River Slaney (Enniscorthy) Drainage Scheme

Environmental Impact Assessment Report

16 April 2019

Wexford County Council

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Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	May 2018	N Roche	P Kelly	B O'Connor	For information
B	Sept 2018	N Roche	B O'Connor /K Stephens	B O'Connor	For review
C	March 2019	N Roche	P Kelly	B O'Connor	Final Draft updated following comments
D	April 2019	N Roche	N Samachetty /K Stephens	B O'Connor	Final

Document reference: 229355741 | 1 | D

Information class: Standard

Contents

1 Introduction

1.1 Introduction

Confirmation for the River Slaney (Enniscorthy) Drainage Scheme, also referred to as the Enniscorthy Flood Defence Scheme, is sought from the Minister for Public Expenditure and Reform under the Arterial Drainage Act 1945 as amended. The Arterial Drainage Act 1945 established a national drainage authority (the Office of Public Works hereafter referred to as OPW) with the remit of implementing a national arterial drainage programme. The Arterial Drainage Act was amended in 1995 to include for the protection of urban areas suffering from flooding.

The OPW in consultation with Wexford County Council has identified appropriate flood defence measures for Enniscorthy Town. The town has historically suffered from severe flooding. Major flood events were recorded in 1924, 1947, 1965, 2000 and most recently in December 2015. In line with OPW flood protection best practice, the proposed scheme will protect the town against 1 in 100 Year flood event (1% AEP)[1].

In 2015, Mott MacDonald Ireland Limited were appointed as lead consultant for the detailed design of Enniscorthy flood defence scheme by Wexford County Council. The proposed scheme requires the removal of Seamus Rafter Bridge and the construction of a new road bridge 600m further downstream. Roughan & O'Donovan were appointed as consultant engineers for the design of the new road bridge, associated roadworks and overall traffic management within the Town.

1.2 Background to the Proposed Scheme

Enniscorthy has a history of severe flooding in the town. After considering several different alternative design options, the OPW in consultation with Wexford County Council have developed an outline design for the preferred flood defence scheme for Enniscorthy Town. Royal Haskoning were appointed in 2009 to produce an Environmental Impact Statement (EIS) for the proposed defence works.

In accordance with the requirements of the Arterial Drainage (Amendment) Act, 1995 a public exhibition of the proposed scheme was held in Enniscorthy in 2009. The public was invited to view plans of the proposed works and to make observations. Observations that emerged from the public exhibition were compiled and considered by the OPW. Submissions from the public raised concerns relating to the visual impact of the proposed works, the loss of views of the River Slaney from the town of Enniscorthy due to the construction of high walls, loss of connectivity between the quays and perceived potential for an impeded access to the river for recreational use.

In response to the issues raised in submissions, the scheme was refined and revised and Royal Haskoning prepared an addendum to the earlier EIS in 2012. The refined scheme was put back on public display in 2012. In 2015, Mott MacDonald Ireland Limited and Roughan O'Donovan were appointed by Wexford County Council to progress the design of the flood defence scheme for the town.

Wexford County Council on behalf of the OPW is now developing the scheme with a view to seeking confirmation for it by the Minister for Public Expenditure and Reform. Given the lapse in

[1] 1 in 100-year event- this is a 1% chance of a flood of this magnitude, occurring in any given year.

time since the last EIS, revisions to the proposed flood defence scheme and the publication of the new Environmental Impact Assessment (EIA) Directive (2014/52/EU), it was decided to revise and update the project Environmental Impact Assessment Report. A public display event was held in June and July 2018. The purpose of the public display was to inform the public of developments made with the scheme and to provide an indicative programme of works proposed in Enniscorthy.

Feedback from the public display was incorporated into the final scheme as referred to hereunder as “River Slaney (Enniscorthy) Drainage Scheme”. Confirmation is now being from the Minister for Public Expenditure and Reform under the Arterial Drainage Act 1945.

