction and Demolition Waste Management Plan (CDWMP) have also been developed detailing the mitigation that the contractor shall implement to avoid sediment from entering the River Suir during construction.

The Landscape

Earthworks on site will have an impact on the landscape of the site during the construction phase however the main landuse of the site is infrastructure and is of low landscape importance. Any landscape and visual impacts due to earthworks, presence of construction machinery and the movement of material will be short term and has been assessed in Chapter 11 'The Landscape' of this EIAR.

Noise and Vibration

Earthworks activities and the movement of construction materials will have potential for short term impacts on noise and vibration during construction. Earthworks machinery have been included in a noise model and mitigation measures have been included in Chapter 12 'Noise and Vibration' and in the outline CEMP to mitigate noise and vibration impacts due to earthworks and the movement of construction materials where possible.

Air Quality and Climate

Earthworks and the movement of construction materials have the potential to create airborne dust. Controls and mitigation have been proposed in Chapter 13 'Air Quality and Climate' to mitigate any impact from dust during construction.

Archaeological and Cultural Heritage

The construction of the sheet pile wall and clearance of the site will require the removal of old masonry quay walls within the site. The significance of this impact and mitigation measures put in place are discussed in Chapter 15 Architectural Heritage of this EIAR.

Ground disturbances have the potential to impact on unidentified archaeological sites during excavation and construction. All ground disturbances associated with the proposed development will be monitored by a suitably qualified underwater archaeologist. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH). Impacts and mitigation measures proposed for the earthworks stage are discussed further in Chapter 14 Archaeological and Cultural Heritage of this EIAR.

17.3.5 Hydrogeology

Hydrogeology will interact and / or interrelate with the following environmental topics:

- Population and Human Health
- Hydrology
- Material Assets and Land

Population and Human Health

Routine run-off and / or a spillage event during construction phase has the potential to pose a risk to groundwater due to potential infiltration of contaminated surface water to groundwater.

Construction best practice guidelines will be followed to reduce the risk of spillage events and the contamination of groundwater. Therefore, when considered in conjunction with the overburden to the aquifer, the risk to the groundwater supply is not likely.

Hydrology

Potential changes to aquifers or unsaturated zones may result in changes to existing baseflow to watercourses within the site of proposed development. The proposed development represents a negligible to slight impact on the saturation zone of the aquifer recharge area.

Material Assets and Land

The potential risk of pollution to groundwater from routine run-off would have a resultant impact on water quality and therefore material assets. The drainage system incorporates treatment prior to discharge to minimise the potential for pollution. Therefore, in conjunction with the overburden to the aquifer, there is a very slight risk of groundwater pollution impacting material assets.

17.3.6 Hydrology

Hydrology will interact and / or interrelate with the following environmental topics:

- Population and Human Health
- Biodiversity
- Soils and Geology
- Material Assets and Land

Population and Human Health

The construction works for the proposed development will increase the number of people near a known source of flooding, namely the River Suir, thus increasing the potential for flood risk related impacts on human health. Mitigation measures have been proposed as part of Chapter 6 'Population and Human Health' and Chapter 10 'Hydrology' to reduce the risk of flood-related impacts on human health.

The proposed development has been designed to avoid the potential for flooding through the provision of flood defence measures for the north quays area of Waterford City, thereby having a beneficial impact on population and human health during the operation phase by avoiding the potential impacts from flooding.

Biodiversity

Construction activities have potential to pose a risk to watercourses, particularly if contaminated surface water from construction activities was to enter the River Suir. Chapter 7 'Biodiversity', Chapter 10 'Hydrology' and the Outline CEMP set out measures to prevent the runoff of contaminants during construction. These measures will mitigate the risk to biodiversity within River Suir and the European sites.

Soils and Geology

During the construction earthworks, heavy rainfall events have the potential for run-off to impact on the usability of materials stored onsite. This could therefore require the importation of additional material from external sources. In conjunction with this, the run-off from the site would have the potential to increase the sediment loading to the adjacent watercourses. Mitigation measures have been included in Chapter 8 'Soils and Geology' to prevent contamination of watercourses such that silt and sediment barriers are installed and maintained at the perimeter of earthworks areas. Furthermore, the outline Environmental Operating Plan (EOP) has been developed which sets out measures to avoid the silt laden runoff from contaminating the receiving watercourses.

Material Assets and Land

There is potential for the build-up of excess silts in the existing drainage networks derived from construction runoff that could limit the network capacity. However, standard pollution control measures will be implemented so as to manage contaminated runoff and ensure the existing drainage pathways are maintained during the construction phase. Refer to Chapter 9 'Hydrology' and the outline CEMP for details of pollution control measures to be used during the construction phase.

17.3.7 The Landscape

The Landscape will interact and / or interrelate with the environmental topic of Population and Human Health.

Population and Human Health

The sensitive visual receptor, as described in Chapter 11 'The Landscape' is the population, and therefore all visual impacts relate directly to the residents, those working in the area and visitors. The proposed development will likely have negative, moderate to imperceptible impact on the visual receptors during the operation phase due to the physical presence of the flood defence sheet pile walls. Due to the nature of the site and the works proposed, Chapter 11 'The Landscape' concluded that there are no practical landscape or visual mitigation measures that would make a significant difference to the impacts identified at either construction or operational stage. The levels of landscape and visual impact generated by the proposed development however are relatively low.

17.3.8 Noise and Vibration

Noise and Vibration will interact and / or interrelate with the following environmental topics:

- Population and Human Health
- Biodiversity
- Material Assets and Land

Population and Human Health

The sensitive receptor, as described in Chapter 12 'Noise and Vibration', is the population, and therefore all noise and vibration impacts relate directly to the residents, those working in the area and visitors. Potential noise and vibration impact related to population and human health are likely during the construction phase of proposed development due to construction-related noise. Mitigation measures have been included in Chapter 12 and the outline CEMP to reduce such impacts on sensitive receptors. There are no predicted noise and vibration impacts during the operational phase of the proposed development on population and human health.

Biodiversity

Construction noise and vibration is likely to have an impact on and number of Key Ecological Receptor (KER) including KER 5 Otter and KER 6 Bat Species and KER 4 Fish Species including Annex II migratory species, most notably on Twaite Shad, if there are prolonged periods of continuous piling or if there are inadequate or uncoordinated breaks between pile drives. Mitigation measures have been proposed as part of Chapter 7 of this EIAR to ensure that the noise and vibration associated with the construction of the sheet pile wall does not have a significant impact on the above KERs.

Material Assets and Land

Noise and vibration levels during construction stage will also interact with Material Assets and Land. Businesses within Sallypark may be subject to temporary indirect impacts during construction as a result of noise and vibration increases.

17.3.9 Air Quality and Climate

Air Quality and Climate will interact and / or interrelate with the following environmental topics:

- Population and Human Health
- Biodiversity
- Material Assets and Land

Population and Human Health

Increases in air pollutant and dust emissions from construction activities have potential to impact on population and human health. Impacts associated with air pollutant and dust emissions during the construction phase are discussed in Chapter 13 'Air Quality and Climate' and Chapter 6 'Population and Human Health' of this EIAR. There are no potential air quality impacts on population and human health during the operation phase of the proposed development.

Biodiversity

Air pollutants and dust emissions have the potential to interact with the biodiversity of the area due to pollutant deposition. The potential for deposits on Lower River Suir SAC are assessed in Chapter 13 Air Quality and Climate of this EIAR. Air quality mitigation measures will reduce impacts on the biodiversity of the area as a result of construction traffic.

Material Assets and Land

Dust generated from construction activities may cause annoyance or nuisance to businesses within the area. Measures to control the production of dust, which have been outlined in Chapter 13 'Air Quality and Climate' and included in the outline CEMP, will be put in place by the contractors to reduce any potential impacts experienced by receptors. Good communication between the contractors and business owners in the proximity of construction activities will facilitate on-going operations.

17.3.10 Material Assets and Land

Material Assets and Land will interact and / or interrelate with the following environmental topics:

- Population and Human Health
- Hydrogeology
- Hydrology

Population and Human Health

The proposed development is likely to have a long-term positive impact on the transport infrastructure (incl. road and rail) during its operation phase by protecting the existing assets from existing and future flood risk, having a positive impact on population and human health.

Hydrogeology

The provision of improved utilities such as a surface water drainage system across the site will have a positive impact on the hydrogeology of the area. The proposed development will provide filter drains which will treat the surface water runoff before it is discharged into the River Suir.

Hydrology

The existing surface water drainage system within the site of the proposed development will be upgraded with filter drains to collect and treat the surface water runoff before discharging it into the River Suir.

17.4 Cumulative Impacts

Plans and projects which were identified, and which may be of significance are assessed and discussed in Table 17.2 below in relation to cumulative impacts.

Table 17.2 Assessment of Projects in Respect of their Potential to Result in Cumulative Impacts with the Proposed Development

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
Project Ireland 2040- National Planning Framework **(Distance: 0 m)**	The National Planning Framework (NPF) is the Government's high-level strategic plan for shaping the future growth and development of the country out to the year 2040. The NPF with the National Development Plan also set the context for each of Ireland's three regional assemblies to develop their Regional Spatial and Economic Strategies taking account of and co-ordinating local authority County and City Development Plans in a manner that will ensure national, regional and local plans align. An SEA and AA have been completed to support the plan. The proposed flood defences will protect the railway corridor, including Plunkett Station and the associated rail infrastructure against coastal, tidal, and combined flood events. The proposed development will also support the implementation of a number of NSOs and NPOs identified in the NPF and NDP respectively.	As the proposed development supports the National Planning Framework, it is considered that there will be positive cumulative impacts as a result of the proposed development.
National Adaptation Framework: Planning for a Climate Resilient Ireland **(Distance: 0m)**	The National Adaptation Framework (NAF) has been developed to address current and future risks associated with climate change, including impacts attributed to increase in heavy rainfall events; intensity of storms; sea level rise etc. The NAF recognises that climate change will have a negative impact on a number of key socio, economic and environmental sectors including critical infrastructure: transport, emergency, water, energy, and communications services and are at risk from a range of climate induced impacts such as sea level rise, changing rainfall patterns, increasing temperature and extreme weather events. In response to climate change, the NAF aims to set up effective adaptation strategies to reduce the vulnerability of Ireland's environment, society, and economy and to increase its resilience to the effects of climate change. The NAF identified an array of adaptation measures that "enhance adaptive capacity of social, industrial and environmental infrastructures and mitigate the effects of climate change". Adaption measures have been categorised as soft, green and grey adaptation measures. Building new or raising the level of existing flood defences is an example of 'grey' adaptation measures. The proposed development will provide protection of the rail corridor, a critical infrastructure against existing and future flood risk and will support Waterford City in building its resilience to climate change.	As the proposed development supports the National Adaptation Framework, it is considered that there will be positive cumulative impacts as a result of the proposed development.
Southern Region Regional Spatial and Economic Strategy (SRRSES) **(Distance: 0m)**	Arising under the Local government Reform Act 2014, the Southern Regional Assembly has assumed a number of new functions. Chief among these responsibilities is the preparation of a Regional Spatial and Economic Strategy (RSES) for the Southern Region. The Southern Regional Assembly prepared the Regional Spatial and Economic Strategy (RSES) in 2020. The Southern RSES seeks to align with the National Policy Objectives (NPOs) and goals set out in the NPF including NPO 7 which seeks to accelerate the development of Waterford, Cork, and Limerick to grow by at least half of the 2016 Census population, i.e., by 50% to 60% by 2040. The Waterford Metropolitan Area Strategic Plan (MASP) was developed as part of the RSES to *"develop a concentric city both north and south of the River Suir"*. The proposed development is in line with this objective by minimising flood risk to the north quays area which will facilitate sustainable development of the City. The proposed development is also in line with the Regional Policy Objective **RPO 9** which aims to *"ensure investment and delivery of comprehensive infrastructure packages to meet growth targets that prioritise the*	As the proposed development supports the Southern Regional RSES, it is considered that there will be positive cumulative impacts as a result of the proposed development.

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
	delivery of compact growth". The infrastructure packages *include "climate change adaptation and future proofing infrastructure including flood risk management measures, environmental improvements*". The proposed development is consisted with the Southern RSES and will protect the existing and future built infrastructure from climate changed induced flood risk.	
Waterford City Development Plan 2013-2019 (as extended)	The Waterford City Development Plan 2013- 2019 sets out an overall strategy for the proper planning and sustainable development of the functional area of Waterford City, pursuant to section 9 of the Planning and Development Act 2000 (as amended). The purpose of the Plan is to inform the public, statutory authorities, service providers, developers and other interested parties, of the policy framework that will guide development decisions within the city over the Plan period. The Plan provides: • *A sustainable strategy to guide the location and pattern of development* • *Guidance on the phased release of housing land for development* • *A framework for infrastructural provision.* • *A framework for the conservation and protection of the heritage, built and natural, whilst facilitating appropriate use* • *A framework for the integration of development with the social, community and cultural requirements of the population* • *Guidance for the public and developers on development.* The Plan also includes the following policy in relation to allieviating flood risk: • *To seek to alleviate flood risk in areas currently liable to flooding (POL 11.5.10)* An SEA , SFRA and AA have been completed to support the plan.	As the proposed development supports the Waterford City Development Plan, it is considered that there will be positive cumulative impacts as a result of the proposed development.
Waterford Heritage Plan 2017-2022 **(Distance: 0 m)**	The Heritage Plan sets out the priorities for Heritage in Waterford over the next 5 years and is a cross agency plan with input from as wide a sector as possible who are involved in heritage projects, policy and work programmes across the city and county along with an extensive public consultation process. The plan also sets the framework for the Heritage Council allocation that we apply for through the annual Heritage Plan Fund. The plan sets out a Vision to: *To increase engagement with, and access to, all aspects of heritage in Waterford City and County and promote conservation, best practice, appreciation and enjoyment of our shared heritage.* The Mission Statement for this plan is: *To set out a strategic and co-ordinated approach for heritage in recognition of the benefits that heritage delivers; identifying a sense of place for Waterford, learning lessons from our past to plan for the future and added value for the development of Waterford City and County*	No likely significant cumulative impacts are predicted to arise from the combination of this plan with the proposed development.

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
Waterford North Quays Strategic Development Zone Planning Scheme 2018 **(Distance: 0 m)**	The Government designated lands at North Quays in Waterford City as Strategic Development Zone (SDZ) on 20th January 2016. SDZ designations are created to facilitate development which in the opinion of the Government is of economic or social importance to the State. Waterford City and County Council as the 'Development Agency' prepared the North Quays SDZ Planning Scheme which was adopted by the elected members of Waterford City and County Council in February 2018. The Planning Scheme sets out a Vision to: • To create a sustainable, compact extension to the City Centre that will serve a future population of 83,000 people. • Creation of an integrated multi-modal transport hub designed to sustainably meet the access requirements of The City. The Planning Scheme vision is supported by a range of principal goals, including, but not limited to, the following: • To promote the expansion of the City Centre to the north of the River Suir in a manner that enhances and supports balanced and sustainable growth in Waterford City and encourages its vitality and viability • To provide sustainable solutions that address and manages the risk of flooding and climate change. The proposed Flood Defences West will form a continuation of the flood defences east which received a planning approval as part of the SDZ Transportation Hub and will cumulatively protect the Waterford City north quays area against existing and future flood risk. As such, the proposed development will complement the sustainable development of the Waterford SDZ site.	As the proposed development adjoins the Waterford North Quays SDZ site and complements the sustainable development of the site, it is considered that there will be positive cumulative impacts as a result of the proposed development.
Waterford Planning Land Use and Transportation Study 2004 **(Distance: 0 m)**	The Waterford Planning Land Use and Transportation Strategy (PLUTS) was adopted by Waterford and Kilkenny Councils in 2004 in order to provide a vision and strategy for the development of Waterford City and Environs up to the year 2020. The core provisions of PLUTS are: • Provision for a population increase of almost 30,000 people (or 57% population growth) in Waterford City and Environs; • Investment needed for almost 12,800 new jobs or 46% growth; • Requirement for approximately 11,500 new dwellings transitioning predominantly to the north of the River Suir; • Significant retail expansion in the expanding City Centre; • A Downstream River Crossing to facilitate the extension of the Outer Ring Road northwards to the N25; • A new City Centre Bridge for pedestrians and cyclists to link the redeveloped North Quays with the existing City Centre; • Provision of a rail-passenger platform on the North Quays as part of a new Public Transport Interchange; • Development of a high-quality bus-based public transport system in the City supported by Park and Ride facilities located north and south of the River;	As the proposed development will enhance and protect the transport infrastructure, it is considered that there will be positive cumulative impacts as a result of the proposed development.

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
	Waterford has developed some of this infrsatructure since 2004, most notably the provision of the Waterford Bypass and up river crossing of the River Suir and the Outer Ring Road. A number of these projects have received planning within the past few years and are considered further within this table.	
Transforming Waterford Integrated transport proposals **(Distance: 0 m)**	This document relates to costing relating to transportation proposals some of which are based on the PLUTS Strategy and strategic City infrastructure, necessary for the future development of the City. They are consistent with the Planning Land Use and Transportation Strategy for the City and with Regional and National Planning Policies. The proposed transportation components include: • City centre – Enabling City Growth • City Centre Improvement – Building On The Essential Character • Sustainable Transport Corridor/Regional Greenway • Abbey Road Improvement Works • Dock Road Improvement Works • Integrated Transport Hub – Redefining Urban Transport Modal Integration As above, a number of these projects have received planning within the past few years and are considered further within this table.	No likely significant cumulative impacts are predicted to arise from this plan and the proposed development.
Port of Waterford Waste Management Plan 2017 **(Distance: 5.5 km)**	The Port's waste management plan outlines the Port's policies and procedures in relation to the management of waste. The plan describes the Port's current facilities in terms of waste management and also how the adequacy of these facilities will be reviewed. In the context of the plan, "waste" includes waste originating both from ships using the Port and from the Port itself. Procedures for the handling of different types of waste (e.g. general waste, galley waste, international catering waste, cargo waste, hazardous waste and electrical waste) are described. Procedures for how incoming ships must notify the Port regarding their waste reception needs and how Port users may lodge complaints about waste management are also included. The small volume of waste associated with the proposed Flood Defences West, will be disposed of as per the mitigation measures in Chapter 8 Soils and Geology.	There are no significant cumulative impacts predicted to arise from this plan and the proposed development.
Port of Waterford Company – Dumping at Sea / Dredging (EPA Licence No. S0012-03) **(Distance: Approx. 15 m)**	This permit is for the loading and dumping at sea of dredged material (consisting of sand, silt and gravel) arising from maintenance dredging by Port of Waterford Company at a number of discrete locations in the Suir Estuary Waterford Harbour over a six-year timeframe (2020 - 2025). The licence provides the Port of Waterford Company a Dumping at Sea Permit from the Environmental Protection Agency to maintain the shipping corridor through dredging and dispose of the dredged material in an approved disposal site located c. 2.5km west of Hook Head and c. 2.8km southeast of Dunmore East within the Port's limits. The licence provides for three areas of dredging within the River Suir at Waterford City. These three locations are located downstream of Rice Bridge, namely North Wharf, Frank Cassin Wharf and Forde Wharf & Merchant's Quay Marina. The Port of Waterford have commissioned numerous environmental assessments over the past two decades, as included in the application, to ensure that the impact of the development is minimal. A Natura Impact Statement (NIS) was prepared as part of the application and	No significant cumulative impacts predicted to arise from this licence and the proposed development.

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
	concluded that the proposed dredging and disposal operations will not negatively impact on the integrity of the Natura 2000 sites, their qualifying interests or marine mammals.	
The Southern Waste Management Plan 2015-2021 **(Distance: 0 m)**	The Southern Waste Management Plan 2015-2021 is a statutory planning document whose objective is to set out a framework for the prevention and management of wastes for the Southern region. The overarching strategic objectives of the SRWMP as presented in June / July of 2014 were: 1. *Policy & Legislation The Region will implement EU and national waste and related environmental policy, legislation, guidance and codes of practice to improve management of material resources and wastes.* *2. Prevention Natura Impact Report: Southern Region Waste Management Plan MDR0998RP0015F02 9 Prioritise waste prevention through behavioural change activities to decouple economic growth and resource use.* *3. Resource Efficiency. The Region will encourage the transition from a waste management economy to a green circular economy to enhance employment and increase the value, recovery and recirculation of resources.* *4. Coordination Coordinate the activities of the Regions and to work with relevant stakeholder to ensure the effective implementation of objectives.* *5. Infrastructure Planning. The Region will promote sustainable waste management treatment in keeping with the waste hierarchy and the move towards a circular economy and greater self sufficiency.* *6. Enforcement & Regulations. The Region, will implement a consistent and coordinated system for the regulation and enforcement of waste activities in cooperation with other environmental regulators and enforcement bodies* *7. Protection Apply the relevant environmental and planning legislation to waste activities to protect and reduce impacts on the environment, in particular European Sites, and human health from the adverse impact of waste generated.* *8. Other Wastes. The Region will establish policy measures for other waste streams not subject to EU and national waste management performance targets.* An SEA, AA and SFRA have been completed to support the plan.	No significant cumulative impacts predicted to arise from this plan and the proposed development.
Suir River Basin Flood Risk Management Plan **(Distance: 0 m)**	The purpose of the Plan is to set out the strategy, including 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. This Plan, which is for the period of 2018-2021, is one of 29 Plans being published; each setting out the feasible range of flood risk management measures proposed for their respective River Basins. The preparation of these Plans addresses Ireland's obligations under the 2007 EU 'Floods' Directive (EU, 20074). The Plan includes feasible measures developed through a range of programmes and policy initiatives including: • *Non-structural flood risk prevention and preparedness measures that are applicable nationally, aimed at reducing the impacts of flooding, that have been and are being developed to implement Government policy on flood risk management (OPW, 2004).*	No significant cumulative impacts predicted to arise from this plan and the proposed development.

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
	• *Structural flood protection measures proposed for communities at significant flood risk, aimed at reducing the likelihood and/or degree of flooding, identified through the National Catchment Flood Risk Assessment and Management (CFRAM) Programme.* The CFRAM Programme has examined the flood risk, and possible measures to address the risk, in 300 communities throughout the country at potentially significant flood risk. These communities were identified through the Preliminary Flood Risk Assessment, which was a national screening assessment of flood risk. The communities identified through the PFRA process as being at potentially significant flood risk in the Suir River Basin, along with the sources of flood risk that were deemed to be significant for each community. A set of flood maps, indicating the areas prone to flooding, has been developed and published for each of the communities. The Plan builds on and supplements the national programme of flood protection works completed previously, that are under design and construction at this time or that have been set out through other projects or plans, and the ongoing maintenance of existing drainage and flood relief schemes. A Strategic Environmental Assessment, and an Appropriate Assessment under the Habitats Directive where appropriate, have been undertaken as part of the preparation of, and have been published with the Plan.	
Ferrybank Local Area Plan (LAP) 2017 – 2023 **(Distance: 0m)**	The Ferrybank- Belview Local Area Plan (LAP) 2017 – 2023 outlines a strategy for the proper planning and sustainable development of an area of land stretching from Grannagh to Belview and from the River Suir to the line of the Waterford bypass, adjacent to the proposed Waterford Flood Defences West. The Ferrybank LAP supports the development strategy set out in the Waterford Planning, Land Use and Transportation Study (PLUTS) to achieve a balanced and sustainable growth of Waterford. The PLUTS proposed to bring the "North Quays and the Suburbs fully into the social and economic domain of the City". To achieve this overarching objective, the study advocated for future growth to be distributed between the north and south quays of the city, including Ferrybank. The proposed development will assist Ferrybank LAP to realise its sustainable growth objectives by protecting the north quays area from potential flood events.	Significant positive direct, indirect, cumulative impacts are predicted to arise impacts this plan with the proposed development.
Waterford-New Ross Greenway **(Distance: 1.1km)**	The development of the disused railway line on lands which extend from within Waterford City and County Council's administrative boundary through to Rosbercon, New Ross as a cycle and pedestrian route. The route which is 22km in length will begin at Abbey Road, Ferrybank, Waterford and will follow the disused line through or in close proximity to the townlands of Abbeylands, Rathculliheen, Gorteens, Drumdowney Lower, Rathpatrick, Luffany, Curraghmore, Ballyrowragh, Scartnamoe, Rathinure, Rochestown, Aylwardstown, Carrickcloney, Ballyverneen, Forestalstown, Shanbogh Upper and Raheen (Rosbercon), Co. Kilkenny. The project screened out for Appropriate Assessment.	No significant cumulative impacts predicted to arise from this project and the proposed development.
Bilberry to Waterford City Centre Greenway Link **(Distance: 0.2km)**	Part 8 application was submitted to WCCC in 2019 to carry out works at existing greenway car park at Bilberry, to the Clock Tower on Merchants Quay. • Construction of an approximate 4000mm wide cycle and pedestrian corridor from the Greenway car park at Bilberry, along Bilberry Road, Grattan Quay and Merchants Quay, to the proposed South Quay Plaza • Road widening along Bilberry Road, erection of railings and fences and provision of accommodation works where necessary for adjoining landowners	The construction phases of both development are not likely to overlap and due to the scale and nature of the project, no significant cumulative impacts are predicted from this project and the proposed development.

<table>
<tr><th>Plan or Project</th><th>Description of Plan or Project</th><th>Cumulative Impact(s)</th></tr>
<tr><td></td><td>Provision of 2 No. 4000 mm wide boardwalks at the eastern end of Bilberry Road
Upgrade the existing facilities on Grattan Quay and Merchants Quay, and upgrade the existing facilities in the car parks in Merchants Quay
The proposed development has undergone Appropriate Assessment Screening under the Habitats Directive (92/43/EEC) and the Planning and Development Act 2000, as amended, and the Planning Authority has determined that a Stage 2 Appropriate Assessment is not required in this instance. In addition, the proposal has also undergone screening for Environmental Impact Assessment under the EIA Directive 2014/52/EU (and the relevant provisions of the Planning and Development Act, as amended), and the Planning Authority has determined that there will be no likelihood of significant effects on the environment arising from the proposed development and therefore, an Environmental Impact Assessment is not required.</td><td></td></tr>
<tr><td>River Suir Sustainable Transport Bridge

(Distance: 440 m approximately)</td><td>Planning Permission was granted in 2019 (ABP ref no. ABP-303274-18) for construction of a 5-span, 8m wide sustainable transport bridge which will be a shared space for pedestrians, cyclists and a public transportation service. The bridge crossing point is approximately 550m downriver of the existing Rice Bridge. The Lower River Suir is in the region of 207m wide at this location and is part of the Lower River Suir Special Area of Conservation (SAC). The proposed development is located approximately adjacent to Barronstrand Street (commercial partially pedestrianised and in front of the existing Clock Tower on the south quays in Waterford city centre.

An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement were submitted to An Bord Pleanála with the River Suir Sustainable Transport Bridge (RSSTB) Application.

Biodiversity

The residual impacts identified in the RSSTB EIAR during operation phase include permanent, slight negative impact on KER 1 River Suir as a result of the permanent loss of estuarine habitat. The residual impacts predicted on the estuarine habitats of River Suir as a result of the proposed development constitutes a Permanent Slight Positive Impact on the River Suir. As such, no significant cumulative impacts likely to arise from the combination of this project with the proposed development.

Noise and Vibration

The residual noise impact for the construction activities for the RSSTB which will be carried out during normal working hours are likely to have negative, moderate, short-term impact on sensitive receptors while there are no night-time construction works for the RSSTB. There will be negative temporary, slight to not significant impacts on receptors as a result of construction activities for the proposed Flood Defences West during normal working hours while negative, significant, temporary impacts are predicted at one receptor during night-time works (see Chapter 12 Noise and Vibration of this EIAR for more details).

No further significant cumulative impacts are predicted as a result of construction phase activities for the RSSTB and the proposed Flood Defences West as localised, temporary noise impacts on different noise sensitive receptors are predicted for both projects.</td><td>The construction phase of this Project and of the proposed development are likely to overlap.

With the implementation of the mitigation measures proposed within Chapter 19 of the EIAR and the NIS as part of this application, and the CEMP, the impacts will be minimised. No further significant effects are likely to arise from the River Suir Sustainable Transport Bridge and the proposed development, other than those localised temporary significant impacts identified in Chapter 12 of this EIAR during the night-time works.</td></tr>
</table>

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
	AA The NIS for the River Suir Sustainable Transport Bridge concluded that the *Project, either individually or in combination with other plans or projects, will not adversely affect the integrity of the Lower River Suir SAC, the River Barrow and River Nore SAC or any other European site*. Furthermore, the NIS *recommends that it be a binding condition of any consent granted in respect of the Project that the mitigation prescribed in this NIS be fully and properly implemented*.	
Falcon Real Estate Development Ireland Limited **SDZ Planning Application** **Distance (0m)**	Planning Permission was granted in 2020 (WCCC ref no. 19928) to a single 10 year planning application for development of lands that is required to conform with the Waterford NQ SDZ Planning Scheme. The proposed development will comprise a mixed-use development consisting of nine blocks of between 1 to 18 storeys. The development described below on a block by block basis will be built on a new raised podium structure, which establishes new ground/ street formation levels, which varies from 8.075m OD to 9.3m OD across the site. This is to ensure the floorspace of the proposed development is above the flood level of the River Suir. The proposed development also includes various areas of landscaping and public realm, infrastructure to connect to the surrounding road network and the City Centre, services infrastructure and all associated site and development works. The proposed development will include the following elements: • 220 bed Hotel, 15 storey building (Block A); • A Mixed-use Commercial Building (Block B) contained over three levels comprising a Visitor Centre (tourism / cultural use), retail (including a licenced supermarket), Foodcourt and individual food and beverage units with associated outdoor seating areas, Leisure/ entertainment, cinema and associated circulation and ancillary areas. Some ancillary accommodation associated with Block B is located below podium. The maximum building height is 32.45m (41.2m OD). This is the height of the portal building at the main entrance to Block B, adjacent to the proposed Sustainable Transport Bridge landing point. Generally, the building height is c.17m (25.65m OD) rising at the western and eastern ends to c21.7m (30.45m OD). There are three main access points to Block B from the south elevation and two on the north elevation (the northern entrances onto Dock Road will be opened in tandem with the proposed Transport Hub development by WCCC). Vehicular access / egress to the carpark is provided from the eastern and western access points off Dock Road. • A seven-storey office block Office Development (Block C) located on the eastern side of the site. • A Residential (Blocks D1-D5) comprising five apartment blocks with a total of 298 apartments with associated balconies, ancillary accommodation, resident support facilities, services and amenities are proposed at the eastern end of the site. • Energy Building (Block E) is a standalone single level building (11.45m) located to the west of the Hotel (Block A). The building contains utilities and plant to service the proposed development. A green roof and PV panels are proposed on the roof structure. Carparking: A car park and services / plant associated with the Blocks A-D will be provided below podium, beneath Blocks A – D on a new formation level of 4.75m OD. A total number of 1,481 parking spaces will be provided across the development site. This includes parking and basement accommodation (GFA) directly	The construction phase of this Project and of the proposed development are likely to overlap. With the implementation of the mitigation measures proposed within Chapter 19 of the EIAR and the NIS as part of the Flood Defences West, and the CEMP, the impacts will be minimised, and therefore, no further significant effects are likely to arise from this project and the proposed development, in addition to those localised, *temporary significant* impacts identified in the Noise chapters of the respective EIARs.

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
	associated with the relevant block above, vehicle and pedestrian circulation, stair cores, lifts, plant and storage, service/ delivery yards and other ancillary accommodation. The below podium floor level of 4.75m OD is 2 metres above the existing deck level at 2.75m OD. Associated Infrastructure and Public Utilities: Transport: The development connects to the 'SDZ Access and Public Road Infrastructure' project (WCCC Part VIII approved in January 2019) which provides two vehicular access points into the site off Dock Road / Fountain Street (R711) – the western access point is located opposite the entrance to the former Ard Ri Hotel; the eastern access connects to the site from a realigned Abbey Road. This proposed development will connect to the approved New Ross to Waterford Greenway and vehicular access points with minor modifications within the site at the tie-in points. The proposed development has incorporated this design of the proposed Sustainable Transport Bridge (proposed by WCCC and was granted planning permission by ABP (ref no. ABP-303274-18) in) that will tie in at the Central Plaza. Drainage: The development will also include all related infrastructure and associated site and development works and connections to water services and public utilities outside the SDZ site. The proposed works include decommissioning of the existing Ferrybank Pumping Station which is located on the SDZ lands and provision of a new pumping station and associated stormwater tanks on the combined sewer network serving Waterford City (Rockshire Area). The new pumping station is proposed on lands north of the railway line, on the former Dunlop Tyres site. A new connection from the SDZ lands, under the railway line, is proposed east of the eastern access to the lands. An emergency outfall and stormwater outfall from the new pumping station to the River Suir is proposed at the eastern boundary of the SDZ lands. This will replace the outfall from the existing pumping station. These ancillary infrastructure works for the pumping station are located east of Blocks D1-5. WCCC will divert the existing 900mm combined sewer, from a point north of the existing railway crossing to drain by gravity to the proposed pumping station location. The Council will also upgrade (if required) the existing rising main to Abbey Road. All floorspace associated with the building blocks (Blocks A – E) are within the Waterford North Quays Planning Scheme boundary on a site of c 7.3 ha. The ancillary infrastructure works outside the Planning Scheme boundary relate to an area of 0.5 ha and include the proposed new pumping station and related infrastructure. An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement have been submitted to the Planning Authority with the Application. The residual impacts identified in the EIAR during construction and operation phase for the project include a slight effect on the road network, a minimal impact on hydrology once the appropriate mitigation and monitoring measures are implemented throughout. Chapter 12 Noise and Vibration of the EIAR prepared for the development at the North Quays SDZ lands determined that *"noise impacts will be negative moderate short-term and, in some instances, negative significant and temporary depending on the activities involved at the closest noise sensitive locations".* No night-time construction works are proposed for the development at the North Quays SDZ lands. There will be *negative temporary, slight to not significant* impacts on receptors as a result of construction activities for the	

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
	proposed Flood Defences West during normal working hours while *negative, significant*, temporary impacts are predicted at one receptor during night-time piling works (see Chapter 12 Noise and Vibration of this EIAR for more details). The construction programme for the Flood Defences West is short, lasting approximately 7 months of which, 4 weeks of night-time piling will be required which will locally significantly impact on one receptor. This receptor will not be impacted by works associated with the development at the North Quays SDZ lands. Therefore, no further significant cumulative impacts are predicted as a result of construction phase activities for the development at the North Quays SDZ lands and the proposed Flood Defences West. The NIS concluded that the *project, alone or in combination with other projects, will not adversely affect the integrity of the River Barrow and River Nore SAC*.	
SDZ Transport Hub **(Distance: 0km)**	Waterford City and County Council granted planning permission in September 2019 for a Part VIII Planning Application for the construction of a Transport Hub at Ferrybank, Waterford. The new Transport Hub is to include; a Rail station to replace the existing Plunkett Train Station along the existing Waterford City to Rosslare Iarnród Éireann railway (active only to Belview Port); re-configuration to the layout of the existing Bus Éireann depot site; construction of additional parking for Bus Éireann at an adjoining site (former Dunlop site); construction of drainage network upgrades along the Dock Road and in the vicinity of the Transport Hub and construction of Flood Defences East along the southern boundary of the Iarnród Éireann railway. The noise and vibration section of the Part VIII report identified that *"there is little likelihood of a significant adverse impact from construction works"* for the Transport Hub development which will occur during normal working hours. There are no night-time construction works for the Transport Hub. There will be *negative temporary, slight to not significant* impacts on receptors as a result of construction activities for the proposed Flood Defences West during normal working hours while *negative, significant*, temporary impacts are predicted at one receptor during night-time works (see Chapter 12 Noise and Vibration of this EIAR for more details). No further cumulative significant impacts are predicted as a result of construction phase activities for the Transport Hub and the proposed Flood Defences West, further to those identified in Chapter 12 of this EIAR, as *localised*, *temporary* noise impacts on different noise sensitive receptors are predicted from both projects.	The construction phase of this Project and of the proposed development are likely to overlap. With the implementation the CEMP, the impacts will be minimised, no further significant effects are likely to arise from this project and the proposed development during the construction phase, other than those localised *temporary significant* impacts identified in Chapter 12 of this EIAR during the night time works. The proposed Flood Defences West will form a continuation of flood defences with those proposed as part of the SDZ Transportation Hub. Both projects will cumulatively protect the north quays area against potential flood risk during their operation, resulting in positive cumulative impacts.
Rock Stabilisation and Rock Protection measures Plunkett Railway Station	Waterford City and County Council granted planning permission for a Part VIII Planning Application in January 2019 for Rock Stabilisation and Rock Protection measures at Plunkett Railway Station. The rockface running parallel to the railway line behind Plunkett station requires works to reduce the risk of global slope instability and of rockfalls which could affect railway infrastructure, Irish Rail personnel or the public. The project comprises of approximately 380 metres of rockface remedial works consisting of a combination of rock face	The construction phase of this Project and of the proposed development are not likely to overlap.

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
(Distance: >10 m approximately))	stabilisation measures (rock bolting and netting) and rock fall protection systems (metal rockfall barriers fixed to the rockface or rockfall strengthened earth embankments). Other works which are anticipated to be required to facilitate the construction include the temporary removal of the existing signal cabin adjacent to the rockface (to be reinstated following the works), construction of a temporary access embankment from imported & site won material in front of sections of the rockface to enable rockface reprofiling, installation of a cut off drain at the top of the rockface and its connection into the existing station drainage network, excavation of existing rockfall debris at the place of the proposed rockfall embankment and de-vegetation of the rock face where required.	Likely significant positive effects are predicted to arise from this project and the proposed development which aim to protect the existing rail infrastructure.
SDZ Access and Public Road Infrastructure (Distance: 0 m)	Waterford City and County Council granted planning permission for a Part VIII planning application in January 2019 for the proposed SDZ road and access infrastructure improvement that will consist of modifying and upgrading the existing R711 dual carriageway and Abbey Road to facilitate the connection of the existing and proposed future planned road, cycling and pedestrian network with a future planned internal road, cycle and pedestrian network within the NQ SDZ. Connection into the SDZ is proposed through two bridge access points located at the eastern and western ends of the SDZ respectively. The eastern access will connect into a realigned Abbey Road and the western access will connect to the R711 opposite the currently unoccupied 'Ard Rí Hotel' entrance. The site is set back from the existing Dock Road and adjacent properties and is also set back from the River Suir.	The construction phase of this Project and of the proposed development are not likely to overlap. No significant effects are likely to arise from this project and the proposed development.
Gracedieu LIHAF Scheme **(Distance: 900 m)**	A Part VIII planning approval was granted to the Gracedieu LIHAF Scheme which consists of Public Infrastructure: An access road and Housing Delivery: Located in the Electoral Division of Gracedieu, north west suburbs of Waterford City on the south bank of River Suir. It is proposed to develop roads infrastructure to support the initial development of 200 housing units. The roads infrastructure will serve a site of approx. 7.4 ha, part of which is in WCCC / HSCA ownership and part of which is privately owned. The proposal is to construct an access road along with roundabouts at the northern and southern end of the Phase 1 road proposal.	No significant cumulative impacts are predicted to arise from this project and the proposed development due to the nature of the works and distance from the site.
Kilbarry LIHAF Scheme **(Distance: 3.4 km)**	A Part VIII planning approval was granted to the Kilbarry LIHAF Scheme which consists of Public Infrastructure: A ring and distributor road in the Electoral Division of Kilbarry, approximately 3.4km south of proposed Flood Defences West. Housing Delivery: This proposal relates to the provision of a distributor road network to open up a landbank in the Lacken/Kilbarry area of Waterford City. This involves opening up of a large tract of residentially zoned lands consisting of c. 105 ha. The land is zoned as High Density and Low Density housing with mixed use, open space and community facilities. It will provide community facilities, amenity spaces, parkland and neighbourhood services along with the development potential of 450 housing units by 2021 with a longer-term potential of 1500 units.	No significant cumulative impacts predicted to arise from this project and the proposed development, due to the distance from the proposed development.
Ferrybank LIHAF Scheme **(Distance: 600 m)**	A Part VIII planning approval was granted to the Ferrybank LIHAF Scheme which consists of Public Infrastructure: Provision of community and amenity facilities. Housing Delivery: This proposal relates to the provision of a Neighbourhood Park at Ferrybank in South Kilkenny. This is a joint venture between Kilkenny County Council and Waterford City & County Council. Housing supply in this area has been almost stagnant since mid-2000. The provision of a park will increase the attractiveness of the area and lead to the activation of housing supply. In addition, Ferrybank District shopping centre is located across the Belmount Road from	No significant cumulative impacts predicted to arise from this project and the proposed development due to the nature of the works proposed as part of the proposed development.