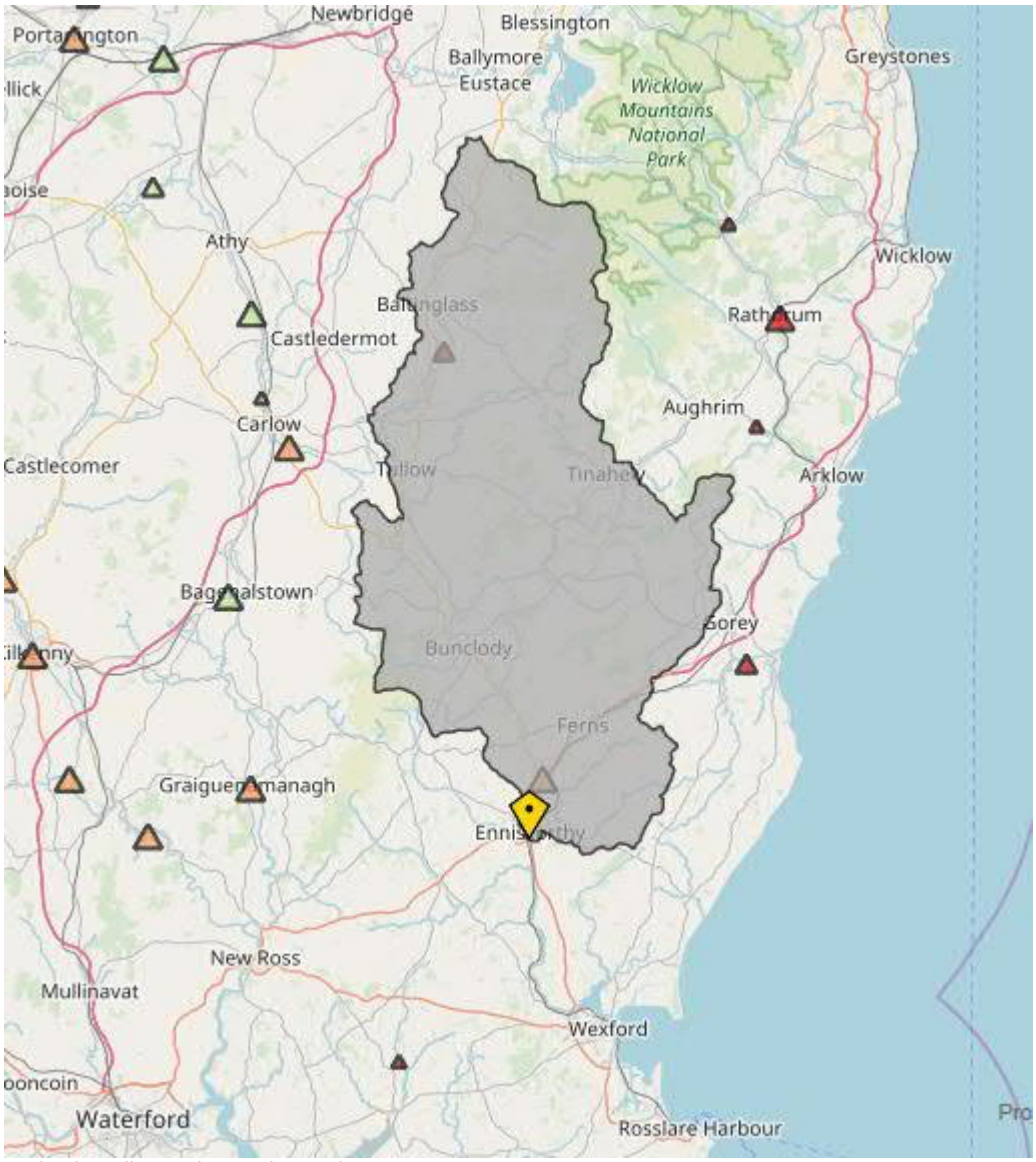
1.3 The River Slaney Catchment

The River Slaney rises on Lugnaquilla Mountain in Wicklow and enters the Irish Sea at Wexford Harbour. Church Mountain and Lugnaquilla provide the small mountain sub-catchments that come together to form the upper reaches of the river that runs through the Glen of Imaal. From there, the river flows south for approximately 25km passing through Baltinglass and flows towards Tullow. Below Tullow the river changes its course to a south/south east direction and flows approximately 35km towards Scarawalsh where the Wexford Road (N11) crosses it. It is at this stretch of the river that the Derreen and Derry Rivers converge with the River Slaney. Immediately downstream of the N11, The Bann River joins with the River Slaney. The Slaney Catchment upstream of Enniscorthy is shown in Figure 1.1.

As it enters the tidal waters of Enniscorthy Town, the contributing catchment area of the Slaney is 1277km^2. Flooding within the Slaney Catchment, in the general area of Enniscorthy occurs due to a lack of sufficient flood plains for the Slaney and its tributaries. The floodplains that are present are generally narrow with steep sided embankments, which results in water levels within the river rising rapidly during prolonged rainfall periods. The River Slaney is tidal upstream as far as Enniscorthy. The tidal and freshwater boundary along the River Slaney is defined at the Enniscorthy Bridge, by the (Marine and Foreshore Unit within the Department of Housing, Planning Community and Local Government, *pers comm*., 2016).

The confluence of the River Slaney with the Urrin River occurs approximately 1km downstream of Enniscorthy Town and is joined approximately 2.5km further downstream by the River Boro, both of these rivers enter from the west and channel water from the Blackstairs Mountains. The Slaney continues south for approximately 12km, before turning east and continues south for almost 5km before discharging to Wexford Harbour.