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
	the proposed park. This is constructed, but largely vacant apart from Kilkenny County Council Area office and library.	
Nevin Construction - Development at Waters Gate, Bilberry, Waterford **(Distance: 180m)**	Planning permission was granted in 2018 (WCCC ref no. 17780) for demolition of an existing dwelling and construction of 9 No. dwelling houses comprising 6 No. semi-detached 3-storey 4-bed units, 2 No. semi-detached 2-storey 3-bed units and 1 No. detached 2-storey 3-bed unit together with a 2 m high boundary wall/railing and all associated site works at Waters Gate, Bilberry, Waterford. This development is located on the southern bank of the River Suir, 180m southwest of the proposed development. A Natura Impact Statement (NIS) was submitted as part of the application which proposed a number of mitigation measures to protect the Lower River Suir SAC. The NIS concluded that the development would not have an adverse effect on the integrity of the Lower River Suir SAC or any other Natura site.	No significant cumulative impacts are predicted to arise from this project and the proposed development.
Glanway Ltd. **(Distance: 5.3km)**	Planning Permission was granted in 2019 (KCC ref no. 19328) for a change of use at units 3 and 4 Belview Port. It is intended to change its current warehousing use to allow for the acceptance and processing of non-hazardous waste into Solid Recovered Fuel (SRF) and for the composting of organic fines. The application will allow for acceptance and processing of up to 98,500 tonnes per annum at the facility. The application is accompanied by An Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS). On review of the above-mentioned reports, it is concluded that significant cumulative impacts will not arise as a result of the proposed development.	The site is located at Belview Port, 5.3km east and on review of the EIAs and NISs for both developments, no significant cumulative impacts are expected as a result of the proposed Flood Defences West and the additional processing at Glanway Ltd.
Jackie Greene Construction Ltd. – Strategic Housing Development **(Distance 5.4km)**	Planning permission was granted in 2019 (ABP ref no. ABP-304423) for construction of 361 no. units comprising 207 no. houses (13 no. 2-beds, 116 no. 3-beds, 78 no. 4-beds), 154 no. apartments within 15 no. 4 storey blocks (providing 53 no. 1-beds, 90 no. 2-beds and 11 no. 3-beds); A creche of c.574 sq.m.; 7 no. internal/external communal waste storage facilities (total floor area c.214.3 sq.m); 638 car parking spaces and 390 no. bicycle parking spaces within 15 no storage facilities (total floor area c.232 sq.m). Additional visitor bicycle parking provided in the public realm; 2 no. ESB sub-stations/switchrooms (totalling c.10 sq.m); and Vehicular/pedestrian/cyclist accesses to the public road (Ballygunner Hill/St. Mary's Place). An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS) accompany the planning application. The NIS concluded that *"concluded that the proposed development will not have significant effects on the WFD environmental objectives associated with the Lower Suir Estuary, nor is it likely to impact on the qualifying habitats and species of the Lower River Suir SAC or the River Nore and River Barrow SAC"*. Due to the distance between the two developments, there will be no significant cumulative impacts.	No significant cumulative impacts predicted to arise this project and the proposed development due to the distance between the two developments.
Kilbarry Developments Ltd – Housing Development (Distance: 4.4km)	Planning permission was granted by WCCC for a permission for the construction of a residential development (ref no. 18734) at Kilbarry, Co. Waterford (phase 3). The Project will comprise construction of 90 no. dwellings consisting of: 24 no. apartments in 3 no. 2 storey blocks containing 4 no. 2-bed and 4 no. 1-bed apartments in each block; 46 no. 2 storey 3-bed semi-detached dwellings; 20 no. 2 story 4-bed semi-detached dwellings; and all associated works. The application is accompanied by An Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS). The NIS concludes: *whilst it has been acknowledged that there is the potential for the project to have significant indirect impacts on two European sites, with the implementation of*	No significant cumulative impacts predicted to arise from this project and the proposed development due to the distance between the two developments.

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
	the detailed mitigation measures identified in this NIS, it is concluded beyond reasonable scientific doubt that the proposed development shall not result in a significant impact to any European sites. Due to the distance between the two developments, there will be no significant cumulative impacts.	
Kilbarry Developments Ltd – Housing Development (Distance: 4.4km)	Planning permission was granted in 2019 (WCCC ref no. 18735) for the construction of a residential development within the townland of Lacken, Kilbarry, Co. Waterford (phase 4) comprising of the following: 92 no. dwellings consisting of: 24 no. apartments in 3 no. 2 storey blocks containing 4 no. 2-bed and 4no. 1-bed apartments in each block; 46 no. 2 storey 3-bed semi-detached dwellings with optional attic conversion and/or ground floor sunroom; 22 no. 2 storey 4-bed semi-detached dwellings with optional attic conversion and/or ground floor sunroom. Permission is also sought for access from the proposed new Kilbarry LIHAF Road; drainage and water connections to include pumphouse, rising main and associated access road with new entrance from the public road (Lacken Road); all associated site works; landscaping and boundary treatments, at Kilbarry, Co. Waterford. This application is associated with a concurrent planning application being lodged with Waterford City and County Council for 90 no. dwellings on adjoining lands. A Natura Impact Statement (NIS) and Environmental Impact Assessment Report (EIAR) accompany this application. The NIS concludes: *whilst it has been acknowledged that there is the potential for the project to have significant indirect impacts on two European sites, with the implementation of the detailed mitigation measures identified in this NIS, it is concluded beyond reasonable scientific doubt that the proposed development shall not result in a significant impact to any European sites.* Due to the distance between the two developments, there will be no significant cumulative impacts.	No significant cumulative impacts predicted to arise from this project and the proposed development due to the distance between the two developments.
JHOK Ltd Company **(Distance: 4.3km)**	Planning Permission was granted to JHOK Limited in 2019 (KCC ref no. 19668) for a seven-year planning permission for a Continental Cheese manufacturing plant at the IDA Ireland, Belview Science and Technology Park, Gorteens, Slieverue, Co Kilkenny. The development will include a part single storey and part two storey production building approximately 14 metres high with intakes, processing plant and equipment, packing, stores, despatch, offices, laboratories, utilities and personnel facilities; a 10 bay milk intake and cream despatch building approximately 11 metres high and associated plant and equipment with office, milk testing and personnel facilities; storage silos up to 28 metres high for milk, whey and water; pipe and service bridges, salt silos and brine mixing; sprinkler storage tank and pumphouse; waste water treatment plant comprising balancing, waste water treatment and sludge drying and a truck wash; waste recovery compound and store and a monitoring building. The development consists of an activity for which an Industrial Emissions Licence is required. An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS) have been submitted to the Planning Authority with the Application. The NIS concludes that the project *alone or in-combination with other projects, will not adversely affect the integrity and conservation status of any of the qualifying interests of the Lower River Suir SAC and the River Barrow and River Nore SAC*. Due to the location of the proposed plant and the distance to the proposed development, there will be no significant cumulative impacts.	No significant cumulative impacts predicted to arise from this project and the proposed development due to the location of the proposed plant and the distance to the proposed development.
Solas Eireann Development Ltd **(Distance: 8.7km)**	Application (WCC ref no. 20170330) was granted for the construction of a solar PV panel array at Kilmannock & Great Island, Kilmokea, Co. Wexford. The development comprises photovoltaic panels on ground mounted frames within a site area of 28.14 ha, 11 no. single storey mv substations, 1 no. single storey DSO substation,	No significant cumulative impacts predicted to arise from this project and the proposed development

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
	1 no. single storey customer. An Environmental Impact Assessment Report (EIAR) accompanies the planning application. Due to the nature of the development, there will be no significant cumulative impacts.	due to the nature of the proposed development.
Waterford Institute of Technology **(Distance: 2.5km**	Planning permission was granted in 2019 (WCCC ref no. 19669) for a development consisting of a third level educational building comprising of engineering, computing and general teaching facilities of a floor area of 12,894 m^2. The application site is located within the Waterford Institute of Technology Campus which is generally bounded by Paddy Browne's Road on the west and the Cork Road to the south. The building consists of a five storey over lower ground floor building, together with roof top plant and architectural screening. The application includes for 2 no. new disabled access parking bays, 294 no. cycle spaces, removal of existing campus service road, soft landscaping and footpath connections to the existing campus landscaping, hard landscaped entrance area, seating and lighting stands. An Ecological Impact Assessment (EcIA) was submitted with the planning application. The EcIA concluded that *provided that the proposed development is constructed and operated in accordance with the design and best practice that is described within this application, significant effects on ecology are not anticipated at any geographical scale*. Due to the nature of the project and the distance to the proposed Flood Defences West, there will be no significant cumulative impacts.	No significant cumulative impacts predicted to arise from this project and the proposed development due to the nature of the project and the distance to the proposed Flood Defences West.
Smartply Europe DAC **(Distance: 5.8km)**	A planning permission was granted to Smartply Europe DAC in 2019 (KCC ref no. 19509) for amendments to planning permission ref: 11/443, as extended by Extension of Duration of planning permission ref: 19/8, in respect of buildings containing a blending plant, for external drying, screens and associated equipment, structural steel support structures and associated platforms, for site works including alterations to existing road and drainage layout and to relocate the energy plant permitted by permission 09/635. The proposed amendments involve repositioning permitted external plant, changes to the layout and design of external plant (primarily the external energy plant and dryer), relocation of the fuel mix area and fuel bin structures and all associated site works. The planning application is for development of lands at Gorteens, Belview Port, Slieverue, Co. Kilkenny. A Natura Impact Statement (NIS) was submitted with the planning application. The NIS concluded that the *project, alone or in-combination with other projects, will not adversely affect the integrity, and conservation status of any of the qualifying interests of the Lower River Suir SAC or River Barrow and River Nore SAC*.	No significant cumulative impacts predicted to arise from this project and the proposed development due to the distance between the two developments and the conclusion of the environmental assessments and the Appropriate Assessment (AA) from both projects.
Smartply Europe DAC **(Distance: 5.8km)**	A planning application was submitted in 2020 (KCC ref no. 20700) by Smartply DAC to develop a log yard and associated works. The log yard will extend the area available for stockpiling and handling of logs for use in SmartPly's oriented strand board mill which adjoins the site at Gorteens, Slieverue, Co. Kilkenny. A Natura Impact Statement (NIS) accompanies the Application. The NIS concluded that the *project, alone or in-combination with other projects, will not adversely affect the integrity, and conservation status of any of the qualifying interests of the Lower River Suir SAC or River Barrow and River Nore SAC*.	No significant cumulative impacts are predicted to arise from this project and the proposed development due to the distance between the two developments and the conclusion of the environmental assessments and the Appropriate Assessment (AA) from both projects.

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
Suir Shipping Ltd **(Distance: 5.4km)**	A planning permission was granted in 2021 (KCC ref no. 20552) for a 7-year planning permission for Bulk Stores, an uncovered storage yard and associated offices, personnel facilities and site works including earthworks, road works, entrance, gates, and fencing, concrete paving, water services, borewell, drainage works, site lighting and landscaping. The stores will be used to store Port related products such as bulk goods, break bulk and unitised products. The yard will be used to store Port related break bulk products at Gorteens, Slieverue, Co. Kilkenny. Entry and exit will be via a new entrance and also via the adjacent site (Planning Ref. No. PD18/317) for trucks to be weighed. A Natura Impact Statement (NIS) accompanies this application. The NIS concluded that the *project, alone or in-combination with other projects, will not adversely affect the integrity, and conservation status of any of the qualifying interests of the Lower River Suir SAC or River Barrow and River Nore SAC*.	No significant cumulative impacts are predicted to arise from this project and the proposed development due to the distance between the two developments and the conclusion of the environmental assessments and the Appropriate Assessment (AA) from both projects.
Roadstone Limited **(Distance: 3.6km)**	A planning permission was granted in 2017 (KCC ref no. 16700) for a development consisting of continuation of quarrying activities at Aglish North, Granny, Kilmacow, Co. Kilkenny within the red line application area of 62.04 ha to include the extension of the existing excavation by an additional 2 x 15m high benches from the current floor level of ca.-15m AOD to -45 m AOD within the permitted extraction footprint area of 27.06 ha. The proposed development will involve the continuation of stripping of overburden and its storage for use in site restoration; the extraction of rock by means of blasting, the crushing of blasted rock on the quarry floor, and subsequent processing of crushed rock in the existing aggregate plant to produce a range of aggregates. The proposed development will also include the continuation of use of the existing wheel-wash and associated hardstanding area, bunded fuel tank and associated refuelling area. An Environmental Impact Statement (EIS) and Natura Impact Statement (NIS) have been prepared and submitted to the Planning Authority with this Planning Application. Chapter 6 (Water) of the EIS predicts that surface and groundwater quality and quantity will not be adversely affected by the Site extension proposals. The NIS concluded that *the implementation of the committed mitigation measures outlined herewith will ensure that no significant impacts are considered likely on ecological features present on receiving waters that extend downstream to the Lower River Suir SAC*. Furthermore, the Applicant will continue to carryout environmental monitoring in compliance with current Discharge and Planning conditions while meeting EPA and Dept. of Housing, Local Government and Heritage Guidelines.	Due to the considerable distance of 3.6 km between the sites, and the conclusion of the environmental assessments and the Appropriate Assessment (AA) from both projects, no significant cumulative impacts are expected.
Bellvue Port Services (Waterford) Ltd **(Distance: 6.2km)**	A planning permission was granted in 2017 (KCC ref. no. 17623) for extension of duration for a previously granted permission (KCC ref no. 10363) for a development at Gorteens and Drumdowney Upper, Belview Port, Slieverue, Co. Kilkenny. The planning permission is for a for a tank farm for the storage and distribution of petroleum products including petroleum, diesel and kerosene. The tank farm will include six large tanks each 35 metres diameter and 16 metres high, a range of smaller vertical and horizontal tanks, bunded areas, truck loading canopy, vapour recovery building, pumps, gantries, pipelines throughout the site and from the site to Belview Port, firewater tank, store, offices, parking, roads, drains, outfalls to the river, services, landscaping, wastewater treatment plant and fencing. The application also includes a large store for the temporary storage of non perishable imported goods prior to distribution or for the temporary storage of non perishable goods prior to export. An Environment Impact Assessment (EIS) and a Seveso II Land Use Planning Risk Assessment accompany the Application.	No significant cumulative impacts are predicted to arise from this project and the proposed development due to the distance between the two developments and the conclusion of the environmental assessments from both projects.

Plan or Project	Description of Plan or Project	Cumulative Impact(s)
	Biodiversity The 'Flora and Fauna' chapter of the EIS concluded that provided the mitigation measures are implemented, the project will not adversely affect the integrity and conservation status of the Lower River Suir SAC and the River Nore SAC. **Hydrology** The Hydrology Chapter in the EIS concluded that provided the mitigation measures are implemented, there will be a negligible impact on surface water and groundwater during the construction and operational phases of the project.	

Waterford City and County Council are currently progressing a number of projects in support of the SDZ. Based on this knowledge, consideration of likely future planned projects was deemed to be required, as far as is practicable at this stage in the process. Projects are at different stages in the design process with some nearing completion and others at Scoping Stage. However, in the interests of ensuring that all known likely and potential cumulative impacts are identified, Table 17.3 assesses the likely cumulative impacts as a result of these projects. Each of these projects will also be the subject of their own Screening process and EIA and AA where required.

Table 17.3 Assessment of Future Planned Projects in Respect of their Potential to Result in Cumulative Impacts with the Proposed Development

Project	Description of Project	Cumulative Impact(s)
Upgrade of Rail Line east of Plunkett Station to the Proposed Transport Hub (0m)	In order to facilitate the passenger trains at the SDZ Transport Hub Iarnród Éireann will undertake an upgrade to the rail line east of Plunkett Station to the approved SDZ Transport Hub. The primary works to be carried out by Iarnród Éireann are trackworks, including the reinstatement and realignment of double track in the vicinity of the proposed new train station; and signalling works to facilitate the proposed train station and track layout.	While the design details and the environmental assessments are not available yet, based on the nature of the project and the mitigation outlined in the SDZ Planning Scheme for all future developments, significant cumulative impacts between the two developments are not predicted at this stage.

Chapter 18
Major Accidents and Disasters

Chapter 18 Major Accidents and Disasters

18.1 Introduction

This Chapter presents the information required to allow the Competent Authority (An Bord Pleanála) to complete an assessment of the proposed Flood Defences West development (the 'proposed development' hereafter) in terms of its potential to cause major accidents and disasters ('MADs' hereafter), and its vulnerability to the negative impacts of same.

18.2 Legislation

Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU ('the EIA Directive' hereafter) mandates the consideration of MADs in EIA.

Article 3 of the EIA Directive requires an assessment of *"the expected effects deriving* from *the vulnerability of the project to risks of major accidents and/or disasters that are relevant to the project concerned".* Furthermore, Annex IV, Point 8 of the EIA Directive states that the EIAR shall contain:

> *"… a description of the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or disasters which are relevant to the project concerned. […] Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies."*

Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances (the 'Seveso-III Directive' hereafter) is also relevant to this assessment. It aims to prevent and control major accidents involving dangerous industrial substances. The Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2015 (S.I. 209/2015) (the 'COMAH Regulations' hereafter) transpose the Seveso-III Directive into Irish law. They set out a suite of legal obligations for operators of industrial establishments where dangerous substances may be present. Such establishments, referred to as 'Seveso sites', are classified as 'upper tier' or 'lower tier' establishments. In Ireland, there are 95 Seveso sites, of which 46 are lower tier establishments and 49 are upper tier establishments. Under Regulation 25 of the COMAH Regulations, Upper Tier Establishments are required to submit certain information regarding their operations to the Health and Safety Authority (HSA). Each Seveso site also has a consultation zone. If a proposed development falls within a consultation zone for a Seveso site, the Applicant in question is required to consult with the HSA in relation to same.

18.3 Guidance Documents

The assessment of impacts in relation to MADs is a relatively new requirement in the context of EIA, and specific national guidelines have not yet been published. In the absence of official guidelines, the following documents have been given due consideration in the preparation of this Chapter:

- De Ville de Goyet, C., Marti, R.Z. & Osorio, C. (2006). Chapter 61: Natural Disaster Mitigation and Relief, in *Disease Control Priorities in Developing*

Countries (2nd Ed.), Eds.: Jamison, D.T., Breman, J.G., Measham, A.R., Alleyne, G., Claeson, M., Evans, D.B., Jha, P., Mills, A. & Musgrove, P. New York: Oxford University Press. ISBN-10: 0-8213-6179-1

- European Commission (2017). *Environmental Impact Assessment of Projects: Guidance on the Preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU)*.
- IEMA (2020). *Major Accidents and Disasters in EIA: A Primer.*
- IEMA (2019). *EIA Quality Mark Article: Major Accidents and Disasters and the Assessment of Significance.*
- IEMA (2018a). *Disasters in EIA.*
- IEMA (2018b). *EIA Quality Mark Article: Risk of Major Accidents and / or Disasters: An NSIP Experience*.
- IEMA (2018c). *EIA Quality Mark Article: Major Accidents and Disasters in EIA.*
- IEMA (2017). *EIA Quality Mark Article: What is this MADness?*
- IPCC (2012). *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.* Special Report of Working Groups I and II of the IPCC [Field, C.B., Barros, V., Stocker, T.F., Qin, D., Dokken, D.J., Ebi, K.L., Mastrandrea, M.D., Mach, K.J., Plattner, G.-K., Allen, S.K., Tignor, M. & Midgley, P.M.]. Cambridge, UK and New York, USA: Cambridge University Press.
- UN/ISDR (2004). *Living with Risk: A Global Review of Disaster Reduction Initiatives*. Geneva, Switzerland: UN Publications. ISBN 92-1-101050-0.

18.4 Methodology

18.4.1 Scope

This Chapter presents the information required to allow the Competent Authority to complete an assessment of the significant adverse effects of the proposed development in terms of its potential to cause major accidents and disasters ('MADs' hereafter), and its vulnerability to the negative impacts of potential MADs. In accordance with the IEMA guidelines (IEMA, 2020), it considers whether the associated risks are mitigated to a level that is 'as low as reasonably practicable' (ALARP).

This Chapter differs from the other specialist Chapters of this EIAR in that it does not deal with *likely* effects. Rather, its scope is limited to sudden events of *low likelihood*, which *may conceivably occur*, and which would result in *major negative impacts* on human health, cultural heritage and / or the environment (or events of *"low likelihood but potentially high consequence"* as described by IEMA (2020; p. 13; Plate 18.1). Additionally, the understanding of what constitutes a 'significant' effect or impact in this context must differ from that of other Chapters of the EIAR, which typically apply the standard definitions provided by the EPA draft guidelines (EPA, 2017). As stated in those guidelines, *"'Significance' is a concept that can have different meanings for different topics"* (ibid.; p. 50). In relation to MADs, the IEMA guidelines (IEMA, 2020) define a 'significant environmental effect' as one which *"Could include the loss of life, permanent injury and temporary or permanent destruction of an environmental receptor which cannot be restored through minor clean-up and restoration"* (p. 6). This definition has been adopted herein.

As recommended by IEMA (2018a), minor accident risks of relatively low consequence, e.g. localised flooding, have been scoped out of the assessment. Such events are addressed, where appropriate, in the relevant specialist Chapters of this EIAR.

This Chapter does not deal with the impacts of gradual trends associated with climate change, e.g. sea level rise or increasing annual rainfall volumes. It does, however, address sudden events whose frequency may be increased as a result of climate change related trends, e.g., extreme weather events.

The geographic scope of the assessment shall take in all external features which may present a hazard to the development, even if these are beyond the development boundary.

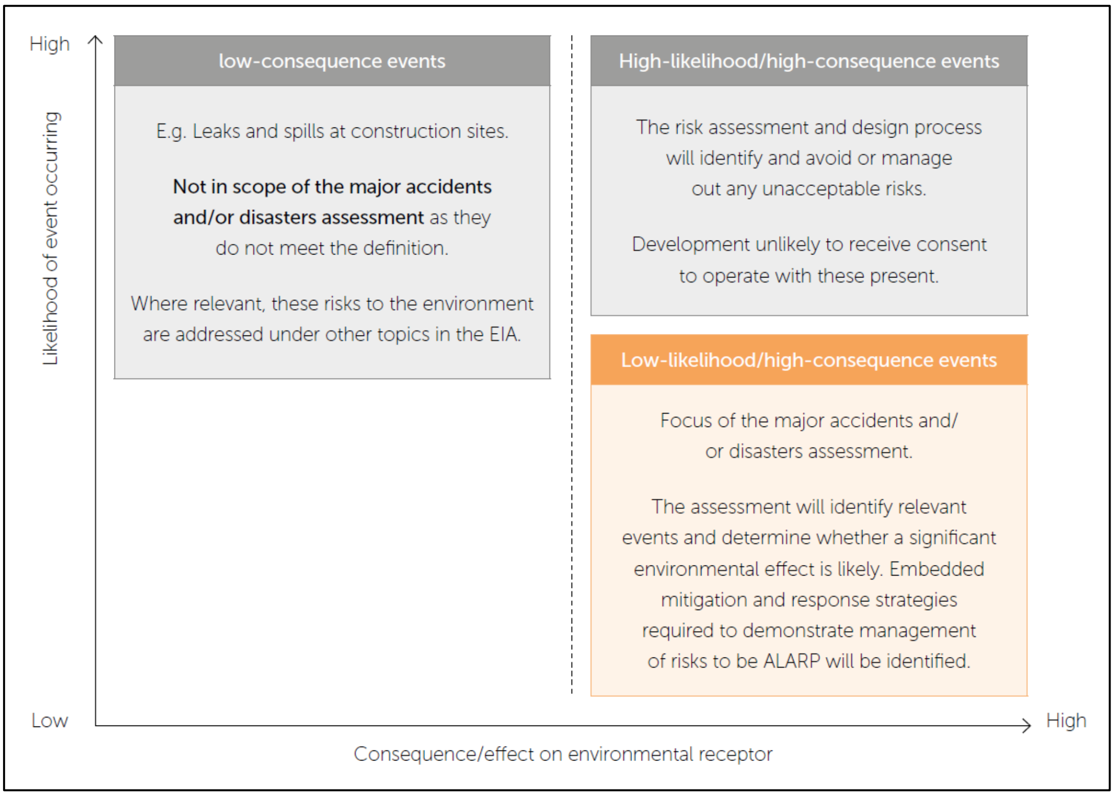


Plate 18.1 Summary of risk events considered in the scope of the impact assessment in relation to MADs (IEMA, 2020)

18.4.2 Definitions

This assessment is based on the following definitions of key concepts, which have been informed by the IEMA (2020), IPCC (2012) and UN/ISDR (2004) definitions, as well as the relevant sections of the EIA Directive.

Hazard

A potentially harmful, sudden event of natural, semi-natural or anthropogenic origin, including latent conditions which may pose future threats; and single, sequential, or combined events.

Receptors

Annex IV, Point 5(d) of the EIA Directive states that *"the risks to human health, cultural heritage or the environment"* [as a result of major accidents and disasters] should be considered. As such, humans, cultural heritage assets and the environment are considered potential receptors herein.

Vulnerability

The propensity of a receptor to be adversely affected by a hazard.

Major Accident / Disaster (MAD)

A hazard to which vulnerable receptors (i.e. humans, cultural heritage and / or the environment) are exposed, resulting in major negative impacts on one or more of these, which requires the use of resources beyond those of the Applicant or its appointed representatives (i.e. Contractors) to manage.

Note: Some sources differentiate between 'accidents' and 'disasters' as different classes of hazards, e.g. anthropogenic versus natural in origin. This is not necessary for the purposes of this assessment and is not carried out herein.

Risk

Risk = Hazards × Vulnerability. It is the probability of negative impacts on human health and / or cultural heritage and / or the environment as a result of the interaction between a hazard and receptors.

Significant Environmental Effect[1]

Effect which could include the loss of life, permanent injury and temporary or permanent destruction of an environmental receptor which cannot be restored through minor clean-up and restoration.

As Low As Reasonably Practicable (ALARP)

ALARP describes the level to which we expect risks to be controlled, i.e. a tolerable level. Whether a risk is ALARP comes down to a qualitative, professional judgement.

18.4.3 Methodology

According to the IEMA guidelines (IEMA, 2020), this assessment will follow a three-stage methodology:

Stage 1 – Screening

The IEMA (2020) guidelines state that *"During screening it should be sufficient to identify if a development has a vulnerability to major accidents and / or disasters and to consider whether a development could lead to a significant effect"* (p. 10). Questions to consider at this stage include the following (adapted from IEMA, 2020):

- Is the proposed development a source of hazard itself that could conceivably result in a major accident and / or disaster occurring?
- Does the proposed development interact with any sources of external hazards that may conceivably make it vulnerable to a major accident and / or disaster?
- If an external major accident and/or disaster occurred, would the existence of the proposed development conceivably increase the risk of a significant effect to an environmental receptor occurring?

Since the proposed development has screened in for mandatory EIA (i.e., is not a sub-threshold development), an EIA Screening Report has not been prepared for same. Accordingly, the screening exercise in respect of MADs is presented herein.

[1] In the context of MADs

Stage 2 – Scoping

If the proposed development is screened in for the assessment of impacts in relation to MADs at Stage 1, the scoping stage aims to determine *in more detail* whether there is potential for significant effects as a result of MADs in relation to the proposed development.

At this stage, various hazard classes are considered in relation to the proposed development. The UK National Risk Register of Civil Emergencies (2017 Edition) has been used as the primary source to identify hazard classes herein. The baseline (i.e., receiving) environment is described insofar as is relevant to the hazard class in question.

IEMA provide a useful infographic illustrating the scoping decision process to aid at this stage (Plate 18.2).

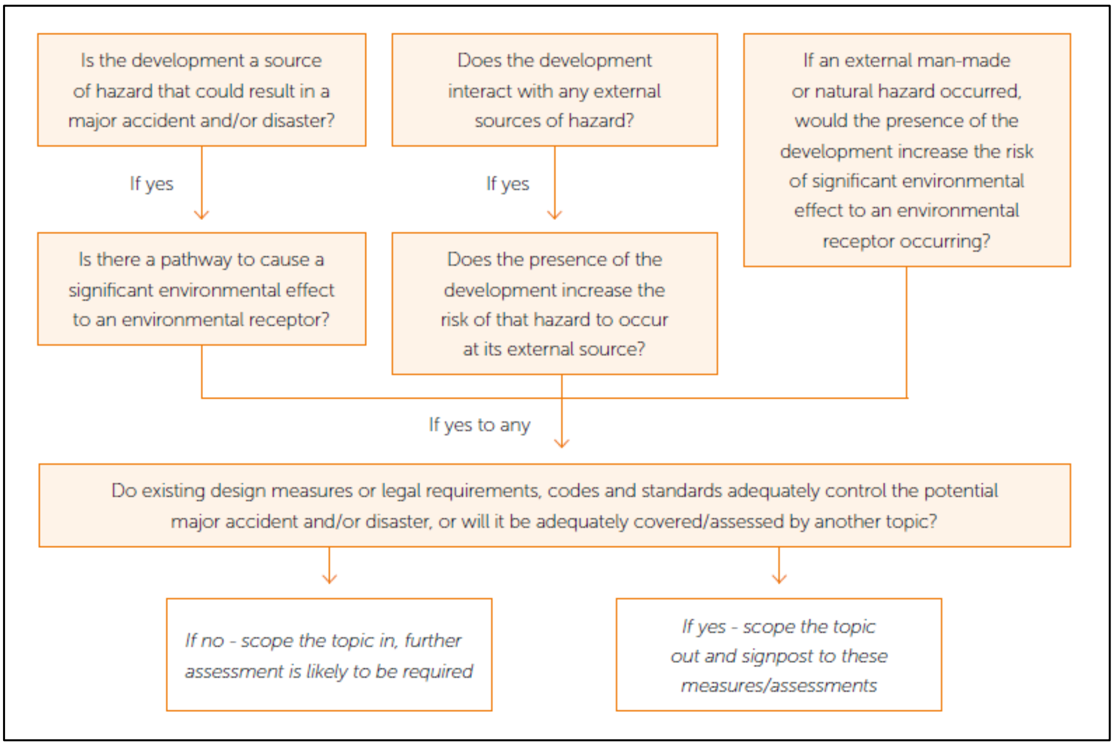


Plate 18.2 Scoping decision process flow (IEMA, 2020)

It is stated that the assessment of impacts in relation to MADs can be scoped out if it can be demonstrated that:

1. *"There is no source-pathway-receptor linkage of a hazard that could trigger a major accident and / or disaster or potential for the scheme to lead to a significant environmental effect; or*
2. *All possible major accidents and / or disasters are adequately covered elsewhere in the assessment or covered by existing design measures or compliance with legislation and best practice."* (IEMA, 2020; p. 12)

It is pointed out in the IEMA (2020) guidelines that *"A major accidents and / or disasters* assessment *will be relevant to some developments more than others, and for many developments it is likely to be scoped out of the assessment"* (p. 11).

The EIA Scoping Report for the proposed development did not consider MADs, so this exercise is presented herein.

Stage 3 – Assessment

If hazard class(es) are screened in at Stage 2, they are brought forward to Stage 3 for a detailed consideration of the potential for significant impacts to arise. At this stage, the following exercises are carried out (as per IEMA, 2020):

- The potentially affected receptors are identified with as much specificity as is practicable. If no receptors can be identified, the hazard class in question is excluded from further consideration, since there is no valid source-pathway-receptor linkage.
- The reasonable worst-case impacts on the receptors are identified insofar as possible. This exercise is based on a qualitative, professional judgement. Uncertainty at this stage is to be acknowledged. Hazard classes which are not predicted to result in significant impacts under this reasonable worst-case scenario are excluded from further consideration.

If, after all of the above-stated exercises have been carried out, there remain hazard classes which may potentially give rise to significant effects as a result of the proposed development or interaction with the proposed development, it is considered whether mitigation measures can be incorporated into the design of the proposed development which would mitigate the associated risk level(s) to be ALARP.

18.5 Stage 1 – Screening

It is considered that the proposed development should screen in for the impact assessment in relation to MADs since, on the basis of a preliminary consideration of the proposed development and receiving environment, it is *conceivable* (although highly unlikely) that:

- the proposed development could result in a MAD;
- the proposed development could interact with external sources of hazards that could conceivably make it vulnerable to a MAD; and that
- if an external MAD occurred, the proposed development could conceivably exacerbate the associated risk of significant impacts.

18.6 Stage 2 – Scoping

The scoping exercise is documented in Table 18.1.

Table 18.1 Stage 2 – Scoping

Class of Hazard	Reason(s) for Scoping Out	Scoped In/Out?
Flooding	Subject addressed in Chapter 10 – Hydrology. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Storm surges	The proposed development does not have the potential to cause such an event. Flooding at the location of the proposed development (which may occur, in the event of a storm surge) is addressed in Chapter 10 – Hydrology – and is discounted from further consideration herein. Otherwise, the proposed development is not considered especially susceptible to the impacts of such events. Nor is it likely to exacerbate such an event. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Gale force winds / tornado / cyclone / hurricane / typhoon	The proposed development does not have the potential to cause such an event. Flooding at the location of the proposed development (which may occur, in the event of an extreme wind event) is addressed in Chapter 10 – Hydrology – and is discounted from further consideration herein. Structural damage can occur in the built environment as a result of high wind events (NBS, 2015; Thoman, 1975). However, the proposed development is not considered especially susceptible to such impacts by virtue of its nature or scale / dimensions, and the detailed design of the proposed development will be in accordance with the relevant design codes and standards in order to ensure structural integrity such that the level of risk associated with such an event will be mitigated to a tolerable level. **Likelihood of significant impacts ALARP.**	Out
Lightning strikes	The proposed development does not have the potential to cause such an event. The detailed design of the proposed development will be in accordance with the relevant design codes and standards in order to ensure structural integrity such that the level of risk associated with such an event will be mitigated to a tolerable level. **Likelihood of significant impacts ALARP.**	Out
Heatwaves	The proposed development does not have the potential to cause such an event. The proposed development is not particularly susceptible to the negative impacts of such an event. Nor is it likely to exacerbate such an event. Accordingly, it is considered that the design of the proposed development is such that the level of risk associated with such an event will be mitigated to a tolerable level. **Likelihood of significant impacts ALARP.**	Out
Drought	The proposed development does not have the potential to cause such an event. It is not especially vulnerable to negative impacts as a result of water supply shortages / restrictions. Nor is it likely to exacerbate such an event. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Extreme cold weather	The proposed development does not have the potential to cause such an event. The detailed design of the proposed development will be in accordance with the relevant codes and standards, including *BS EN 1991-1-5:2003 Eurocode 1 – Actions on structures. General actions – Thermal actions*, such that the level of risk associated with such an event will be mitigated to a tolerable level. **Likelihood of significant impacts ALARP.**	Out
Severe snowfall / blizzard / hailstorm	The proposed development does not have the potential to cause such an event. The proposed development is not considered to be vulnerable to negative impacts as a result of severe snowfall events. Nor is it likely to exacerbate such an event, e.g. by increasing the accumulation of snow on the adjacent railway line. **Likelihood of significant impacts ALARP.**	Out
Volcanic eruption	There is no volcanic activity in Ireland. Indirect impacts (i.e., tsunamis and disruption to air travel) are considered separately below. Subject discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Earthquake	The proposed development does not have the potential to cause such an event.	Out

Class of Hazard	Reason(s) for Scoping Out	Scoped In/Out?
	Seismic activity in and around Ireland is typically of low magnitude – although moderately damaging events of higher magnitude do occasionally occur (Blake, 2006). Besides houses, no account could be found of any damage to built infrastructure in Ireland as a result of a seismic event and it is considered that the proposed development is not especially vulnerable to the impacts of seismic activity by virtue of its nature or scale / dimensions. The detailed design of the proposed development will be in accordance with the relevant design codes and standards in order to ensure structural integrity such that the level of risk associated with such an event will be mitigated to a tolerable level. **Likelihood of significant impacts ALARP.**	
Mass wasting[2]	The topography immediately north of the location of the proposed flood defences is steeply sloping, and there is exposed rock cutting (south face of Mount Misery hill) to the rear (north) of the train tracks and station which has a history of landslide / rockfall events. According to the Geological Survey of Ireland (GSI) map viewer and desk research previously carried out by ROD under the scope of a Part VIII Planning Report (ROD, 2018), there have been a number of landslide events immediately north of the location of the proposed development: • A large rockfall event occurred in the 1950s (date not specified) at the location of the gentler sloping rock face directly opposite the Plunkett Station building. • January 1977 – A rockfall event in which a boulder approximately 0.9 m^3 in volume damaged a house near the slopes at Sally Park. • January 1983 – A wedge failure approximately 4 m long, exposing faces at the top of the rock face at a location approximately 25m east of the signal box. • A rockfall event in 1989, which *"emanated from the top of a large rock outcrop behind the houses in Sallypark"*, displacing a 30 m^2 area of made ground / debris. The trigger of the Sallypark landslide is identified as exceptional rainfall. • A rockfall event of New Years' Eve 2013, when an area of exposed rock behind the train station collapsed and was displaced a small distance, burying 20m of the Waterford – Kilkenny train tracks. The trigger for this event is identified as an exceptional rainfall / winter storm event. Irish Rail passenger services were prohibited from using this section of track thereafter due to the risk of further rockfall events. The locations of the two more recent events, from 1989 and 2013, have been logged on the GSI map viewer and are illustrated in Plate 18.3, below. A Part VIII planning application was approved by WCCC in January 2019 to carry out remedial works to the rock cutting in question, in order to reduce the risk of future landslides. These works include rock bolting, netting, drainage measures and rock fall barriers / embankments, as illustrated in Plate 18.4. The Planning Report states that these rock stabilisation measures will *"provide a significant positive impact to reduce the risks of landslides"* (ROD, 2018, p. 18). It is not clear whether these rock stabilisation measures will address the stability of the slope which was the source of the 1989 Sallypark landslide described above. The GSI record for this event (Plate 18.3) is situated slightly to the west of the extents of the rock stabilisation measures which have been approved. However, a visual inspection of the rock face in question using Google Street View (© 2021) indicates that measures, including rock bolting, have already been applied to this face, which also happens to be located at a further remove from the location of the proposed development (Plate 18.5). This hazard class has been considered in relation to the proposed development by the Soils and Geology specialist who has concluded that the potential for the proposed development to trigger a landslide/rockfall, and the potential for landslide/rockfall to be exacerbated by the proposed development is virtually non-existent, given that the proposed development will not affect the rockfall source area nor it will change the indirect triggering mechanism such as groundwater levels. The likelihood of landslide/rockfall from Mount Misery Hill slope negatively affecting the	Out

[2] Landslides, rockfalls, debris flows, mudflows, avalanches, soil creep, *etc*.

<table>
<tr><th>Class of Hazard</th><th>Reason(s) for Scoping Out</th><th>Scoped In/Out?</th></tr>
<tr><td></td><td>
proposed development is exceedingly low. This is partly due to large distance between the proposed development and the hazard area (with the exception of short segment of proposed trackside drainage running between Plunkett station and the slope), and partly due to the rock stabilisation works that will be carried out to rock face before the construction of proposed development, under the scope of previously approved Rock Stabilisation project discussed above.

Likelihood of significant impacts is ALARP.

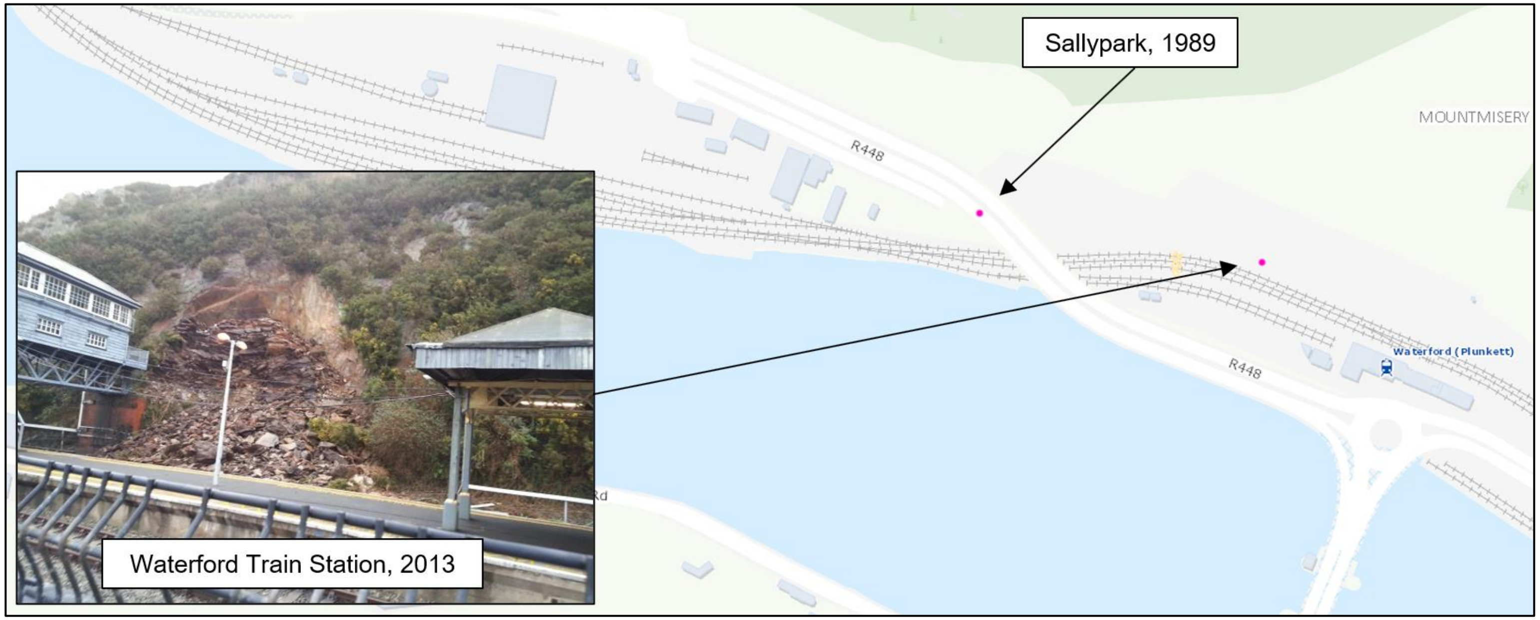
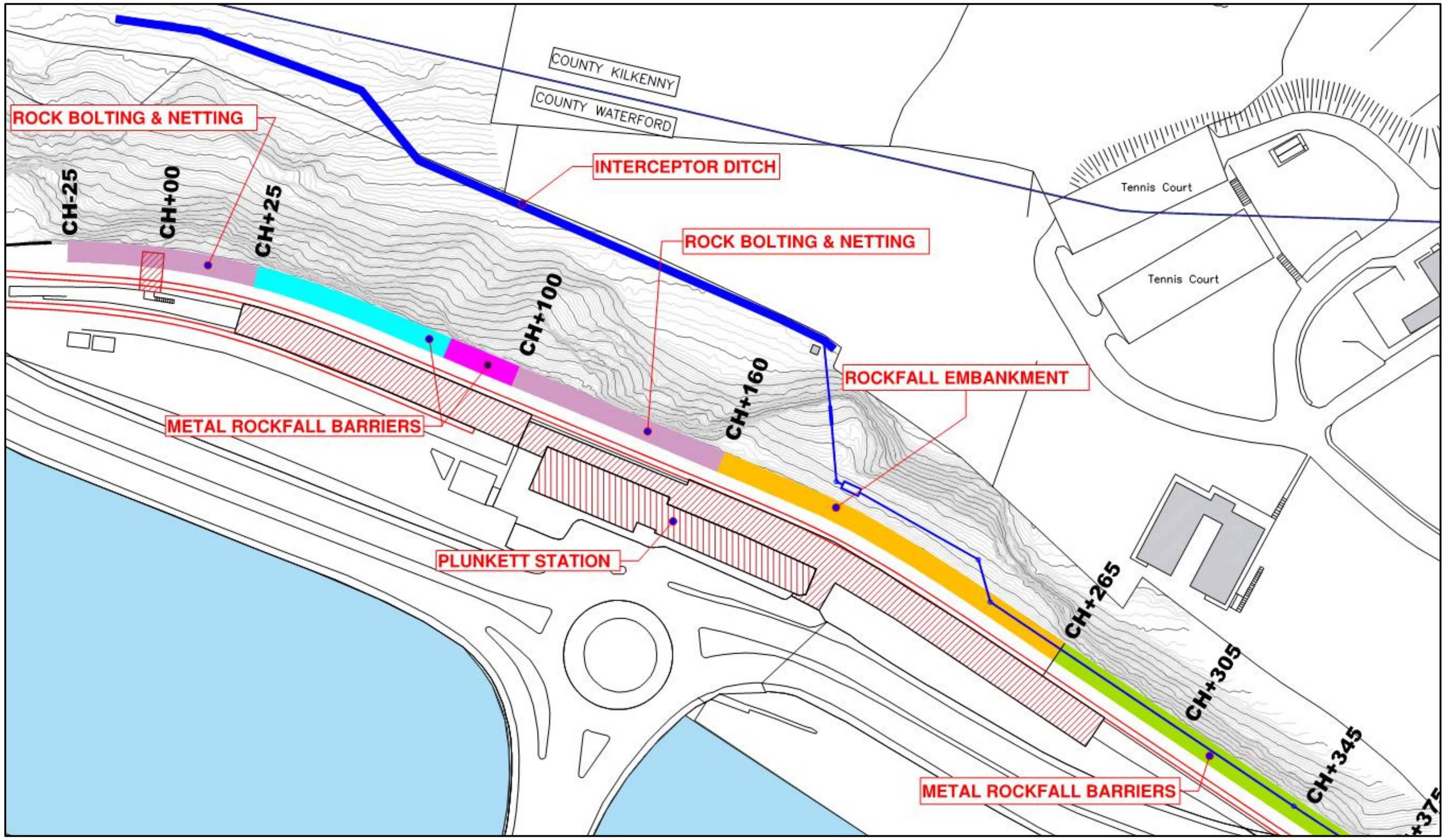
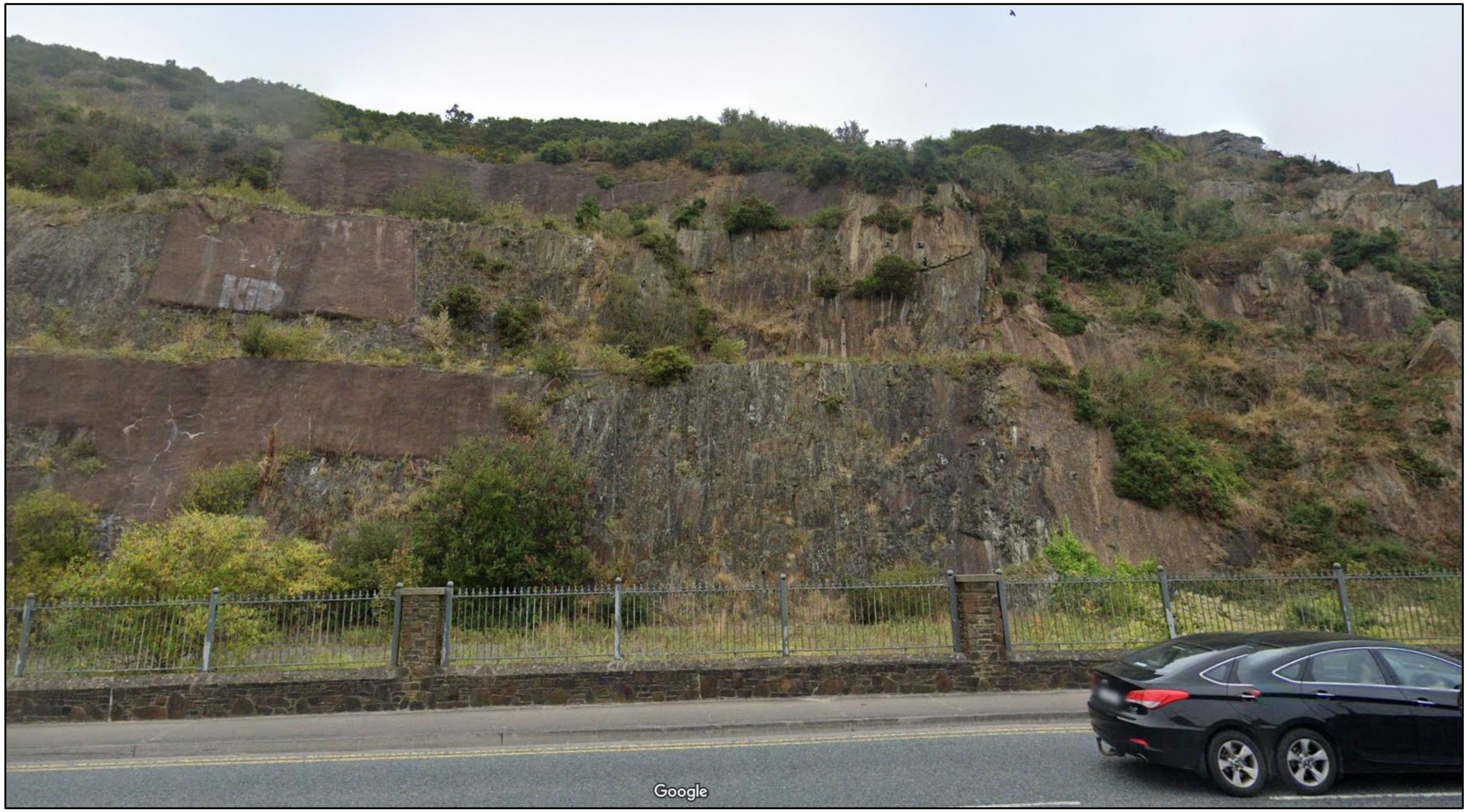