Figure 1.1: River Slaney Catchment Upstream of Enniscorthy

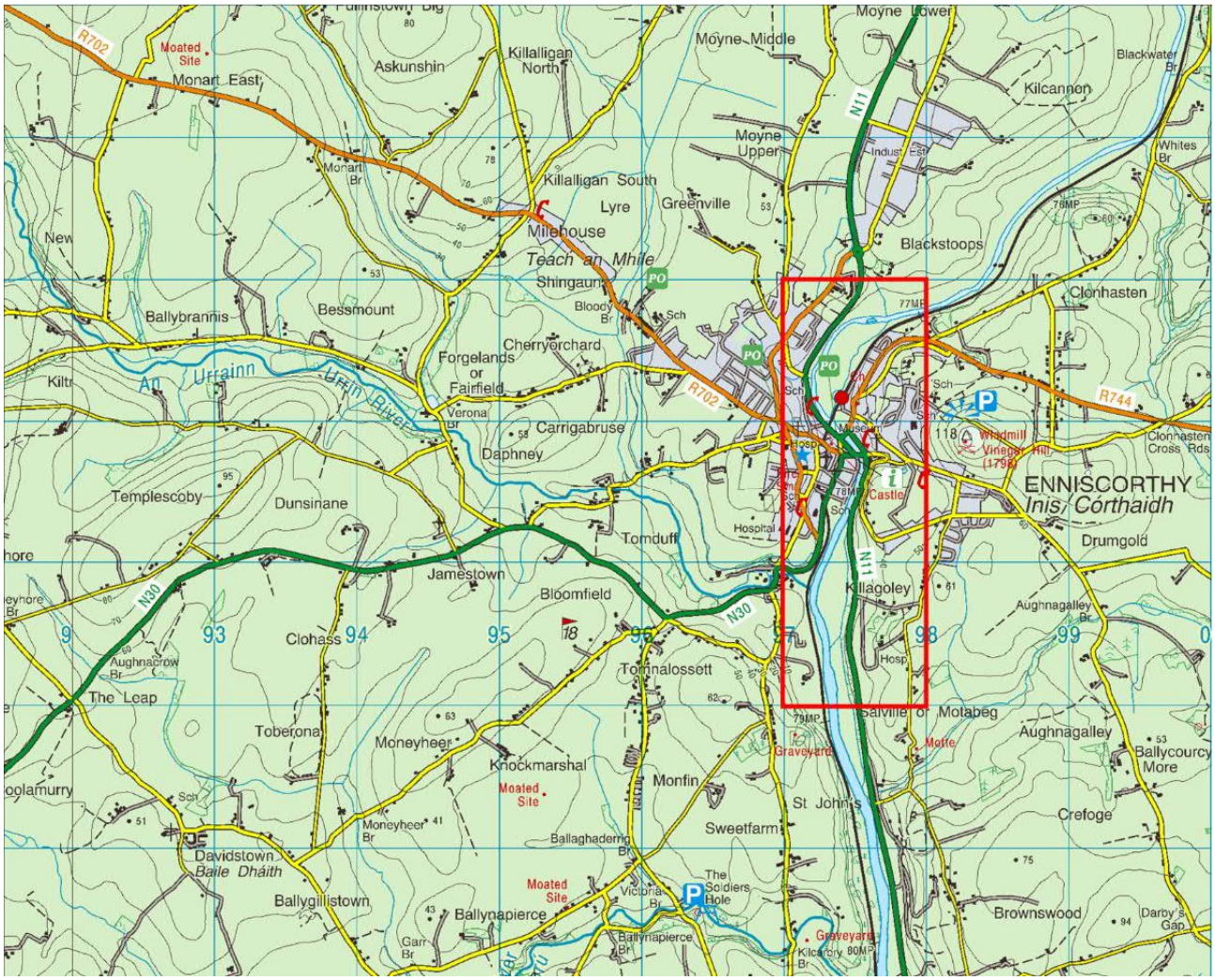


Source: Flood Studies Update Web Portal

1.4 The Project Study Area

Enniscorthy Town is located on the banks of the River Slaney in County Wexford. The proposed scheme extends approximately 1.5km upstream of the Enniscorthy Bridge and 2km downstream of the bridge. The proposed scheme incorporates works to improve flow conveyance, and containment measures to prevent flooding within Enniscorthy Town. The scheme contains a number of localised measures including the removal of Seamus Rafter Bridge and its replacement with a new road bridge downstream of the Riverside Park Hotel and construction of a new footbridge within the town. The extent of the study area is shown in Figure 1.2.

Figure 1.2: Proposed scheme Overview



Source: Mott MacDonald 2017

1.5 Screening for Environmental Impact Assessment (EIA)

Annex I and Annex II of the Environmental Impact Assessment Directive set out are projects where national authorities have to decide whether an EIA is needed. This is done by the "screening procedure", which determines the effects of projects on the basis of thresholds/criteria or a case by case examination. The projects listed in Annex II are in general those not included in Annex I which may be considered to have a lesser environmental impact.

The proposed scheme is of a type identified in paragraph (10)(f) which refers:

'*Inland-waterway construction not included in Annex I, canalisation and flood relief works"*

The proposed scheme comprises several localised measures including: the removal of Seamus Rafter Bridge and construction of a replacement bridge downstream of the Riverside Park Hotel and the construction of a new pedestrian bridge in the town. As such, an EIA is required under Annex II of the EIA Directive. The project EIA will consider all elements of the proposed scheme under consideration.

Having regard to the provisions of Section 4 of the European Union (Environmental Impact Assessment) (Arterial Drainage) Regulations 2012 and European Union (Environmental Impact Assessment) (Flood Risk) Regulations, 2012, where a proposed scheme involves the execution of an arterial drainage scheme it shall contain a statement of the likely effects on the environment (referred to as an environmental impact assessment) of the proposed works.

The definition of environmental impact assessment as set out in the Regulations means an assessment (including an examination, analysis and evaluation), carried out by the Minister in accordance with this Act that shall identify, describe and assess in an appropriate manner, in light of each individual case and in accordance with Articles 4 to 11 of the EIA Directive 2011/92/EU as amended.

1.6 Environmental Impact Assessment Report

Environmental Impact Assessment (EIA) is the process by which the anticipated effects on the environment of a proposed scheme or project are measured. If the likely effects are unacceptable, design measures or other relevant mitigation measures should be taken to reduce or avoid those effects. This Environmental Impact Assessment Report (EIAR) has been prepared to inform the application for confirmation to be submitted to the Minister for Public Expenditure and Reform.

1.7 Preparation of this EIAR

1.7.1 Structure of this EIAR

The structure of this EIAR is set out in Table 1.2 below.

Table 1.2: Structure of EIAR

Chapter No.	Chapter Title
1	Introduction
2	EIA methodology
3	Project Development and Consultation
4	Description of the Proposed Scheme
5	Population and Human Health
6	Biodiversity

Chapter No.	Chapter Title
7	Hydrology and Geomorphology
8	Geology and Soils
9	Landscape and Visual
10	Archaeology, Architectural and Cultural Heritage
11	Air Quality and Climate
12	Noise and Vibration
13	Traffic and Transportation
13	Material Assets and Land
14	Interactions between the Foregoing

The EIAR is supported by technical appendices for a number of environmental topics listed below:

- Biodiversity;
- Hydrology and Geomorphology;
- Landscape and Visual;
- Archaeology and Historic environment; and
- Air Quality and Climate.

1.7.2 Supporting Documentation

A number of supporting documents have also been prepared to accompany this EIAR as part of the confirmation application made to the Minister for Public Expenditure and Reform, as follows:

- Natura Impact Statement;
- Preliminary Invasive Species Management Plan;
- Traffic Modelling Report;
- Construction Environmental Management Plan; and
- OPW Engineering Report.

1.7.3 Statement of Qualifications

Mott MacDonald is a multidisciplinary consultancy with over 30 years' experience of undertaking complex and challenging environmental impact assessments (EIA) in accordance with the requirements of the EIA Directive and of writing environmental impact assessment reports for a wide range of projects. These include some of the world's largest infrastructure, engineering and development projects.

Mott MacDonald is a corporate member of the Institute of Environmental Management and Assessment and hold its EIA Quality Mark. The Quality Mark Scheme allows organisations that lead the co-ordination of statutory EIAs in the UK and Ireland to make a commitment to excellence in their EIA activities and have this commitment independently reviewed. The EIA Quality Mark is a voluntary scheme, with organisations free to choose whether they are ready to operate to its seven EIA Commitments.