Plate 18.3 Records of landslide events in immediate vicinity of proposed development (Map: GSI Map Viewer, 2021; Inset image: The Journal, 2014)
</td><td></td></tr>
</table>

Class of Hazard	Reason(s) for Scoping Out	Scoped In/Out?
	 **Plate 18.4 Overview of rock stabilisation measures approved in 2019**	

Class of Hazard	Reason(s) for Scoping Out	Scoped In/Out?
	 **Plate 18.5 Evidence of rock stabilisation measures on rock face associated with 1989 Sallypark landslide. Rock stabilisation measures were carried out in the 1990s.**	
Sinkhole	Subject addressed in Chapter 8 – Soils & Geology. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out

Class of Hazard	Reason(s) for Scoping Out	Scoped In/Out?
Limnic eruption / venting[3]	The proposed development does not have the potential to cause such an event. No lakes in immediate vicinity. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Tsunami	The proposed development does not have the potential to cause such an event. Extreme waves events do occur in Ireland's marine and coastal waters, although seldom resulting in major impacts (O'Brien *et al*., 2013). Future extreme wave events affecting the British Isles are conceivable (Giles, 2020; Ward & Day, 2001). However, as pointed out by O'Brien and co-authors (2013; p. 643), *"… these types of events occur very rarely, approximately of the order of thousands of years"* and tsunami risk in Ireland is, on the whole, *"very low"* (ibid; p. 645). Accordingly, this class of hazard is discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Major system / utilities / infrastructure failure[4]	*Damage to Existing Utilities Infrastructure* Construction works can have the potential to result in damage to existing utilities infrastructure, including underground and overhead lines, if improperly planned and managed. The proposed works will involve the excavation of a shallow underground trench within the car parking area in front of Plunkett Train Station, where there is likely to be a high density of underground utilities as detailed in Chapter 16 Material Assets and Land. However, these works will be carried out in such a way as to ensure there are no impacts on utilities and to ensure the safety of site personnel. **Likelihood of significant impacts ALARP.** *Failure of Proposed Flood Defence Measures* As detailed in Chapter 4 – Description of the Proposed Development – the proposed development aims to prevent flooding of critical rail infrastructure including the existing Plunkett Train Station and railway lines to the east and west, and the future Waterford North Quays SDZ Transportation Hub, thereby preventing associated interruptions to transport services. In extreme weather events, surface water and pluvial flooding of the railway line and adjacent road network at the eastern end of the site could occur, with the associated possibility of temporary interruptions to rail service and / or road use. However, as discussed in Chapter 10 Hydrology, the provision of pumping stations within the defended lands will ensure the continued drainage of the subject lands during exceptional flood events within the River Suir. It is considered that the associated impacts (in terms of flooding and journey characteristics for affected persons) would not be of the order of magnitude which would constitute a MAD. **Likelihood of significant impacts ALARP.**	Out
Major nuclear radiation event[5]	The proposed development does not have the potential to cause such an event. It is not especially vulnerable to negative impacts as a result of elevated levels of background radiation. Nor is it likely to exacerbate such an event. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Major disruption of air travel	The proposed development does not have the potential to cause such an event. It would not be affected negatively by a major disruption of air travel. Nor is it likely to exacerbate such an event. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out

[3] Sudden or gradual liberation of dissolved gases reaching saturation in lake waters, resulting in formation of deadly cloud in low-lying areas (Hirslund, 2020).
[4] Of electrical supply, communications systems, energy supply, fuel supply, water supply, wastewater drainage and treatment systems, etc.
[5] As a result of space weather, nuclear arms, accident at nuclear reactor or otherwise.

Class of Hazard	Reason(s) for Scoping Out	Scoped In/Out?
Major air pollution event	Likely significant effects of the proposed development in relation to air quality have been addressed comprehensively in Chapter 13 – Air Quality and Climate. Protocols to be implemented in the unlikely event of a major construction phase pollution incident shall be set out in the Incident Response Plan (IRP), which has been appended to this EIAR in an outline form (see Appendix 4.1 – C) and is to be finalised by the Contractor prior to the commencement of works. The proposed development does not have the potential to cause a major air pollution event of the order of a MAD. The proposed development is not especially vulnerable to such an event or likely to exacerbate such an event. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Major water pollution event	Potential impacts of the construction and operation of the proposed development in relation to water quality have been addressed comprehensively in Chapter 7 – Biodiversity – and Chapter 10 – Hydrology. Protocols to be implemented in the unlikely event of a major construction phase pollution incident shall be set out in the Incident Response Plan (IRP), which has been appended to this EIAR in outline form (see Appendix 4.1 – C) and is to be finalised by the Contractor prior to the commencement of works.The proposed development is not considered to be particularly vulnerable to the effects of such an event. Nor does it have the potential to exacerbate such an event. It is considered that the design and operational procedure of the proposed development are such that the risk associated with such an event is mitigated to a tolerable level. **Likelihood of significant impacts ALARP.**	Out
Major explosion / fire	During the construction phase of the proposed development, it is conceivable that an explosion could occur as a result of improper handling / storage of flammable substances. However, as discussed in Chapter 4, the Environmental Operating Plan (and all of its constituent elements and plans, including the IRP) and best practice guidelines will be adhered to during the construction phase such that the level of risk associated with such an event will be mitigated to a tolerable level. It is not outside the realm of possibility that, due to unforeseen circumstances, a major explosion or fire could occur in the vicinity of the proposed development, e.g. as a result of a road traffic accident, rail accident or an accident at a nearby industrial facility. In the unlikely event that such an event was to occur, direct or indirect structural damage of the proposed development would be highly unlikely, considering the nature and scale / dimensions of the proposed development. **Likelihood of significant impacts ALARP.**	Out
Wildfire	The proposed development does not have the potential to cause such an event. No vegetation which could support wildfire in the immediate vicinity. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Infectious disease pandemic	The proposed development does not have the potential to cause such an event. It would not be affected negatively by such an event. Nor is it likely to exacerbate such an event. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Major traffic accident	*Road Traffic* Road safety during the construction and operation of the proposed development are addressed in Chapter 4 – Description of the Proposed Development – and in Chapter 5 – Traffic Analysis. Potential associated water pollution events (e.g., due to hydrocarbon spillage from construction traffic or plant) are addressed in Chapter 10 – Hydrology. Potential associated fire / explosion(s) are addressed above. There is the possibility that a traffic accident on the R448, R711 or at the Rice Bridge Roundabout could result in structural damage to adjacent flood defences, necessitating repair works. The likelihood of such an accident occurring while the flood defences in question are holding back significant flood waters is exceedingly low and it is considered that such an event in and of itself would not constitute a MAD. **Likelihood of significant impacts ALARP.**	Out

Class of Hazard	Reason(s) for Scoping Out	Scoped In/Out?
	Rail Since the proposed development is to be situated immediately adjacent to an active commuter railway line, there is the potential for rail accidents to occur in the study area. During the construction phase of the proposed development, there are risks associated with site personnel working in close proximity to moving trains. However, these risks will be minimised / avoided during the construction of the landside flood defences with the provision of a temporary fence separating the works from the tracks. During the operational phase, there are risks associated with maintenance personnel working in close proximity to moving trains. These risks to construction site and maintenance personnel are addressed in the IRP which has been appended to this EIAR in outline form (see Appendix 4.1 – C) and is to be finalised by the Contractor prior to the commencement of works. Otherwise, the proposed development does not have the potential to cause a rail accident in and of itself. On the contrary, by preventing flooding of the tracks, the proposed development may be expected to improve the safety of this section of the line. Rail accidents, such as derailments and collisions, are uncommon, with rail being the safest form of land-based transportation in Ireland and the Irish rail network being among the safest in Europe (Irish Rail, 2018). However, accidents do occasionally occur, most commonly at platforms, level crossings and on rail bridges (ibid). In the unlikely event of an unrelated rail accident occurring on the track or at the station adjacent to the proposed flood defences, the proposed development is not expected to exacerbate such an event and is unlikely to be directly affected itself. As stated in Chapter 4 – Description of the Proposed Development – the proposed flood defence walls are situated at a sufficient distance from the adjacent tracks that it is not necessary to design the walls for horizontal impact loading as a result of train derailment, in accordance with Irish Rail standards. On the basis of this statement, it is assumed that, in the unlikely event of derailment, impact with the proposed development will not occur. **Likelihood of significant impacts ALARP.**	
Major industrial accident	Of the Seveso Sites listed on the HSA website, three are situated within 10km of the proposed development; one of which is an upper tier establishment and the other two of which are lower tier establishments (Table 18.2). On the 19th of February 2021, the Health and Safety Authority (HSA) were consulted, and it was confirmed that the location of the proposed development does not fall within the consultation distances of any of the sites in question (Table 18.2). Accordingly, no consultation with any of the operators is required. The proposed development does not have the potential to cause a major accident / disaster at a Seveso site or any other industrial facility in the vicinity. Regarding the potential release of harmful substances from a Seveso site or other industrial facility, the proposed development is not considered to be especially vulnerable to such an event. Nor is the proposed development likely to exacerbate such an event. **Likelihood of significant impacts ALARP.**	Out
Building collapse	The proposed development does not include any buildings and does not have the potential to cause such an event. It is not especially vulnerable to such an event or likely to exacerbate such an event. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Major public disorder	The proposed development does not have the potential to cause such an event. It is not especially vulnerable to such an event or likely to exacerbate the unrelated occurrence of such an event. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Physical attack	The proposed development does not have the potential to cause such an event. It is not likely to be targeted for such an event, or to exacerbate the unrelated occurrence of such an event. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out
Cyber attack	The proposed development does not have the potential to cause such an event. It is not likely to be targeted for such an event, or to exacerbate the unrelated occurrence of such an event. Discounted from further consideration herein. **Likelihood of significant impacts ALARP.**	Out

Table 18.2 Seveso Sites within 10km of the Proposed Development (HSA 2020a; 2020b; 2020c)

* Linear distance from location of proposed development to the nearest 0.5 km, based on Google Maps (© 2021) search.

Tier	Site	Classes of Dangerous Substances	Characteristics of Dangerous Substances	Approx. Distance*	Consultation Distance
Upper	Trans-Stock Warehousing and Cold Storage Ltd Christendom, Ferrybank, Co. Waterford	E1 Hazardous to the Aquatic Environment E2 Hazardous to the Aquatic Environment H1 Acute Toxic Cat. 1 P5a Flammable Liquids P5c Flammable Liquids Ammonia Petroleum Products (Kerosene)	H226 Flammable liquid and vapour H330 Fatal if inhaled H400 Very toxic to aquatic life H410 Very toxic to aquatic life with long lasting effects H411 Toxic to aquatic life with long lasting effects	1.5 km	700m
Lower	SSE Generation Ireland Ltd Great Island Generating Station, Campile, New Ross, Co. Wexford	Hydrogen	H220 Extremely flammable gas H280 Contains gas under pressure; may explode if heated	8.5 km	300m
	Stafford Wholesale Ltd Lockheed Avenue, Airport Business Park, Co. Waterford	P5c Flammable Liquids	H225 Highly flammable liquid and vapour	9.5 km	300m

18.7 Stage 3 – Assessment

Not applicable.

18.8 Mitigation Measures

Not applicable.

18.9 Residual Impacts

Not applicable.

18.10 Difficulties Encountered

No particular difficulties were encountered in the compilation of the information presented herein.

18.11 Conclusion

It is the conclusion of this assessment that there are no risks of MADs associated with the proposed development which are not already mitigated to levels that are ALARP through the design and / or proposed operational procedures of the proposed development. As such, no mitigation measures beyond that which is already proposed under the scope of the design and proposed operational procedures of the proposed development, are required in relation to MADs. No consultation or mitigation measures are required in relation to Seveso Sites.

18.12 References

Blake, T. (2006). Measuring Ireland's earthquakes, *Extractive Industry Ireland*.

Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances (as amended)

De Ville de Goyet, C., Marti, R.Z. & Osorio, C. (2006). Chapter 61: Natural Disaster Mitigation and Relief, in *Disease Control Priorities in Developing Countries (2nd Ed.)*, Eds.: Jamison, D.T., Breman, J.G., Measham, A.R., Alleyne, G., Claeson, M., Evans, D.B., Jha, P., Mills, A. & Musgrove, P. New York: Oxford University Press. ISBN-10: 0-8213-6179-1

Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment Text with EEA relevance

European Commission (2017). *Environmental Impact Assessment of Projects: Guidance on the Preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU)*.

Giles, D.P. (2020). Chapter 3: Tsunami hazard with reference to the UK, in *Geological Society, London, Engineering Geology Special Publications: Geological Hazards in the UK; Their Occurrence, Monitoring and Mitigation – Engineering Group Working Party Report*, **29**, pp. 61 – 80.

GSI (2021). *GSI Map Viewer*. Accessed here.

Highways England (2019). Chapter 16 – Major Accidents and Disaster, in *A27 Arundel Bypass Environmental Assessment Report*.

Hirslund, F. (2020). A single limnic eruption at the origin of today's large-scale density structure of Lake Kivu, *Journal of African Earth Sciences*, **161**, 1 – 13.

HSA (2020a). *Public information on an upper-tier establishment as required by Regulation 25 – Trans-stock Warehousing and Cold Storage Ltd.* Accessed here.

HSA (2020b). *Public information on an upper-tier establishment as required by Regulation 25 – SSE Generation Ireland Ltd.* Accessed here.

HSA (2020c). *Public information on an upper-tier establishment as required by Regulation 25 – Staffords Wholesale Ltd t/a Staffords Bonded.* Accessed here.

IEMA (2020). *Major Accidents and Disasters in EIA: A Primer.*

IEMA (2019). *EIA Quality Mark Article: Major Accidents and Disasters and the Assessment of Significance.*

IEMA (2018a). *Disasters in EIA*. Article published online 02/03/2018.

IEMA (2018b). *EIA Quality Mark Article: Risk of Major Accidents and / or Disasters: An NSIP Experience*.

IEMA (2018c). *EIA Quality Mark Article: Major Accidents and Disasters in EIA.*

IEMA (2017). *EIA Quality Mark Article: What is this MADness?*

IPCC (2012). *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.* Special Report of Working Groups I and II of the IPCC [Field, C.B., Barros, V., Stocker, T.F., Qin, D., Dokken, D.J., Ebi, K.L., Mastrandrea, M.D., Mach, K.J., Plattner, G.-K., Allen, S.K., Tignor, M. & Midgley, P.M.]. Cambridge, UK and New York, USA: Cambridge University Press.

NBS (2015). *Dealing with wind damage risks in property and construction*. Accessed here.

O'Brien, L., Dudley, J.M. & Dias, F. (2013). Extreme wave events in Ireland: 14 680 BP – 2012, *Natural Hazards and Earth System Sciences*, **13**, 625 – 648. DOI: 10.5194/nhess-13-625-2013.

ROD (2018). *Waterford City Public Infrastructure Project – Rock Face Stabilistation and Railway Protection Works: Part VIII Planning Application Report [WPIP-ROD-ENV-S4_AE-RP-EN-400021_[S4-P04]].*

The Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2015 (S.I. No. 209 of 2015)

Thoman, H. (1975). Wind effects on buildings and structures, *American Scientist*, **63** (3), 278 – 287. Accessed here.

UN/ISDR (2004). *Living with Risk: A Global Review of Disaster Reduction Initiatives*. Geneva, Switzerland: UN Publications. ISBN 92-1-101050-0.

UK Cabinet Office (2017). *National Risk Register of Civil Emergencies (2017 Edition)*.

Ward, S.N. & Day, S. (2001). Cumbre Vieja Volcano – Potential collapse and tsunami at La Palma, Canary Islands, *Geophysical Research Letters*, **28 (17)**.

Chapter 19
Mitigation Measures

Chapter 19 Mitigation Measures

19.1 Introduction

Mitigation measures are the measures proposed in order to avoid, reduce or, where possible, remedy the significant adverse environmental effects of the proposed Flood Defences West. Mitigation measures have been incorporated into the design of the proposed bridge and will be applied during both the construction and operation phase where they have been assessed as necessary.