This EIAR was prepared by Mott MacDonald with expert technical contributions provided by a number of specialists. Roughan & O'Donovan were appointed as consultant engineers for the design of a new road bridge and associated roadworks. In addition, the following subconsultants were engaged to undertake specialist technical assessments to inform this EIAR;

Table 1.3: Experience and Qualifications of the EIAR Contributions

Topic	Specialist Contributors	Company
Project Principal	Paul Kelly BSc HDip MSc	Mott MacDonald
Introduction	Niamh Roche BSc (Hons) MIEnvSc PIEMA CEnv Barry O'Connor BE CEng	Mott MacDonald
EIA Methodology	Niamh Roche BSc (Hons)MIEnvSc PIEMA CEnv	Mott MacDonald
Project Development and Consultation	Office of Public Works and Wexford County Council	OPW
	Barry O'Connor BE CEng	Mott MacDonald
Description of the Proposed Scheme	Niamh Roche BSc PIEMA CEnv	Mott MacDonald
	Barry O'Connor BE CEng	Mott MacDonald
	Kevin Stephens BA BAI PhD MIEI	Mott MacDonald
Population and Human Health	Niamh Roche BSc (Hons)MIEnvSc PIEMA CEnv	Mott MacDonald
Biodiversity	Paul Scott BSc MSc CEcol CEnv MCIEEM	Scott Cawley
	Maeve Maher McWilliams BSc (Hons) MSc CIEEM	Scott Cawley
	Dr. Evelyn Moorkens BA(Mod) HDip(Ed) MSc PhD MCIEEM CEnv	Independent malacological expert
	Ms Eleanor Mayes BA(Mod) MSc	Eleanor Mayes Ecological Consultant
	Dr William O'Connor BSc MSc PhD CEnv CBiol F.I.Biol MCIEEM, MIFM	Ecofact Ecology
	Dr Joanne Denyer BSc DPhil PhD	Denyer Ecology
Hydrology and Geomorphology	Barry O'Connor BE CEng	Mott MacDonald
	Niamh Roche BSc (Hons)MIEnvSc PIEMA CEnv	Mott MacDonald
	Joanne Barlow BSc MSc CWEIM CEnv CIWEM	Mott MacDonald
	Katie Bishop BSc GMIWEM	Mott MacDonald
Geology and Soils	Niamh Roche BSc (Hons)MIEnvSc PIEMA CEnv	Mott MacDonald
	Barry O'Connor BE CEng	Mott MacDonald
	Kevin Stephens BA BAI PhD MIEI	Mott MacDonald
Landscape and Visual	Richard Barker MLA BA Env PGDip For MILI	Macroworks Ltd
	Nik Hennessy BArg Sc MAgr	Macroworks Ltd
	Colin McCaffrey BArch Sc	Macroworks Ltd
	Amy Doran BA Digital Art	Macroworks Ltd
Architectural, Archaeological and Cultural Heritage including underwater archaeology	Niall Brady PhD	ADCO Ltd
	Rex Bangerter MA	ADCO Ltd
	Ivor McElveen BAI MA CEng FIEI	Ivor McElveen and Associate
Air Quality and Climate	Claire Flynn BA (Hons) MSc MIAQM	AWN Consulting Ltd
Noise and Vibration	Diarmuid Keaney MSc, MIOA, MInstSCE	ICAN Acoustics Ltd
Traffic and Transport	John Bell BEng, CEng	Roughan & O'Donovan Consulting Engineers
Material Assets and Land	Barry O'Connor BE CEng	Mott MacDonald

Topic	Specialist Contributors	Company
	Niamh Roche BSc (Hons)MIEnvSc PIEMA CEnv	Mott MacDonald
Interactions between the Foregoing	Niamh Roche BSc (Hons) MIEnvSc PIEMA CEnv	Mott MacDonald

1.7.4 Difficulties Encountered in the Preparation of the EIAR

No significant difficulties were encountered that could not be appropriately addressed in the design development process or during course of preparing this EIAR.

2 EIA Methodology

2.1 Overview

This assessment of environmental impacts has been conducted having regard to the guidance set out in the following;

- EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Report (EPA, draft 2017);
- EPA Advice Notes on Current Practice in the Preparation of Environmental Impact Statement (EPA, 2015); and
- European Commission, Environmental Impact Assessment of Impacts, Guidance on the preparation of the Environmental Impact Assessment Report, (European Commission 2017).

Having regard to the above guidance the framework methodology used in preparing this EIAR comprised the following steps:

- Definition of existing environment and the study area;
- Methodology for technical assessments;
- Identification of potential environmental impacts;
- Potential for cumulative impacts;
- Definition of mitigation measures to minimise potential impacts; and
- Description and evaluation of residual impacts.

The framework methodology is broadly consistent across all Chapters and has been adopted and adhered to as much as possible, in order to ensure that the assessment methodology is transparent and can be effectively communicated to and understood by all stakeholders including the general public.

2.2 Existing Environment

A ‘study area’ has been defined in each individual technical assessment and Chapter of the EIAR. This study area encompasses all locations that may potentially be impacted upon by the proposed Enniscorthy Flood Defence Scheme (hereafter referred to as ‘proposed scheme’). Impacts may occur during the construction phase or the operation phase and may be temporary or permanent. They may also be positive or negative. All types of impact are considered when defining the study area.

2.3 Technical Assessments

All the data collected as part of the preparation of this EIAR is relevant to the specific study area defined for each individual Chapter. The data requirements for each environmental topic have been determined by technical specialists and are driven by relevant legislation, guidelines and policy requirements. Desktop reviews of existing information have been carried out for all environmental topics. These desktop reviews have been supplemented by specialised field studies and consultation with Wexford County Council and the OPW and, by association, with other consultees, as required. The data sources for all information are clearly set out in each individual Chapter.

2.4 Identification of Potential Environmental Impacts

All specialist technical contributors to this EIAR have reviewed the design of the proposed scheme and the information contained in Chapter 4 *Description of the Development* and identified potential for likely significant impacts based on their experience and expertise. The source and type of all potential impacts is clearly identified for each individual environmental topic in the relevant Chapters of the EIAR.

The proposed scheme has the potential to impact on the environment during:

- The construction phase; and
- The operational phase.

For this reason, the assessment of the impacts of the development is differentiated into construction and operational impacts. Construction impacts can be of temporary and permanent nature whereas operational impacts will typically tend to be permanent only.