This chapter provides a summary of the mitigation measures for the Flood Defences West as contained within chapters 5 – 18 of the Environmental Impact Assessment Report (EIAR). This is a summarised version stating only the mitigation measures to be provided and does not discuss the requirement for the measure to be applied or the residual impacts. This chapter also deals only with mitigation measures to be applied to the Flood Defences West and does not address the avoidance or reduction mitigation which has been applied through the design development.

19.2 General Mitigation and Monitoring Measures

Table 19.1 General Mitigation and Monitoring Measures

No.	Description
4.1	**Piling** • The following general procedure will be followed for installation of both riverside and landside sheet pile walls: • Vibratory piling shall be the standard method for the installation of all piles. Impact piling shall only be employed where the required depth below ground cannot be achieved by vibratory piling, and shall not exceed 10 strikes in any one piling event • No more than two piling rigs shall operate simultaneously at any time. • The duration of any one piling event shall not exceed 55 piling minutes, i.e. the duration of piling by one rig or the sum of the duration of piling by two rigs shall not exceed 55 minutes. • Following every piling event, there shall be a quiet period of at least 30 minutes. • The above specifications apply to all piling activity for the proposed development, riverside and landside, daytime and night-time.
4.2	**Cladding** The section of the riverside sheet piles within the intertidal zone of the River Suir (the area between the low- and high-water mark) will be fitted with cladding in a form of an eco-seawall to enhance marine biodiversity.
4.3	**Utilities** Prior to excavation works, a segment of the ground will be surveyed via CAT scan and shallow slit trenches excavated in order to confirm the position of utilities.
4.4	**Drainage – construction of Surface Water Outfall Structures** • A dry works area will be created by placing sheet piling or similar into the river from the bank outwards to construct a cofferdam. • Prior to the commencement of any de-watering operations within the cofferdam, adequate and appropriate facilities for the treatment of silt laden water will be designed prior to discharge to ground or back to the River Suir. • Clean, debris free stone will be utilised for the creation of the stone mattress.

No.	Description
	The dry works area will remain in place until all in-stream works have been completed and all concrete material has had sufficient time to cure.
4.5	**Quarries** • Only those quarries that conform to all necessary statutory consents may be used in the construction phase by the appointed Contractor. For whatever quarry source, or sources, utilised for the fill material to be imported to the proposed road development, all will require suitable access routes for HGV traffic from their sites to the suitable main road network, in accordance with their planning approvals.
4.6	**Construction Traffic** • No construction traffic will be permitted to enter the site via Waterford City Centre. The access route to the main and the ancillary construction compound is the R448 Regional Road which has a direct connection to the N25 National Road.
4.7	**Environmental Operating Plan** The Environmental Operating Plan (EOP) shall be finalised by the Contractor, in agreement with Waterford City and County Council, prior to the commencement of the construction phase. The EOP is a document that outlines procedures for the delivery of environmental mitigation measures and for addressing general day-to-day environmental issues that can arise during the construction phase of developments. Essentially the EOP is a project management tool. It is prepared, developed and updated by the Contractor during the construction stage and will be limited to setting out the detailed procedures by which the mitigation measures proposed as part of the EIAR and NIS and arising out of the Board's decision (if approving the proposed development) will be achieved. The EOP will not give rise to any reduction of mitigation measures or measures to protect the environment. Before any works commence on site, the Contractor will be required to prepare an Environmental Operating Plan (EOP) in accordance with the TII/NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIAR and measures stipulated in the planning conditions. Details within the plan will include, as a minimum: • All environmental commitments and mitigation stipulated in the planning documentation in respect of the proposed development, including sediment controls and other measures to ensure that water quality in the River Suir and Waterford Harbour is not degraded. • Any requirements of statutory bodies such as the NPWS and IFI, including adherence to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016). • A detailed Biosecurity Protocol. • A list of all applicable legislative requirements in relation to environmental protection and a method of documenting compliance with these requirements. • Outline methods by which construction activities will be managed in such a manner as to avoid, reduce or remedy potential negative impacts on the environment. To oversee the implementation of the EOP, the Contractors will be required to appoint a person to ensure that the mitigation measures included in the EIAR, the EOP and the statutory approvals are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly.

No.	Description
	The EOP has been appended (Appendix 4.1). This is a preliminary document, which will be updated and finalised by the successful Contractor. Appended to the EOP are the following constituent plans, also to be finalised by the Contractor: **Appendix A:** Construction Environmental Management Plan (CEMP) **Appendix B:** Construction and Demolition Waste Management Plan (CDWMP) **Appendix C:** Incident Response Plan (IRP) Each of these plans is discussed in the following sections. The obligation to develop, maintain and implement the EOP and all of the above-listed plans will form part of the contract documents for the construction phase. It will be a condition of the Contract for the construction of the proposed development that the successful Contractor fully implement the EOP throughout the works. To oversee the implementation of the EOP, the Contractor will be required to appoint a responsible Site Environmental Manager (SEM) to ensure that the environmental commitments (as described above) and the EOP are fully executed for the duration of works, and to monitor whether the mitigation measures employed are functioning properly (i.e. are effectively addressing the environmental impact(s) which they were prescribed for).

19.3 Mitigation and Monitoring Measures for Traffic Analysis

Table 19.2 Mitigation and Monitoring Measures for Traffic Analysis

No.	Description
	There are no mitigation measures proposed for Chapter 5 Traffic Analysis as part of the Flood Defences West.

19.4 Mitigation and Monitoring Measures for Population and Human Health

Table 19.3 Mitigation and Monitoring Measures for Population and Human Health

No.	Description
6.1	Develop and implement all mitigation measures detailed in Chapter 4 (Description of the Proposed Development) this is to include development of Construction Environmental Management Plan (CEMP) and associated traffic management proposals to address all modes of transport including the navigational channel and will be required to be agreed with WCCC prior to construction stage. • The CEMP will be required to maximise the safety of the workforce and the public and minimise traffic delays, disruption and maintain access to properties. • The CEMP will also address temporary disruption to traffic signals, footpath access and the management of pedestrian crossing points. • The contractor shall provide an appropriate information campaign for the duration of the construction works. • The CEMP should minimise disruption to economic, marine users and residential amenities to be agreed by WCCC prior to construction and ensure access is maintained along the R448 & R680 for vehicles, pedestrians, cyclists, and economic operators at all times and ensure marine navigation is maintained. The contractor will be required to develop and implement Stakeholder Management and Communication Plan and will be required to be agreed with WCCC prior to construction stage. • All stakeholders will be required to be agreed with WCCC prior to construction commencing.

No.	Description
	Details of the general construction process/phasing will be communicated to the relevant stakeholders prior to implementation to ensure local residents and businesses are fully informed on the nature and duration of construction works.
6.2	Noise and Vibration mitigation will be provided for during construction of the development. Measures to mitigate noise and vibration impacts on sensitive receptors are detailed within Chapter 12 Noise and Vibration. The contractor will work within stringent construction limits and guidelines to protect residential and commercial amenities including the application of binding noise limits, hours of operation, along with implementation of appropriate noise and vibration control measures.
6.3	In order to minimise dust emissions during construction, a series of mitigation measures have been prepared as part of Chapter 13 Air Quality and Climate. Provided the dust minimisation measures are adhered to, the air quality impacts during the construction phase will not be significant. No further mitigation measures are required.
6.4	Emissions from the construction activities such as dust and risk of accidents were found to be potential short-term, negative impacts. It was found that noise emissions from construction activities, plant and machinery on site is likely to have a significant noise impact within the immediate area during distinct construction phases (i.e. piling activities) of the development.
6.5	Nightworks will also have a significant impact during the short duration they are required. All construction stage impacts will be temporary in nature and reduced and managed by CEMP and associated EOP and CDWMP and the range of mitigation measures of this EIAR.
6.6	All construction works will be temporary in nature and will be carried out in line with best practice thereby minimising the likely significant impacts to the community and human health impacts. The contractor will work within stringent construction limits and guidelines to protect surrounding populations and amenities.

19.5 Mitigation and Monitoring Measures for Biodiversity

Table 19.4 Mitigation and Monitoring Measures for Biodiversity

No.	Description
General Mitigation	
7.1	**Mitigation by Avoidance** The proposed development minimises land-take from ecologically sensitive areas and has been constraints-led from the initial phase, through an iterative design process, and into the final proposed development. The design of the flood defences has followed the basic principles outlined below to eliminate the potential for impacts on Key Ecological Receptors where possible, and to minimise such impacts where total elimination is not possible. The proposed development has been designed to minimise direct or indirect impacts on any habitats or species or other ecological features that were classified as being of Local Importance (Higher Value) or above. The alignment of the proposed flood wall has been designed to avoid, as far as possible, direct, indirect or secondary adverse effects on European sites and other designated sites for nature conservation.
7.2	**Mitigation by Design** The proposed development has been developed having regard to European and national legislation and all relevant guidelines and engineering best practice for the planning and construction of developments. These guidelines and best practice

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>provide practical measures that can be incorporated into the design to minimise the impact and protect the receiving environment.</td></tr>
<tr><td colspan="2">Specific Mitigation Measures – KER 1 River Suir, including Annex I 'Estuaries'
This subsection describes the mitigation proposed for general impacts on biodiversity in and immediately adjacent to the River Suir. Mitigation specific to other individual Key Ecological Receptors is described separately in relation to each Receptor.</td></tr>
<tr><td>7.3</td><td>Habitat Loss, Fragmentation and Degradation
The principal impact of the proposed development on the River Suir relates to the direct and indirect loss, fragmentation and degradation of intertidal and shoreline habitats. The direct loss of c. 800 m^2 of intertidal habitat cannot be avoided through design. However, indirect loss can be avoided and fragmentation and degradation mitigated through the ecological enhancement of the riverside sections of the new sheet pile flood defence wall.
This enhancement will be provided by the attachment of highly structured or bio-active pre-cast concrete cladding ("eco-cladding") to the intertidal river face of the riverside sheet pile section of the new flood defence wall (see photomontages in Figures 11.1 and 11.2 in Volume 3 of this EIAR). The physical structure of this cladding will mitigate these impacts as follows:
• Any indirect loss of intertidal mudflats which might result from erosion associated with increased flow velocities immediately adjacent to the riverside sheet pile wall will be mitigated by the "rough" surface of the cladding, which will reduce flow velocities immediately adjacent to the wall. This will safeguard the remaining mudflats and fringing habitats from the effects of erosion.
• The highly structured surface of the cladding will maximise the opportunity for biological communities of hard intertidal substrates to colonise the new wall. The structure and composition of these communities will depend on the structure of the wall and the communities already present in the River Suir, which will act as a source to "seed" the cladding with encrusting organisms, including macroalgae ("seaweeds") and bivalve molluscs. The physical structure will also provide shelter/habitat for mobile species such as crabs and small fish.
• As the biological communities develop, particularly the seaweed, e.g. Fucus spp., the flow velocity moderation provided by the cladding will be enhanced, providing further protection against erosion for mudflats and shoreline habitats. Depending on the magnitude of this effect, over time, this may lead to an indirect recovery of a small portion of the mudflat habitat lost and, consequently, a slight increase in the area of saltmarsh (though this is unlikely to be significant).
• Once fully developed, the biological communities on the cladding would act as a source of food for a wide range of aquatic fauna in the River Suir and also as a reservoir of larvae or "seed" for the colonisation of other hard intertidal substrates elsewhere in the Suir Estuary.
• The flow velocity moderation provided by the cladding would also benefit fish and other mobile species, as discussed under KER 4 Fish Species, including Annex II migratory species. This addresses the habitat fragmentation impact.
The quantum of each benefit will depend on the final specification, e.g. the roughness of the surface and whether or not the cladding incorporates ledges or "shelves" to encourage shoreline vegetation at the top and/or accumulation of narrow strips of intertidal mudflats in the upper and mid-littoral zones. Incorporation of such features would further enhance the biodiversity value of the new flood defence wall through the provision of greater habitat zonation, heterogeneity and connectivity.
Assuming the specification of an appropriate cladding for the new riverside sheet pile wall, the replacement of intertidal mudflats (of high biodiversity value) and existing quay wall (of moderate biodiversity value) with a new sheet pile wall (of very low biodiversity value) would be mitigated as the cladding would increase the biodiversity of the new riverside flood defence wall to moderate-high (the as the overall value of the habitats being lost). While the loss of mudflat habitat is permanent and</td></tr>
</table>

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>unmitigable, there would be No Net Loss of Biodiversity within the River Suir. Similarly, there would be no adverse effect on the conservation status of Annex I 'Estuaries'.

This mitigation would also contribute to the achievement of the policies and objectives set out in the National Biodiversity Action Plan, the RSES for the Southern Region and the Waterford City Development Plan with regard to the protection and enhancement of the biodiversity value of ecological features and the provision of green infrastructure (and blue infrastructure), particularly in urbanised environments.</td></tr>
<tr><td>7.4</td><td>Artificial Lighting

Artificial lighting associated with the construction of the proposed development poses a risk of potential negative impacts on habitats and species in and adjacent to the River Suir. Therefore, the following limits on construction lighting is proposed:

• Subject to any Health & Safety and/or navigational requirements, construction lighting over the river channel shall be turned off outside of working hours.
• Construction lighting shall be limited to the minimum area required to be lit and minimise light spill to areas not required for construction.
• In order to further limit any light spill, solid hoarding shall be erected around areas which will be subject to night-time construction activities.

Given the implementation of the above measures and the short duration of night-time construction activities (6-8 weeks), these works are unlikely to give rise to significant impacts beyond the duration of the works and, therefore, no additional mitigation is proposed in relation to these works.

As there will be no new artificial lighting associated with the operation of the proposed development, no mitigation is proposed in relation to lighting for the operational phase.</td></tr>
<tr><td>7.5</td><td>Water Quality

As is normal practice with infrastructure projects, an Environmental Operating Plan (EOP) and Construction Environmental Management Plan have been prepared for the Flood Defences West and are included in Appendix 4.1 and Appendix 1.4A, respectively. These will be updated and finalised by the selected contractor to suit the detailed construction methodology and allocate responsibilities to individuals in the construction team. In doing so, the measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the Plans is sufficient to allow an assessment of the anticipated impacts including residual impacts.

The following will be implemented as part of this plan:

• An Incident Response Plan (see Appendix 4.1 C) detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, non-compliance with any permit or license, or other such risks that could lead to a pollution incident, including flood risks.
• All necessary permits and licenses for in stream construction work for provision of the flood defences will be obtained prior to the commencement of construction.
• Inform and consult with Inland Fisheries Ireland.

During construction, cognisance will have to be taken of the following guidance documents for construction work on, over or near water.

• Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016)
• Central Fisheries Board Channels and Challenges – The enhancement of Salmonid Rivers
• CIRIA C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors
• CIRIA C648 Control of Water Pollution from Constructional Sites
• Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (NRA, 2006)</td></tr>
</table>

No.	Description
	Based on the above guidance documents, the following principal mitigation measures will be adhered to for the construction phase: *General Mitigation Measures* • Site works will be limited to the minimum required to construct the necessary elements of the proposed development; • Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels or cut-off ditches; • Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and bunding; • Protection of waterbodies from silt load will be carried out through use of gully silt/sediment filters and shallow berms in hardstanding areas to provide adequate treatment of run-off to watercourses; • Settlement tanks, silt traps/bags and bunds will be used. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap; • The anticipated site compound/storage facility will be fenced off at a minimum distance of 5 m from the top of the edge of the quay wall/river edge. Any works within the 10 m buffer zone will require measures to be implemented to ensure that silt-laden or contaminated surface water run-off from the compound does not discharge directly to the watercourse. See the EOP and Construction Environmental Management Plan (CEMP) in Appendix 4.1 and 4.1 A of this EIAR for further detail. • Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with NRA (2008d). All chemical and fuel filling locations will be contained within bunded areas and set back a minimum of 20 m from watercourses. • Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner, off site, to prevent pollution; and, • The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses. *Specific Mitigation Measures - Concrete Works* Remedial works to the existing masonry quay wall and increasing its height will require the use of in-situ concrete. The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. As the use of concrete cannot be avoided, the following control measures will be employed: • Sandbags or an aqua-dam will be in place for the duration of remedial works to the existing quay wall to effectively isolate the area beneath these works from the River Suir and thereby control the risk of pollutants entering the river. This mitigation shall be removed once the remedial works are complete. • Hydrophilic grout and quick-setting mixes or rapid hardener additives shall be used to promote the early set of concrete surfaces exposed to water. • When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used; • Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters; • Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW); • The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if wet weather is forecast such that precipitation may make it difficult to maintain a dry working area.

No.	Description
	• There will be no spills of concrete, cement, grout or similar materials hosed into surface water drains. Such spills shall be contained immediately and any run-off shall be prevented from entering the watercourse; • Concrete waste and wash-down water shall be contained and managed on site to prevent pollution of all surface watercourses; • On-site concrete batching and mixing activities shall only be permitted within the identified construction compounds; • Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the manufacturer); • Chute washout shall be carried out at designated locations only. These locations will be signposted. The concrete plant and all delivery drivers will be informed of their location with the order information and on arrival to site; and, Chute washout locations will be provided with an appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste in accordance with the Contractor's Construction and Demolition Waste Management Plan.
7.6	**Operational Phase** The only potential water quality impacts associated with the operational phase relate to accidental spillage of paint which will be used in the periodic (approximately every 10 years) repainting of the exposed sections of the new sheet pile flood defence wall. In order to control this risk, the paint specified for this purpose shall not contain lead or tributyltin (TBT) or shall be otherwise approved for use near water.
7.7	**Invasive Alien Species** Mitigation relating to biosecurity and the management of the risks associated with the spread of invasive alien species described under *KER 7 Invasive Alien Species*. Given the full and proper implementation of that mitigation, the proposed development does not pose a significant risk to Biodiversity in the River Suir in terms of the introduction or spread of invasive alien species.
Specific Mitigation Measures - KER 2 Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide'	
7.8	**Habitat Loss, Fragmentation and Degradation** The direct loss of c. 800 m^2 of intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide', cannot be avoided through design. However, indirect loss can be avoided and fragmentation and degradation mitigated through the provision of a highly structured or bio-active cladding, such as that described in relation to KER 1, to the outside of the riverside sheet pile wall. While the loss of mudflat habitat is permanent and unmitigable, there would be No Nett Loss of Biodiversity with regard to the intertidal habitats at this location and the effect on the conservation status of Annex I 'Mudflats and sandflats not covered by seawater at low tide' would be imperceptible at the National level.
7.9	**Water Quality** The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the protection of water quality during the construction of the proposed development will ensure that the impact on intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide', arising from accidental pollution associated with the proposed development would not give rise to significant effects on those habitats.
7.10	**Invasive Alien Species** Mitigation relating to biosecurity and the management of the risks associated with the spread of invasive alien species described under *KER 7 Invasive Alien Species*.

No.	Description
	Given the full and proper implementation of that mitigation, the proposed development does not pose a significant risk to intertidal habitats in terms of the introduction or spread of invasive alien species.
Specific Mitigation Measures - KER 3 Fringing Habitats, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)'	
7.11	**Habitat Loss** A number of small areas of rough grassland habitats between the railway line and the River Suir will be lost as a result of the proposed development. Given the isolation of these habitats from the River Suir by the new flood defence wall and other habitats to the north by the railway line, it was not deemed appropriate to reinstate or improve these habitats as there is a risk to fauna, e.g. Otter, crossing the railway line to access them. Thus, the impact of the loss of these habitats is permanent, but is of low magnitude given the low biodiversity value of these habitats and their small extents. Any direct losses of saltmarshes and other shoreline habitats of high biodiversity value, including Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', have been largely avoided through the iterative design process. In particular, direct impacts on the area of 106 m^2 of Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' has been avoided entirely through moving the western tie-in point of the new flood defence wall, which was originally to transition back behind the existing quay wall at Ch. 0+950 (within this habitat), to its new position at Ch. 900, which is 25m further east than the most westerly point of the Annex I saltmarsh. Furthermore, the proposed eco-cladding described under *KER 1 River Suir, including Annex I 'Estuaries'*, will further safeguard saltmarsh habitats from future erosion be reducing flow velocities along the shoreline. There are no other areas of Annex I saltmarsh within the extents of the proposed development. Other shoreline habitats include extremely narrow strips of ruderal vegetation on the existing quay wall and at the bottom of the same in places. This vegetation will be lost, but can be fully replaced through specification of an appropriate "eco-cladding" as described under *KER 1 River Suir, including Annex I 'Estuaries'*.
7.12	**Disturbance** In order to provide further protection for 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' from disturbance during the construction stage, the areas of confirmed or potential Annex I saltmarsh habitats identified in this EIAR shall not be included within the lands made available to the Contractor and it shall be made clear on all contract drawings that these areas contain sensitive habitats and shall not be disturbed. The Site Environmental Manager (SEM) and Ecological Clerk of Works (ECoW) shall also highlight the sensitivity of these habitats (and need to avoid disturbance of the same) during tool-box talks and other relevant communications with site personnel.
7.13	**Water Quality** The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the protection of water quality during the construction of the proposed development will ensure that the impact on fringing habitats, including Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', arising from accidental pollution associated with the proposed development would not give rise to significant effects on those habitats in terms of habitat degradation.
7.14	**Invasive Alien Species** Mitigation relating to biosecurity and the management of the risks associated with the spread of invasive alien species described under *KER 7 Invasive Alien Species*. Given the full and proper implementation of that mitigation, the proposed development does not pose a significant risk to shoreline habitats, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)', in terms of the introduction or spread of invasive alien species, especially Common Cordgrass (*Spartina anglica*).

No.	Description
Specific Mitigation Measures - KER 4 Fish Species Mitigation measures prescribed for fish species below are relevant for nocturnal and diurnal fish species, fish of small body size and hearing specialists (fish with highly specialised auditory organs). The rationale for this mitigation is fully detailed in the NIS for the proposed development (included as part of this Planning Application).	
7.15	**Habitat Loss** The only fish habitat will be lost is the c. 800 m^2 of intertidal habitats on the left (north) bank of the River Suir where these are being reclaimed by the new flood defence wall. The mitigation which is being provided for the loss of these habitats include the provision of eco-cladding, which is described in detail above in relation to KER 1 River Suir, including Annex I 'Estuaries'. The positive effects of the eco-cladding are relevant to fish species as follows: • It will provide the physical habitat conditions for quick establishment of biological communities of hard intertidal substrates, supporting macroalgae ("seaweeds"), crustaceans and fish. The establishment of such communities and consequent production of planktonic larvae will provide food for fish, including species of conservation importance, e.g. Twaite Shad. It will mitigate against increased flow velocities at the channel edge resulting from the presence of the new sheet pile wall, which will facilitate movement against the tide by fish, especially small fish such as juvenile Twaite Shad.
7.16	**Hydraulic Impacts** Predictions made from the hydrodynamic model for the proposed flood defences show that there would be a slight increase in flow velocity immediately adjacent to a sheet piled wall. While this will not lead to significant effects in the form or erosion of habitats within or on the banks of the River Suir, the rate of deposition will be slightly decreased. The measures described under *KER 2 Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide'* relating to installation of eco-cladding will ensure that the impact on shoreline habitats, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)', is further reduced/made positive.
7.17	**Hydroacoustic Impacts** The mitigation for hydroacoustic impacts is as follows ("piling event" means any period of continuous piling by one or two rigs; "quiet period" means any period in which there is no piling by any rig): • Night-time piling shall be limited to the minimum number of shifts possible and shall only be permitted for landside piling. • In-stream (riverside) piling shall be restricted to daytime shifts only. • Vibratory piling shall be the standard method for the installation of all piles. Impact piling shall only be employed where the required depth below ground cannot be achieved by vibratory piling. • No more than two piling rigs shall operate simultaneously at any time. • The duration of any *vibratory* piling event shall not exceed 55 piling minutes, i.e. the duration of piling by one rig or the sum of the duration of piling by two rigs shall not exceed 55 minutes. • The length of any *impact* piling event shall not exceed 200 strikes from one piling rig (or 200 strikes from *each* of two piling rigs, if piling simultaneously). • Following every piling event, there shall be a quiet period of at least 30 minutes. Only following 30 minutes of no piling whatsoever can the cumulation of piling minutes be re-zeroed. • The above limitations apply to all piling activity for the proposed development, riverside and landside, daytime and night-time, permanent and temporary.

No.	Description
	Based on the expected time required for the installation of each pile (including ancillary processes), as described in Section 4.2.4, the limits prescribed above will not prolong the proposed programme for riverside or landside piling. Therefore, they are feasible within the proposed construction methodology and do not give rise to any additional effects on fish through extension of the total duration of impacts. Based on the detailed hydroacoustic impact assessment presented in the NIS, there is no necessity for daily/nightly or seasonal restrictions on piling activities or the use of soft-start/ramp-up procedures.
7.18	**Artificial Lighting** The measures described under KER 1 River Suir, including Annex I 'Estuaries' relating to the artificial lighting during the construction of the proposed development will ensure that the impact on fish species, including Annex II migratory species, arising from artificial lighting from with the proposed development will not give rise to significant effects on the populations of those species. There are no lighting impacts associated with the operational phase.
7.19	**Water Quality** The measures described under KER 1 River Suir, including Annex I 'Estuaries' relating to the protection of water quality during the construction of the proposed development will ensure that the impact on fish species, including Annex II migratory species, arising from accidental pollution associated with the proposed development will not give rise to significant effects on the populations of those species.
7.20	**Fish Rescue** During de-watering of temporary cofferdams for the construction of drainage outfalls, any fish remaining within the cofferdams will be collected (by netting) and released into the River Suir outside the cofferdams. These fish rescue operations shall be carried out under the supervision of IFI. Given the Health and Safety implications of working within a stell cofferdam in a partially saline environment, the use of electrofishing is not considered to be appropriate in this case.
Specific Mitigation Measures - KER 5 Otter	
7.21	**Disturbance (Lighting and Noise)** The mitigation proposed under *KER 1 River Suir, including Annex I 'Estuaries'*, for lighting impacts, and under *KER 4 Fish Species, including Annex II migratory species*, for noise impacts, are considered sufficient to eliminate any risk of significant direct and indirect disturbance of otters during the construction of the proposed development. There are no sources of disturbance to otters arising from the operational phase.
7.22	**Prey Biomass Availability** The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the protection of water quality during the construction of the proposed development will ensure that the impact on fish and other prey species for otters which might arise from accidental pollution associated with the proposed development will not lead to any reduction in the prey biomass available for otters. Furthermore, the implementation of the general mitigation of impacts on the River Suir and intertidal habitats, i.e. the proposed "eco-cladding" for the riverside flood defence wall, will likely lead to a slight increase in the total biomass available to otters in the long term.
Specific Mitigation Measures - KER 6 Bats	
7.23	**Disturbance (Lighting and Noise)** The mitigation proposed under *KER 1 River Suir, including Annex I 'Estuaries'*, for lighting impacts, and under *KER 4 Fish Species, including Annex II migratory species*, for noise impacts, are considered sufficient to eliminate any risk of significant direct

No.	Description
	and indirect disturbance of bats during the construction of the proposed development. There are no sources of disturbance to bats arising from the operational phase.
Specific Mitigation Measures - KER 7 Invasive Alien Species	
7.24	**Terrestrial Plant Species** In order to minimise the risk of the introduction or spread of invasive alien plant species (IAPS) during construction, all land-based works shall be executed in accordance with best practice for biosecurity in construction. In particular, prior to commencement, the Contractor shall prepare a detailed Biosecurity Protocol describing his/her proposed approach to ensuring that IAPS are not imported or spread during the construction of the proposed development. The Contractor's Biosecurity Protocol shall be in accordance with The Management of Invasive Alien Plant Species on National Roads – Technical Guidance (TII, 2020) and subject to approval by the Ecological Clerk of Works (ECoW) prior to its acceptance and implementation. The Biosecurity Protocol shall include, as a minimum, the following measures to prevent the spread of invasive species: • Good construction site hygiene will be employed to prevent the introduction and spread of problematic IAPS (especially Japanese Knotweed) by thoroughly washing vehicles prior to leaving any site. • All plant and equipment employed on the construction site (e.g. excavators, piling equipment etc.) will be thoroughly cleaned down using a power washer unit prior to arrival on site to prevent the spread of IAPS. • All washing must be undertaken in areas with no potential to result in the spread of IAPS, as detailed in the Construction Environmental Management Plan. • Any soil and topsoil required on the site will be sourced from a stock that has been screened for the presence of any IAPS and where it is confirmed that none are present. If possible, the known stand of Japanese Knotweed at the location of the proposed main construction compound should be eradicated prior to commencement of construction. Given the proximity of this stand to habitats of conservation importance, i.e. habitats within the Lower River Suir SAC, preference should be given to physical removal rather than chemical control. If for programme or other reasons the known stand of Japanese Knotweed cannot be eradicated prior to construction, it should be fenced off (at a distance of 7 m from all visible parts of the plant) at the outset and the access prohibited except for monitoring por treatment purposes. All site staff shall be made aware of the Contractor's Biosecurity Protocol and receive training in the importance of good site biosecurity.
7.25	**Pioneer Species** The invasive pioneer species Common Cordgrass (*Spartina anglica*) was previously recorded on intertidal mudflats in the River Suir within 500 m of the construction site (in the vicinity of the North Quays Development site and Sustainable Transport Bridge). According to the Saltmarsh Monitoring Project 2007-2008 (McCorry & Ryle, 2009): *"A general policy of active Common Cordgrass control in Irish saltmarshes is not recommended. […] It is recommended that instead of attempting to control or manage established populations of Common Cordgrass in Ireland, the primary policy should be that any available resources should be used to prevent the spread of this species to new sites."* In addition to the measures detailed below in relation to aquatic species, the following shall apply to all works on and adjacent to the mudflats: • Vehicles, vessels, plant, equipment, PPE, construction materials or excavated material shall not be moved directly from areas known to contain Common Cordgrass, e.g. the mudflats in the vicinity of the approved Sustainable Transport Bridge and North Quays Development site, without first having been inspected

No.	Description
	by the Ecological Clerk of Works (ECoW) and authorised by the Site Environmental Manager (SEM). Any material excavated from the mudflats, e.g. for the construction of drainage outfalls, shall be stored in a location where it is not at risk of colonisation by Common Cordgrass and shall be reinstated as quickly as possible.
7.26	**Aquatic Species** The use of barges during the construction of the proposed development poses the risk of the introduction of invasive alien species to the aquatic environment both in the vicinity of the works and in the wider Suir-Barrow-Nore Estuary. This has the potential to significantly affect the integrity of aquatic and intertidal habitats in the Zone of Influence. In order to minimise the risk of either the introduction or spread of aquatic IAS and thereby avoid negative impacts on these habitats, the owner or operator of the barge or barges shall: • Provide documentary evidence (in the form of a completed and signed Marine Institute "Cleaning and Disinfection Declaration Form") that the vessel was fully de-fouled within the 6 months immediately preceding its engagement in the construction of the proposed development; and, • Submit travel records relating to the vessel's movements during, at a minimum, the 6 months immediately preceding its engagement in the construction of the proposed development. In order to ensure full compliance with the above, authorisation to move the vessel to the construction area shall only be granted once the Ecological Clerk of Works (ECoW) has satisfied him/herself that the vessel does not pose a significant risk of importing aquatic IAS to the Suir-Barrow-Nore Estuary. He/she shall do so by: • Boarding the vessel; • Speaking with the skipper; • Inspecting the relevant documents; and, • Carrying out a final inspection of the vessel. In relation to other construction activities, including pre-construction surveys and any other site inspections, the principles and appropriate measures in the IFI guidance document Biosecurity Protocol for Field Survey Work (IFI, 2010) shall be followed and shall form part of the Contractor's Biosecurity protocol.
Specific Mitigation Measures - KER 8 Nationally Designated Sites	
7.27	As explained in the assessment of impact above, due to the distances between the proposed development and the pNHAs in the Zone of Influence, the only complete source-pathway-receptor chains are those relating to water quality impacts, invasive alien species (IAS) and migratory or highly mobile species, i.e. fish species and Otter. The mitigation measures proposed in relation to each of those is already described in detail under KERs 1, 4, 5 and 7 above and are deemed sufficient to eliminate any risk of such impacts on these sites.
Monitoring	
7.28	**Hydroacoustic Impacts** In order to allow for greater accuracy in the assessment of future plans and projects, it is recommended that hydroacoustic monitoring be undertaken for the full duration of the proposed development's construction. This monitoring should establish the ambient underwater noise levels in the estuary (and the rate of sound attenuation) and more accurately characterise the sound outputs in terms of both peak and root-mean-squared sound pressure level, as well as sound exposure level, at different frequencies arising from the different methods of pile driving and different types and sizes of piles. This monitoring shall be carried out by specialist underwater noise surveyors and the results will be frequently reviewed (at least fortnightly) by the Ecological Clerk of Works (ECoW).

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<tr><th>No.</th><th>Description</th></tr>
<tr><td>7.29</td><td>Record of Habitats

In order to maintain an accurate and precise record of changes to intertidal and fringing habitats, particularly mudflats and saltmarshes, a photographic record shall be made of these habitats. This record shall cover both sides of the river from 150m upstream of the new flood defence wall to 300m downstream. All photographs shall be taken at low tide, every 2 months, beginning 6 months prior to commencement of construction and finishing 12 months after completion.

In addition, in order to accurately and precisely record any change in the structure and composition of biological communities of hard and soft intertidal substrates, sampling and analysis of these habitats shall be carried out at 6 months, 1 year, 2 years and 5 years post-construction. To facilitate meaningful comparative analysis and evaluation of the impacts of the proposed development, the sampling and analysis should follow the methodology employed by BEC Consultants Ltd in carrying out the pre-planning benthic surveys on 15th March 2021 (see Brophy (2021) in Appendix 7.1).</td></tr>
<tr><td>7.30</td><td>Water Quality

Water quality monitoring will be undertaken in the River Suir, with monthly samples being taken from at least 6 months prior to commencement of construction until at least 24 months post-completion. Water samples will be taken from at least two locations. The final number and location of sampling points will be determined by the Site Environmental Manager (SEM). The results of the water quality monitoring programme will be reviewed by the SEM and the ECoW on an ongoing basis during construction. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation will be undertaken to identify the source of this non-compliance and corrective action will be taken where this is deemed to be associated with the proposed development.</td></tr>
<tr><td colspan="2">Implementation</td></tr>
<tr><td>7.31</td><td>In order to give effect to the mitigation prescribed in this EIAR, it should be a condition of any consent granted in respect of the proposed development that all of the mitigation, including monitoring and enforcement, prescribed in this EIAR be binding, during the construction phase, on the Contractor and, during operational phase, on WCCC. Accordingly, all of the mitigation prescribed herein shall be transposed into the Contract Documents for the construction of the proposed development.

During construction, all works must comply with relevant legislation and guidelines in order to reduce and minimise environmental impacts and to protect all ecological receptors. In particular, there must be full compliance with the following:

The Schedule of Commitments.
The mitigation prescribed in Chapter 7 of the EIAR and in the NIS.
Any conditions which might be attached to the proposed development's planning consent.
Any requirements of stakeholders and statutory bodies, e.g. the NPWS and IFI, including:
Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016).
All applicable legislative requirements in relation to environmental protection.
All relevant construction industry guidelines, including:
C532 Control of water pollution from construction sites: guidance for consultants and contractors (CIRIA, 2001).
Any biosecurity requirements arising from the preceding points.
The Transport Infrastructure Ireland (TII) and National Roads Authority (NRA) Environmental Assessment and Construction Guidelines, specifically:
Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes.
Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage for National Road Schemes.
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<tr><th>No.</th><th>Description</th></tr>
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Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes.
Guidelines on the Management of Noxious Weeds on National Roads.
Guidelines for the Treatment of Noise and Vibration in National Road Schemes.
Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes.
Management of Waste from National Road Construction Projects.
Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.

This list is non-exhaustive. All environmental commitments/requirements and relevant legislation and guidelines which are current at the time of construction will be followed.</td></tr>
<tr><td colspan="2">Environmental Management Plans</td></tr>
<tr><td>7.32</td><td>Environmental Operating Plan
Appendix 4.1 of this EIAR contains the Environmental Operating Plan (EOP) which shall be finalised by the Contractor, in agreement with Waterford City and County Council, prior to the commencement of the construction phase.
The EOP is a document that outlines procedures for the delivery of environmental mitigation measures and for addressing general day-to-day environmental issues that can arise during the construction phase of developments. Essentially the EOP is a project management tool. It is prepared, developed and updated by the Contractor during the construction stage and will be limited to setting out the detailed procedures by which the mitigation measures proposed as part of the EIAR and NIS and arising out of the Board's decision (if approving the proposed development) will be achieved. The EOP will not give rise to any reduction of mitigation measures or measures to protect the environment.
Before any works commence on site, the Contractor will be required to prepare an Environmental Operating Plan (EOP) in accordance with the TII/NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIAR and measures stipulated in the planning conditions. Details within the plan will include, as a minimum:

All environmental commitments and mitigation stipulated in the planning documentation in respect of the proposed development, including sediment controls and other measures to ensure that water quality in the River Suir and Waterford Harbour is not degraded.
Any requirements of statutory bodies such as the NPWS and IFI, including adherence to Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016).
A detailed Biosecurity Protocol.
A list of all applicable legislative requirements in relation to environmental protection and a method of documenting compliance with these requirements.
Outline methods by which construction activities will be managed in such a manner as to avoid, reduce or remedy potential negative impacts on the environment.

To oversee the implementation of the EOP, the Contractors will be required to appoint a person to ensure that the mitigation measures included in the EIAR, the EOP and the statutory approvals are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly.
The EOP has been appended (Appendix 4.1). This is a preliminary document, which will be updated and finalised by the successful Contractor. Appended to the EOP are the following constituent plans, also to be finalised by the Contractor:</td></tr>
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No.	Description
	Appendix A: Construction Environmental Management Plan (CEMP) **Appendix B:** Construction and Demolition Waste Management Plan (CDWMP) **Appendix C:** Incident Response Plan (IRP) Each of these plans is discussed in the following sections. The obligation to develop, maintain and implement the EOP and all of the above-listed plans will form part of the contract documents for the construction phase.
7.33	**Construction Environmental Management Plan** Prior to any demolition, excavation or construction a Construction Environmental Management Plan (CEMP) will be produced by the successful contractors for each element of the proposed development. The CEMP will set out the Contractor's overall management and administration of the construction project. A Construction Environmental Management Plan has also been prepared as part of this EIAR, see Appendix A of Appendix 4.1. The CEMP will be developed by the Contractors during the pre-construction phase, to ensure commitments included in the statutory approvals are adhered to, and that it integrates the requirements of the Environmental Operating Plan (EOP). The CEMP will contain the following information of general importance: • An overview of the proposed development. • An organisational chart illustrating the structure of the Contractor's project team and the duties and responsibilities of the various members. • The Contractor's communications strategy. • The contact details of relevant persons/entities, e.g. the Safety Officer, the Site Environmental Manager and the emergency services. • A list of the documents which will have informed the CEMP, including all relevant legislation and construction/environmental guidelines. In relation to environmental management, the CEMP will provide and full list of the Contractor's environmental commitments and will detail the Contractor's approach to the following: • Details of working hours and days. • Details of emergency plan - in the event of fire, chemical spillage, cement spillage, collapse of structures or failure of equipment or road traffic incident within an area of traffic management. The plan must include contact names and telephone numbers for: Local Authority (all sections/departments); Ambulance; Gardaí and Fire Services. • Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages). • Details of construction plant storage, temporary offices. • Traffic management plan (to be developed in conjunction with the Local Authority – Roads Section) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic; programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements; • Truck wheel wash details (including measures to reduce and treat runoff). • Dust management to prevent nuisance (demolition & construction). • Control of sediment, run-off, erosion and pollution. • Noise and vibration management to prevent nuisance (demolition & construction). • Landscape management. • Management of contaminated land and assessment of risk for same by suitably qualified, trained and licenced personnel. • Management of waste arising from construction and demolition.

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Minimisation of artificial lighting and shading.
Management of risk from invasive alien species
Stockpiles.
Project procedures & method statements for:

Site clearance, site investigations, excavations
Diversion of services.
Excavation and blasting (through peat, soils & bedrock).
Piling.
Temporary hoarding & lighting.
Borrow Pits & location of crushing plant.
Storage and Treatment of peat and soft soils.
Disposal of surplus geological material (peat, soils, rock etc.).
Earthworks material improvement.
Protection of watercourses from contamination and silting during construction.
Works from a barge, including protection of watercourses from contamination when working in-river

Site Compounds.
Monitoring, inspection and auditing of the Contractor's compliance with his/her environmental commitments.

The production of the CEMP will also detail areas of concern with regard to Health and Safety and any environmental issues that require attention during the construction phase. Adoption of good management practices on site during the construction and operation phases will also contribute to reducing environmental impacts.
</td></tr>
<tr><td>7.34</td><td>
Construction and Demolition Waste Management Plan
The CDWMP sets out the Contractor's strategy (and measures required) to ensure that waste arising during the construction and demolition phase of the proposed development will be managed and disposed of in a way that ensures the provisions of European and Irish waste legislation (particularly the Waste Management Acts 1996 – 2011) are complied with, and to ensure that waste is managed in accordance with waste hierarchy insofar as possible.
The finalised CDWMP will contain the following information:

Material transport routes;
Methods by which construction works shall be managed in accordance with the relevant legislative instruments, including but not limited to:

An analysis of the different waste streams expected to be generated;
A demolition plan, with the purpose of ensuring that demolition occurs in an orderly fashion so that the re-use and recycling of the resultant materials is given due priority;
Details of waste storage (e.g. skips, bins, containers) to be provided for different waste streams and collection times;
Details of where and how materials are to be disposed of, i.e. landfill or other appropriately licensed waste management facility;
Details of storage areas for waste materials and containers;
Details of how unsuitable excess materials will be disposed of, where necessary; and
Details of how and where hazardous wastes, such as contaminated land, hydrocarbons and other hazardous substances, are to be stored and disposed of in a suitable manner;

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No.	Description
	• Estimates of waste management costs; • Specific waste management objectives for the project; • Identification of the roles and responsibilities of the relevant personnel regarding waste management; • Procedures for communication and training in relation to on-site waste management; • Record keeping procedures; and • Details of an audit system to monitor implementation of the CDWMP. The CDWMP is appended to the EOP (i.e. Appendix B of Appendix 4.1). The plan shall be finalised by the successful Contractor, in agreement with WCCC, and in accordance with TII's guidelines on *The Management of Waste from National Road Construction Projects* (2017), the TII *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan* (2007) and the Department of the Environment, Housing and Local Government's *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects* (2006). This will be a live document, which will be amended and updated to reflect the policy context, as well as conditions on site, as the construction of the proposed development progresses.
7.35	**Incident Response Plan** The Incident Response Plan (IRP) describes the procedures, lines of authority and processes that will be followed to ensure that incident response efforts during the construction stage of the proposed development are prompt, efficient, and appropriate to particular circumstances. The Contractor will finalise the IRP prior to the commencement of the proposed works to include the following information, at a minimum: • Contact names and telephone numbers for the local authority, i.e. WCCC (all sections and departments), An Garda Síochána and ambulance and fire services; and, • Method statements for weather forecasting and continuous monitoring of water levels in the River Suir and Waterford Harbour. The plan must outline how the Contractor will respond to forecasted flood events, including but not limited to, details of removal of site materials, fuels, tools, vehicles and persons from flood zones. • The measures to be taken to avoid or reduce the incident risk potential; • Reference to the method statement and management plans for construction activities, insofar as they are relevant for the purposes of mitigating against health and safety and pollution incidents; • Procedures to be adopted to contain, limit and mitigate any adverse effects, as far as reasonably practicable, in the event of a health and safety or pollution incident; • Persons responsible for dealing with incidents and their contact details; • Procedures for alerting key staff, appropriate emergency services, authorities, the Employer's Representative and clean-up companies, where required, and contact details of same; • Procedures for notifying relevant statutory bodies, environmental regulatory bodies, local authorities and local water and sewer providers of pollution incidents, where required, and contact details of same; • Standby / rota systems; and • The types and location of emergency response equipment available and appropriate personal protective equipment to be worn.