The EIAR will identify, describe and assess in an appropriate manner, the potential direct and indirect significant effects on the environmental topics. Furthermore, the EIAR will identify, describe and assess the potential for impacts on any one environmental topic to have an effect on other environmental topics due to interaction between the two topics. The potential for many small impacts (from one or more projects) to have a cumulative impact on the environment will also be considered. These types of impacts are known as interactions and cumulative impacts and further detail in this regard is provided in each individual Chapter and summarised in Chapter 14.

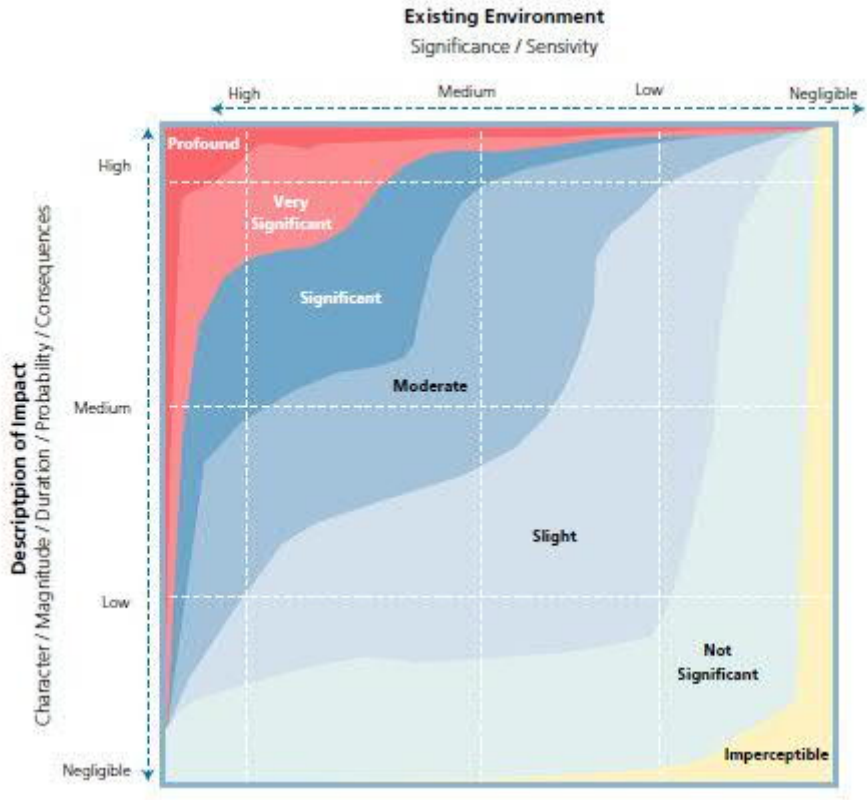
The assessment of impacts is conservative, considering a 'reasonable worst case' where there is any degree of uncertainty'. The EIAR therefore constitutes a robust and transparent assessment of the 'likely significant environmental effects' associated with the 'reasonable worst-case scenario'.

The type, quality, extent, probability of, duration of, and significance of the effects of impacts on each environmental topic from the proposed scheme are described having regard to criteria listed in Annex III of the amended Directive and set out in '*Table 3.3 Descriptions of Effects*' of the EPA *Guidelines (Draft August 2017).* The EIAR also takes into account any potential vulnerability of the project to risks of major unforeseen events or disasters. These are considered in the design of the project and where appropriate, regard is provided in individual Chapters.

2.4.1 Determining significance of effects

The significance of a potential impact is defined by the sensitivity of the receiving environment and the description (i.e. magnitude/probability/duration) of the potential impact. The matrix that is used in this EIAR for evaluating the significance of environmental effects is set out in Figure 2.1. In some cases, magnitude or significance cannot be quantified with certainty, and in these cases professional judgement remains the most effective way to identify the significance of an impact. Where this is necessary, it is highlighted within the text.

Figure 2.1: Determining Significance of Effects



Source: EPA, Environmental Impact Assessment Reports, Draft Guidelines 2017

Where significance of an effect is “Significant” or “Medium” (negative), are considered, mitigation is required.

2.5 Mitigation Measures

Substantial mitigation by avoidance and reduction has been achieved through the consideration of alternative sites and design solutions and processes. The manner in which alternative site layout and development design and alternative processes were considered is described in Chapter 3 – Project Development and Consultation.

In a number of cases, impacts of the proposed scheme could not be completely mitigated through consideration of alternatives during the project design. Where significant effects have been determined for a potential impact, additional mitigation measures have therefore been defined during the course of the EIA to mitigate these impacts. Mitigation measures that have been defined for each environmental topic are set out in the individual Chapters of this EIAR. These mitigation measures relate to both the construction and operational phases of the project.

The mitigation measures and where appropriate proposed monitoring will be implemented by means of targeted management plans implemented by the detailed design and construction phase project engineers and the construction contractors. Such plans will include a Construction and Environmental Management Plan (CEMP), Construction Traffic Management Plan (CTMP), and Non-Native Invasive Species Management Plan (ISMP) as already identified in this document. All agreed mitigation measures will be incorporated into these management plans.

The content of these documents will be agreed with the relevant authorities (i.e. Wexford County Council, OPW, IFI, NPWS, Specialist Technical Advisors) and the implementation of the actions contained therein implemented under contract.

2.6 Residual Impacts

Any likely significant impacts that continue to exist when the mitigation measures have been put in place are assessed for each individual environmental topic. These residual impacts are identified, and the relevant ones are described in detail and assessed (where appropriate) in terms of a combination of magnitude and significance.

3 Project Development and Consultation

3.1 Overview

This Chapter examines the need for the flood defence scheme in Enniscorthy and provides a comprehensive analysis of alternatives (in terms of location, design and construction methods) which have been considered as part of this development.

The development of the proposed scheme process has now been underway for in excess of 12 years. Throughout the preparation of the previous Environmental Impact Statement and EIS addendum and in preparing the current Environmental Impact Assessment Report the design of the proposed scheme has been revised and refined to take account of the findings of all site investigations and from public consultation and stakeholder feedback which have brought the design from its initial design to the current proposed design.