No.	Description
	An IRP has been appended to the EOP (i.e., Appendix C of Appendix 4.1). The document in its current form will be finalised by the successful Contractor prior to the commencement of the construction phase of the proposed development.
7.36	**Site Environmental Manager** To ensure the successful development, implementation and maintenance of the EOP, the Contractor will appoint an independent Site Environmental Manager (SEM). He/she must possess training, experience and knowledge appropriate to the role, including a National Framework of Qualifications (NFQ) Level 8 qualification (or equivalent) or other acceptable qualification in environmental science, environmental management, hydrology or engineering. The principal functions of the SEM will be to ensure that the mitigation prescribed in this NIS, the EIAR, the CEMP, the EOP and the CDWMP, is fully and properly implemented and to monitor the construction stage from an environmental perspective. The SEM will also provide independently verifiable audit reports. Separate from the on-going and detailed monitoring carried out by the Contractor as part of the EOP, the SEM will carry out the inspection and monitoring described below on behalf of WCCC. The results will be stored in the SEM's monitoring file and will be available for inspection or audit by WCCC, the NPWS or IFI. • Daily reporting on weather and flood forecasting and daily reporting on the monitoring of water levels in the Lower River Suir. • Weekly inspections of the principal control measures described in the CEMP and reporting of findings to the Contractor. • Daily inspections of surface water treatment measures. • Daily inspections of all outfalls to watercourses. • Daily visual inspections of watercourse to which there are discharges from the works and those in the vicinity of construction works. • Weekly inspections of wheel-wash facilities. • Daily monitoring of any stockpiles. Auditing at least six times per quarter of the Contractor's EOP monitoring results.
7.37	**Ecological Clerk of Works** In order to ensure the successful development and implementation of the CEMP, an independent Ecological Clerk of Works (ECoW) will be appointed. The ECoW must possess training, experience and knowledge appropriate to the role, including: • An NFQ Level 8 qualification or equivalent or other acceptable qualification in ecology or environmental biology; and, • Demonstrable experience in the protection of European sites. The principal functions of the ECoW are: • To provide ecological supervision of the construction of the proposed development and thereby ensure the full and proper implementation of the mitigation prescribed in Chapter 7 Biodiversity of the EIAR and in the NIS; • To highlight the sensitivity of 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)', and the need to avoid disturbance of the same, during tool-box talks and other relevant communications with site personnel. • To regularly review the outcome of the ongoing monitoring during construction (as described in Section 5.2.7 of the NIS) • To carry out inspections of all vehicles, vessels, plant, equipment, PPE, construction materials or excavated materials prior to their movement from areas known to contain invasive alien species; and, • To carry out weekly inspections and reporting on the implementation of the Contractor's Biosecurity Protocol. During the preparation of the Contractor's EOP, the SEM may, as appropriate, assign other duties and responsibilities to the ECoW. In exercising his/her functions, the ECoW will be required to keep a monitoring file and this will be made available for inspection or audit by WCCC, the NPWS or IFI at any time.

19.6 Mitigation and Monitoring Measures for Soils and Geology

Table 19.5 Mitigation and Monitoring Measures for Soils and Geology

No.	Description
Mitigation by Design	
8.1	The construction works will be carried out with the least feasible disturbance of soils. The main flood defence elements, sheet pile wall and remedial works to the existing quay wall, directly avoid any requirement for excavation of in-situ ground and creation of waste.
8.2	The quantity of imported backfill for the gap between the sheet piles and the existing quay wall (where sheet piles are installed on the riverside), is minimised by design, as the alignment of the sheet pile wall was carefully selected as close as possible to the existing wall without compromising wall stability. Sheet piles were designed to be constructed on the landside of the existing wall wherever the width of cess allowed for safe day-time works without impact to rail operations, thus further minimising the backfill quantity.
8.3	The amount of waste from the excavations required for constructing the drainage system is minimised by reusing approximately a half of this material as a non-structural fill to even out the ground level across the site, wherever possible.
8.4	The potential impacts (ground displacement/settlement) on the Dublin to Waterford railway line have been mitigated by design, whereby the works are designed at a sufficient distance from the line, and are such that no temporary or permanent excavation in immediate proximity to the rail line is required, with the exception of shallow trenching for the construction of the drainage system. The potential impacts to the mudflats and riverbed from further deterioration of the existing masonry quay wall are also mitigated by design through the construction of the sheet pile wall and backfill in front of the quay wall at the most critical locations.
Specific Mitigation Measures	
8.5	The construction works will be carried out with the least feasible disturbance of the soils, minimising the amount of excavated soil with the inert excavated soil will be re-used on site insofar as possible.
8.6	Approximately 1,650m^3 of excavated ground material will be exported from the site. In addition to this, approximately 720 m^3 of construction and demolition waste will be generated during the demolition of the handrails and the upper parts of the existing quay wall which will be exported from site. The quantity is very small given the scale of the project, and will be disposed of by the Contractor who will ensure that all subsurface materials excavated during the construction phase of the proposed development are managed in accordance with the relevant waste management legislation. The successful Contractor will ensure that all subsurface materials are removed from the site and sent to authorised waste management facilities (i.e. which hold all relevant, valid permits / licences) which accept the corresponding types of waste. The contractor will be required to submit a Construction and Demolition Waste Management Plan (CDWMP) to the local authority for approval, which should address all types of material to be disposed of. The contractor will undertake the environmental testing of the material to be disposed of in order to determine the waste acceptability characteristics.
8.7	All imported material will be sourced from the nearest possible locations. A number of suitable active quarries with all necessary statutory consents exist across County Waterford and southwest County Wexford, such as Oaklands Quarry in Ballykelly, New Ross, Co. Wexford and Cappagh Quarry in Cappagh, Dungarvan, Co. Waterford. Both quarries are accessible from the N25 which links to the site of proposed development via the R448 Terminus Street.

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<tr><th>No.</th><th>Description</th></tr>
<tr><td>8.8</td><td>A project-specific Construction Environmental Operating Plan (CEMP) will be prepared for the development by the Contractor for approval by WCCC. It will be maintained by the Contractor for the duration of the construction phase. The CEMP will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the site will be trained in the implementation of the procedures. As a minimum, the CEMP for the proposed development will be formulated in consideration of the standard best practice. The CEMP will include a range of site-specific measures which include:

Safety measures for working from barges in-river, including but not limited to risk of pollutants from the machinery stationed on the barge and operating with bulk materials such as backfill gravel on the barge;
Runoff will be controlled and treated to minimise impacts to groundwater and River Suir.
Temporary storage of any contaminated material on-site shall be carefully managed so as to limit any risk of contaminated surface water runoff leaving the site or infiltrating to groundwater. Runoff from the material shall be directed to a lined pond or temporary sewer/tank and the water shall be disposed of off-site for treatment at an appropriate licenced facility in accordance with the relevant waste management legislation. Alternatively, the material shall be covered while stored to remove the risk of surface water contamination.
All hazardous materials will be stored within secondary containment, designed to retain at least 110% of the storage contents. Temporary bunds for oil/diesel storage tanks will be used on the site during the construction phase.
The successful Contractor will ensure that spill kits and hydrocarbon absorbent packs are stored in the site compound, and that operators will be fully trained in the use of this equipment.
The successful Contractor will ensure that silt and sediment barriers are installed (and maintained in proper working order) at the perimeter of earthworks areas to limit transport of erodible soils to watercourses.
Where soils are being excavated and removed from site, the successful Contractor will ensure that dust generation will be avoided, by damping down material during excavation and loading onto trucks for off-site removal, if necessary.
Safe materials handling of all potentially hazardous materials will be emphasised to all construction personnel employed during construction, including the usage of appropriate PPE.

The successful Contractor will prepare an Incident Response Plan (IRP) which outlines measures to be implemented to prevent and address spillages of hazardous substances.</td></tr>
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19.7 Mitigation and Monitoring Measures for Hydrogeology

Table 19.6 Mitigation and Monitoring Measures for Hydrogeology

No.	Description
9.1	A project-specific Environmental Operating Plan (EOP) and a Construction Environmental Management Plan (OCEMP) have been prepared and appended to Chapter 4 of this EIAR (see Appendix 4.1 and 4.1A respectively). They will be maintained by the Contractor for the duration of the construction phase. The EOP will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the site will be trained in the implementation of the procedures. As a minimum, the EOP for the proposed development will be

No.	Description
	formulated in consideration of the standard best practice. The EOP will include a range of site -specific measures that include: • The successful Contractor will ensure that spill kits and hydrocarbon absorbent packs are stored in the site compound, and that operators will be fully trained in the use of this equipment. • Earthworks shall be carried out such that surfaces promote runoff and prevent ponding and flooding. • Runoff will be controlled and treated to minimise impacts to surface and groundwater. • Temporary pumping of groundwater, if required, shall be treated by means of a temporary sedimentation tanks prior to discharge • All hazardous materials will be stored within secondary containment designed to retain at least 110% of the storage contents. • Temporary bunds for oil/diesel storage tanks will be used on the site during the construction phase. • Contaminated material will be disposed of off-site for treatment at an appropriate licensed facility in accordance with the relevant waste management legislation. Alternatively, the material shall be covered while stored to remove the risk of surface water contamination. • Safe materials handling of all potentially hazardous materials will be emphasised to all construction personnel employed during construction. Mitigation measures during the construction phase will include implementing best practice during excavation works to avoid sediment entering the River Suir (refer to Chapter 10 'Hydrology' of this EIAR for details).

19.8 Mitigation and Monitoring Measures for Hydrology

Table 19.7 Mitigation and Monitoring Measures for Hydrology

No.	Description
Construction Mitigation	
10.1	As is normal practice with infrastructure projects, an Environmental Operating Plan (EOP) and Construction Environmental Management Plan will be prepared for the Flood Defences West and are included in Appendix 4.1 and Appendix 1.4 A, respectively. These will be developed by the selected contractor to suit the detailed construction methodology and allocate responsibilities to individuals in the construction team. In doing so, the measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the current drafts of the Plans is sufficient to allow an assessment of the anticipated impacts including residual impacts. The following will be implemented as part of this plan: • An Incident Response Plan (see Appendix 4.1 C) will be finalised detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, non-compliance with any permit or license, or other such risks that could lead to a pollution incident, including flood risks. • All necessary permits and licenses for in stream construction work for provision of the flood defences will be obtained prior to the commencement of construction. Inform and consult with Inland Fisheries Ireland and Waterways Ireland.
10.2	During construction, cognisance will have to be taken of the following guidance documents for construction work on, over or near water.

No.	Description
	• *Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites* (Eastern Regional Fisheries Board) • *Central Fisheries Board Channels and Challenges – The enhancement of Salmonid Rivers.* • *CIRIA C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors.* • *CIRIA C648 Control of Water Pollution from Constructional Sites.* • *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (TII, 2006).* Based on the above guidance documents concerning the control of construction impacts on the water environment, the following outlines the principal mitigation measures that will be adhered to for the construction phase, in order to protect all catchment, watercourse and ecologically protected areas from direct and indirect impacts:
General Mitigation Measures	
10.3	Site works will be limited to the minimum required to undertake the necessary elements of the project.
10.4	Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels or cut-off ditches.
10.5	Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and bunding.
10.6	Protection of waterbodies from silt load will be carried out through the use of gully silt/sediment filters and shallow berms in hardstanding areas to provide adequate treatment of runoff to watercourses.
10.7	Settlement tanks, silt traps/bags and bunds will be used. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap.
10.8	The anticipated site compound/storage facility will be fenced off at a minimum distance of 5m from the top of the edge of the quay wall/river edge. Any works within the 10m buffer zone will require measures to be implemented to ensure that silt laden or contaminated surface water runoff from the compound does not discharge directly to the watercourse. CEMP has been drafted and will need to be finalised by the appointed Contactor See the EOP and Construction Environmental Management Plan (CEMP) in Appendix 4.1 and 4.1 A of this EIAR for further detail.
10.9	Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with the TII document "*Guidelines for the crossing of watercourses during the construction of National Road Schemes*". All chemical and fuel filling locations will be contained within bunded areas and set back a minimum of 20m from watercourses.
10.10	Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner, off site, to prevent pollution.
10.11	The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses.
10.12	Water quality monitoring will be undertaken in the River Suir, with monthly samples being taken from at least 6 months prior to commencement of construction until at least 24 months post-completion. Water samples will be taken from at least two locations. The final number and location of sampling points will be determined by the Site Environmental Manager. The results of the water quality monitoring programme

No.	Description
	will be reviewed by the Site Environmental Manager and Ecological Clerk of Works on an ongoing basis during construction. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation will be undertaken to identify the source of this non-compliance and corrective action will be taken where the this is deemed to be associated with the proposed development.
Specific Mitigation Measures – Concrete Works	
10.13	Remedial works to the existing masonry quay wall and increasing its height will require the use of in-situ concrete. The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. As the use of concrete cannot be avoided, the following control measures will be employed: • Hydrophilic grout and quick-setting mixes or rapid hardener additives shall be used to promote the early set of concrete surfaces exposed to water; • When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used; • Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters; • Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW); • The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if inclement weather is forecast such that precipitation may make it difficult to maintain a dry working area. • There will be no spills of concrete, cement, grout or similar materials hosed into surface water drains. Such spills shall be contained immediately and runoff prevented from entering the watercourse; • Concrete waste and wash-down water will be contained and managed on site to prevent pollution of all surface watercourses; • On-site concrete batching and mixing activities will only be allowed at the identified construction compound areas; • Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the manufacturer); • Chute washout will be carried out at designated locations only. These locations will be signposted. The Concrete Plant and all Delivery Drivers will be informed of their location with the order information and on arrival to site; and Chute washout locations will be provided with an appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste in accordance with the Contractor's Waste Management Plan.
Flooding	
10.14	The Contractor will provide method statements for weather and tide/storm surge forecasting and continuous monitoring of water levels in the River Suir and Waterford Harbour. The Contractor will also provide method statements for the removal of site materials, fuels, tools, vehicles and persons from flood zones in order to minimise the risk to persons working on the site as well as potential input of sediment or construction materials into the river during flood events.

19.9 Mitigation and Monitoring Measures for The Landscape

Table 19.8 Mitigation and Monitoring Measures for The Landscape

No.	Description
11.1	There are no mitigation measures proposed for Chapter 11 The Landscape as part of the Flood Defences West.

19.10 Mitigation and Monitoring Measures for Noise and Vibration

Table 19.9 Mitigation and Monitoring Measures for Noise and Vibration

No.	Description
12.1	With regard to construction activities, best practice control measures for noise and vibration from construction sites are found within BS 5228 (2009 +A1 2014) *Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2*. Whilst day-time construction noise and vibration impacts are expected to be minimal and well within the criteria set out in this document, there are night-time works that have the potential to cause a temporary, significant impact. The contractor will ensure that all best practice noise and vibration control methods will be used, where practicable in order to minimise emissions to external noise sensitive locations. In this regard, various mitigation measures can be considered and applied during the construction of the proposed development, such as: • No plant used on site will be permitted to cause an ongoing public nuisance due to noise; • The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations; • Where practicable vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order; • Compressors will be attenuated 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; • Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use; • All items of plant will be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures; Limiting the hours during which site activities which are likely to create high levels of noise or vibration are permitted
12.2	Furthermore, it is envisaged that a variety of practicable noise and vibration control measures will be employed. These may include: • Selection of plant with low inherent potential for generation of noise and/ or vibration; • Erection of good quality site hoarding on the landward side of the main works which will act as a noise barrier to general construction activity at ground level; • Situate any noisy plant as far away from sensitive properties as permitted by site constraints Erection of localised barriers as necessary or where practicable around noisy items of plant such as generators or high duty compressors, which is of particular importance during construction works that take place during the night-time.
12.3	Where practicable it is recommended that noise and vibration from construction activities to off-site residences be limited to the values set out in Table 12.2 and 12.8 of the Noise and Vibration EIAR Chapter.

No.	Description
	This may be achieved by undertaking noise and vibration monitoring at locations representative of the closest sensitive receptors. Noise monitoring should be conducted in accordance with the International Standard ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise. Vibration monitoring should be conducted in accordance with BS 6472 for human disturbance and BS ISO 4866:2010 for building damage.

19.11 Mitigation and Monitoring Measures for Air Quality and Climate

Table 19.10 Mitigation and Monitoring Measures for Air Quality and Climate

No.	Description
13.1	The proactive control of fugitive dust will ensure the prevention of significant emissions. The key aspects of controlling dust are listed below. These measures will be incorporated into the overall Construction Environmental Management Plan (CEMP) prepared in respect of the proposed development. In summary, the measures which will be implemented will include: • Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic. • Any road that has the potential to give rise to fugitive dust will be regularly watered, as appropriate, during dry and/or windy conditions. • Vehicles exiting the site shall make use of a wheel wash facility where appropriate, prior to entering onto public roads. • Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates. • Public roads outside the site will be regularly inspected for cleanliness and cleaned as necessary. • Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods. • During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions. • During any demolition processes, water suppression should be used, preferably with a hand-held spray. Only the use of cutting, grinding or sawing equipment fitted or used in conjunction with a suitable dust suppression technique such as water sprays/local extraction should be used. • Drop heights from conveyors, loading shovels, hoppers and other loading equipment should be minimised, if necessary fine water sprays should be employed. At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

19.12 Mitigation and Monitoring Measures for Archaeological and Cultural Heritage

Table 19.11 Mitigation and Monitoring Measures for Archaeological and Cultural Heritage

No.	Description
Archaeology	
14.1	In order to ameliorate any negative impacts upon the archaeological resource, a full intertidal and wade/dive survey will be carried out along the sections of the existing quay wall to be directly impacted by the works and at the location of the upgraded and proposed outfalls. The survey will include a photogrammetry survey of the wall to be demolished (from Ch.350 to Ch.900), along with the mapping and recording of the former landing stages. All timber landing stages will be avoided during the course of works. The survey will also include a metal detecting survey and all works will be carried out by a suitably qualified underwater archaeologist, under licence to the National Monuments Service of the DoHLGH.
14.2	All ground disturbances associated with the works along the River Suir will be monitored by a suitably qualified underwater archaeologist. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).
14.3	All ground disturbances associated with excavations within the car park associated with the existing train station will be monitored by a suitably qualified archaeologist. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).
Cultural Heritage	
14.4	The section of the iron railway bridge that currently occupies the works compound will be left in-situ and undisturbed by contractors.

19.13 Mitigation and Monitoring Measures for Architectural Heritage

Table 19.12 Mitigation and Monitoring Measures for Architectural Heritage

No.	Description
12.1	There are no mitigation measures proposed for Chapter 11 The Landscape as part of the Flood Defences West.

19.14 Mitigation and Monitoring Measures for Material Assets and Land

Table 19.13 Mitigation and Monitoring Measures for Material Assets and Land

No.	Description
16.1	During construction, the following mitigation measures are proposed for the Waterford Flood Defences West: • Measures to control the production of dust will be put in place by the Contractor (refer to Chapter 13 Air Quality and Climate which presents a series of measures to control dust);

No.	Description
	• Noise mitigation will be provided during construction of the development. Measures to mitigate noise impacts on sensitive receptors are detailed within Chapter 12 Noise and Vibration. The Contractor will work within stringent construction limits and guidelines to protect residential and commercial amenities. • The upgrade works to the existing drainage system along the railway corridor west of Plunkett Station will be designed to ensure that the current drainage situation will not be impacted and there will be no increased risk of flooding as a consequence of the proposed development; • Prior to any excavation works, a segment of the ground will be surveyed via a CAT scan and a shallow slit trench will be excavated in order to confirm the position of utilities. • Any services that are interfered with as a result of the proposed development will be repaired / replaced without unreasonable delay. • A site plan will be prepared showing the location of all surface water drainage lines and proposed discharge points to surface water. This will also include the location of all existing and proposed surface water protection measures, including best practice measures such as monitoring points, sediment traps, settling basins, interceptors etc. All construction works will be temporary and will be carried out in line with best practice guidelines, thus minimising the impacts to the receiving communities. The Contractor will work within stringent construction limits and guidelines to protect surrounding amenities.