This Chapter has been structured as follows:

- **Section 3.2**- Need for the Enniscorthy Flood Defence Project;
- **Section 3.3** - Strategic planning and Development Context;
- **Section 3.4-** Consideration of Alternatives;
- **Section 3.5**- Scheme Design Process;
- **Section 3.6**- Appraisal of Technical Feasible Options;
- **Section 3.7-** Scoping the EIAR for the Proposed Enniscorthy Flood Defence Scheme; and
- **Section 3.8**- Consultations.

3.2 Need for the Enniscorthy Flood Defence Project

In the past Enniscorthy has experienced significant infrequent flooding, including at least five flood events in the last century which occurred in 1924, 1947, 1965, 2000 and most recently on 30th of December 2015. Water levels were not accurately recorded for the 1924, 1947 and 1965 flood events, however photographic evidence and detailed accounts advised by local property owners can be used to compare these events to more recent events for which water levels have been comprehensively recorded. A brief description of the extreme flood events is outlined in the sections below. Further details on the hydrology are provided in Chapter 7 of this EIAR.

3.2.1 1924 and 1947 Flood Event

Records of the 1924 & 1947 flood events are scarce, but photographs taken by Ibar Carthy, held in the P.A. Crane Collection and reproduced in the project EIS (2009) are shown in Figure 3.1 and Figure 3.2 can be used to estimate the magnitude and severity for the flooding events.

From the photograph in Figure 3.1, the 1924 flood appears to be similar in scale to that of the 2000 flood, and so it is estimated to be a 1 in 37-year flood event.

From the photograph in Figure 3.2, the 1947 flood appears to be slightly larger in scale than the 2000 flood and so it is estimated to be a 1 in 50-year flood event.

Figure 3.1: The 1924 Flood event (looking downstream along Shannon Quay)

Photograph from the P. A. Crane Collection. Royal Haskoning and the OPW would like to thank Ibar Carthy (photographer), Enniscorthy for the use of the photograph.

Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, Environmental Impact Statement 2009

Figure 3.2: The 1947 Flood Event (Island Road)

Photograph from the P. A. Crane Collection. Royal Haskoning and the OPW would like to thank Ibar Carthy (photographer), Enniscorthy for the use of the photograph.

Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, Environmental Impact Statement 2009

3.2.2 1965 Flood Event

Flooding in the town was exacerbated by debris blocking the arches of Enniscorthy Bridge but the 1965 flood is widely regarded as the largest in living memory. Water levels were not recorded but it is reported that there was 2m of water on Island Road and that the peak level was 1.25m higher than the peak level of the 2000 flood on the upstream side of Enniscorthy Bridge. Comparing the photographs of the 1965 flood shown in Figure 3.3 – 3.6 to those of the 2000 flood it is estimated that this event had a peak flow of 535.1m^3/s, representing a 1 in 115-year flood event.

Figure 3.3: The 1965 Flood Event Temple Shannon

Photograph from the P. A. Crane Collection. Royal Haskoning and the OPW would like to thank Ibar Carthy (photographer), Enniscorthy for the use of the photograph.

Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, Environmental Impact Statement 2009

Figure 3.4: 1965 Flood Event taken at the castle (looking across at the proposed new road bridge location)

Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, Environmental Impact Statement 2009

Figure 3.5: 1965 Flood Event (looking across Shannon Quays)

Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, Environmental Impact Statement 2009

Figure 3.6: 1965 Flood Event (looking across the Railway Bridge)

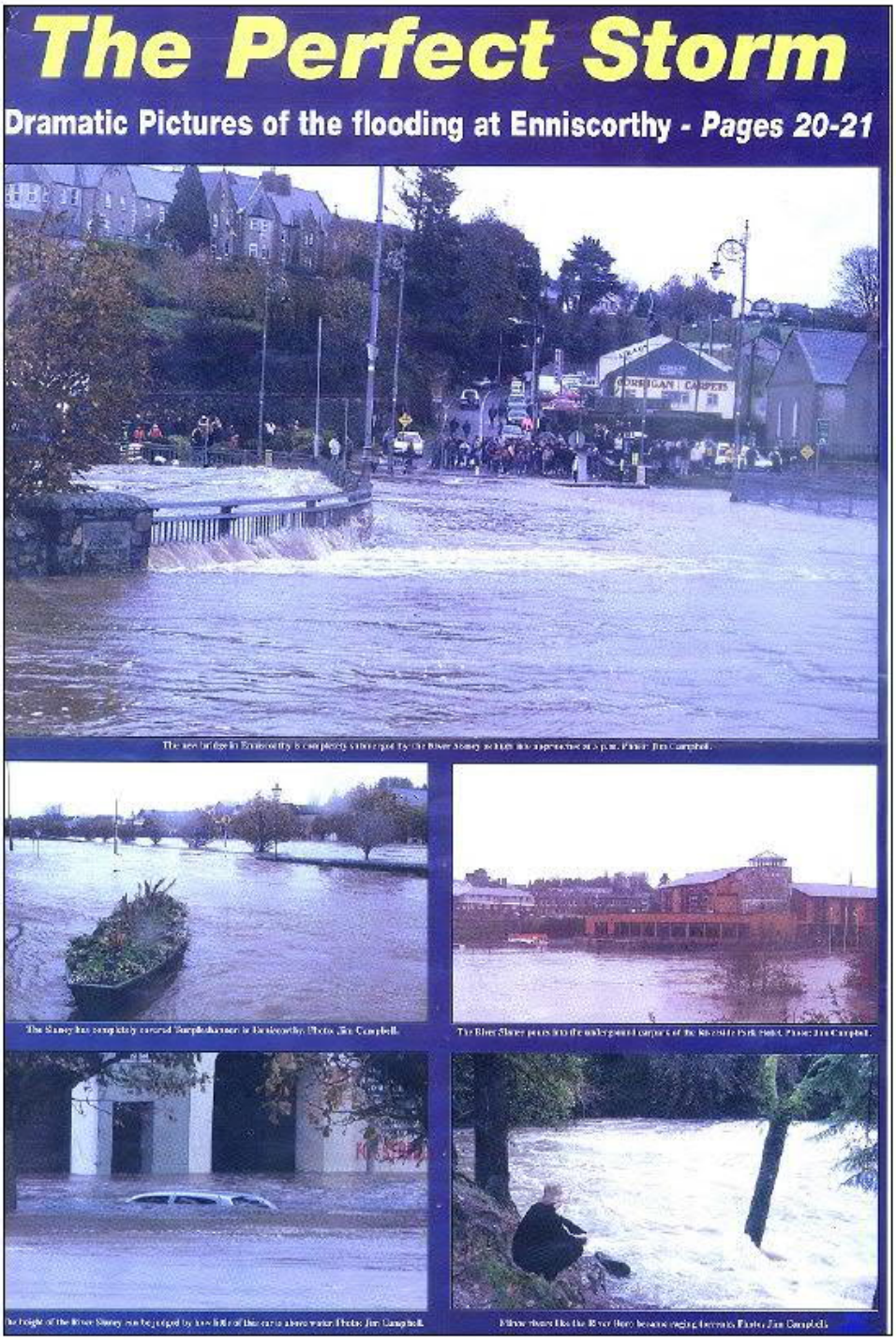
Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, Environmental Impact Statement 2009

3.2.3 2000 Flood Event

The flood event that occurred in November 2000 resulted in a minimum of 109 properties being flooded. The peak flow is estimated to be 404.3m^3/s and at peak flow the water level was 0.6m above the parapet of the Railway Bridge.

This flood event is estimated to represent a 1 in 37-Year flood event. A series of photographs and images published at the time, record the flood conditions encountered in the town, copies of these photographs are reproduced below in Figure 3.7 – 3.15 and a map showing the extent of the flooding is shown in Figure 3.16.

Figure 3.7: Example of archive imagery taken during the 2000 Flood Event



Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, Environmental Impact Statement 2009

Figure 3.8: 2000 Flood Event (Looking downstream at Enniscorthy Bridge

Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, EIS 2009

Figure 3.9: 2000 Flood Event (Looking upstream at Enniscorthy Bridge

Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, EIS 2009

Figure 3.10: 2000 Flood Event (Looking towards Shannon Quay from downstream of Enniscorthy Bridge on Abbey Quay)

Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, EIS 2009

Figure 3.11: 2000 Flood Event (Looking towards Abbey Quay from just downstream of the Enniscorthy Bridge)

Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, EIS 2009

Figure 3.12: 2000 Flood Event (Looking towards Seamus Rafter Bridge from Abbey Square)

Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, EIS 2009

Figure 3.13: 2000 Flood Event (Looking towards the Wexford Road from Abbey Square)

Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, EIS 2009

Figure 3.14: 2000 Flood Event (upstream of Enniscorthy Bridge)

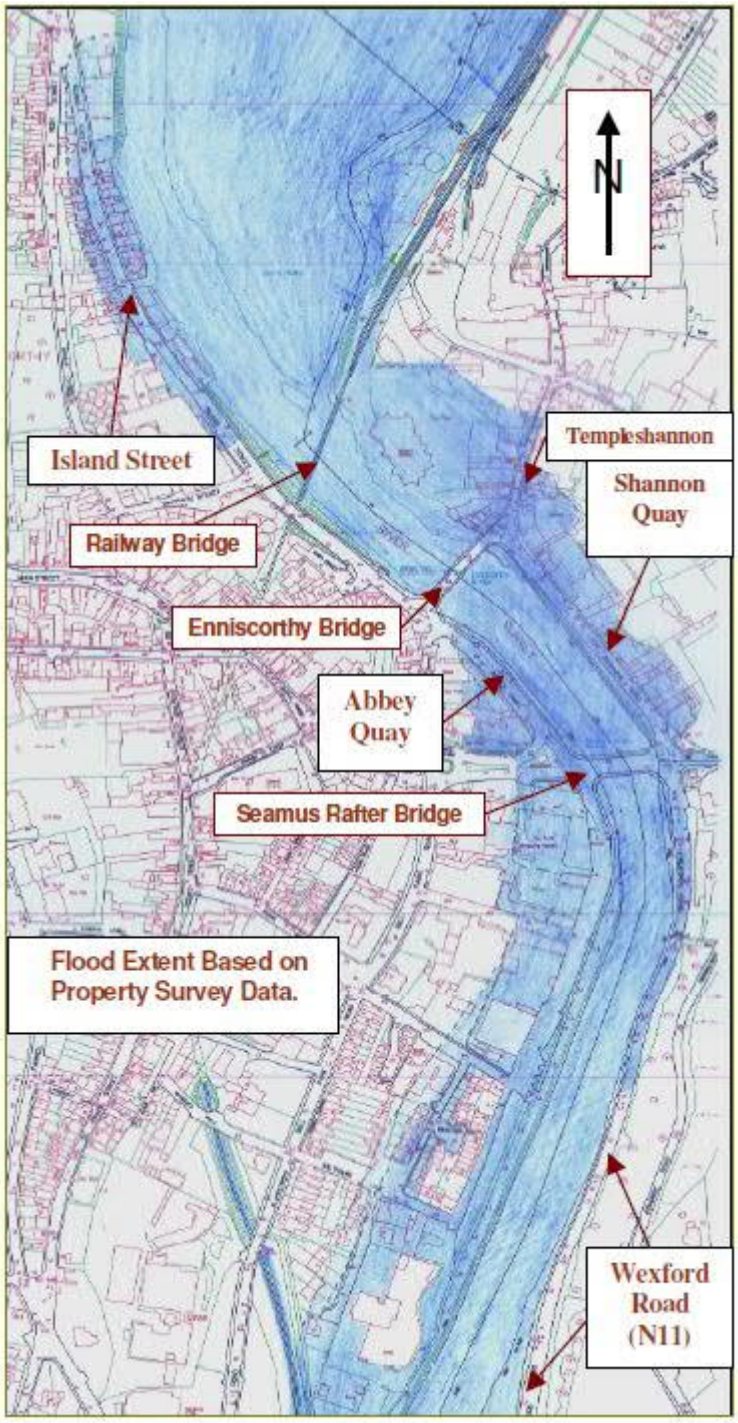
Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, EIS 2009

Figure 3.15: 2000 Flood Event (Looking towards the Wexford Road from Abbey Sq. Shopping Centre Car Park)

Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, EIS 2009

The flood event in November 2000 caused considerable damage in the town. Many properties in the town recorded over 1m flood waters. The extent of the flood was recorded in the OPW, Report on the River Slaney (Enniscorthy Town) Drainage Scheme, 2015, this is reproduced in the Figure 3.16 below. The report found that in many cases, flood waters resulted from flooding upstream and the flood water moving down overland to damage properties. It is estimated that a minimum 109 properties were damaged during the flood event.

Figure 3.16: Map showing the extent of lands flooding during the 2000 flood event



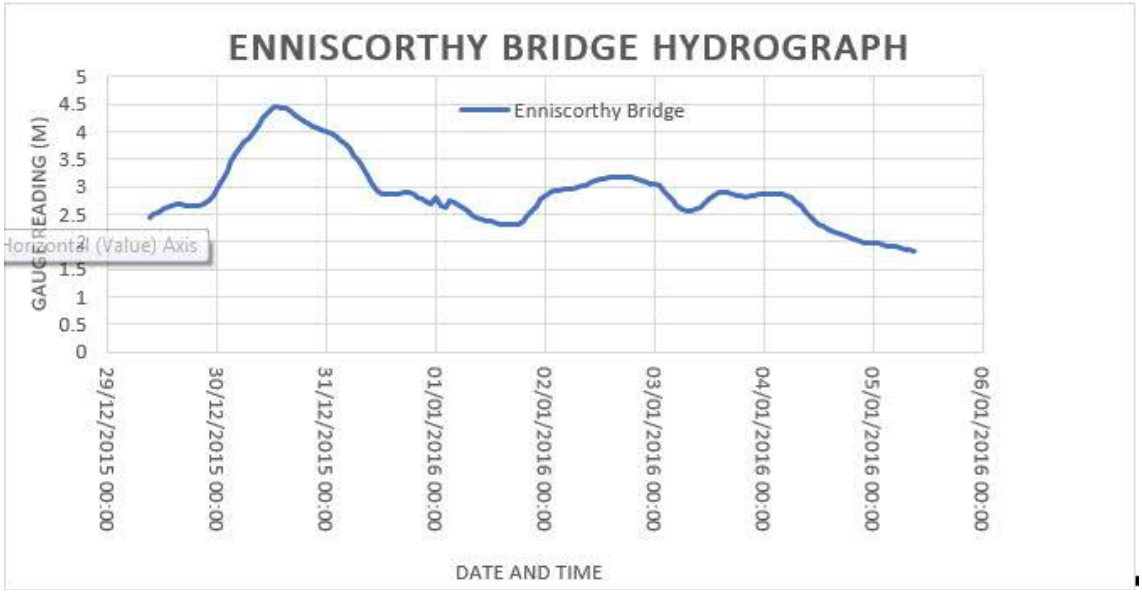
Source: Royal Haskoning and OPW, River Slaney (Enniscorthy) Drainage Scheme, EIS 2009

3.2.4 2015 Flood Event

The most recent flood event to occur on the Slaney at Enniscorthy occured on the afternoon of December 30th 2015. Hydrograph data obtained from Hydrometric Station 12002 at Enniscorthy Bridge, shown in Figure 3.17, recorded a peak water level of 4.464m at 13:00 hours. This water

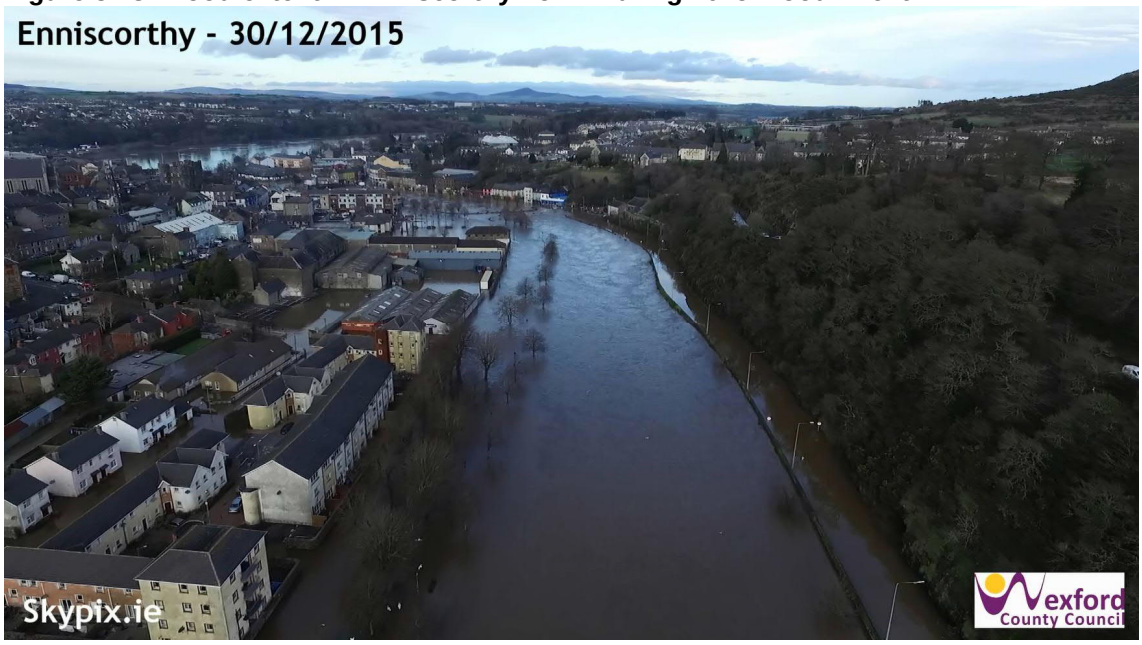
level corresponds to that level predicted to occur during a return period of 8-year event. The peak flow is estimated to be approximately 372m^3/s. It is reported that more than 100 properties were flooded during this event. A drone survey carried out over the town illustrates the extent of flooding during this time. Imagery taken from this survey is reproduced below.

Figure 3.17: Enniscorthy Bridge Hydrograph for the 2015 Flood Event



Gauge station 12002

Figure 3.18: Flood extent in Enniscorthy Town During 2015 Flood Event



Source: Skypix.ie

Figure 3.19: Aerial image of Shannon Quay flooded during 2015 Flood Event

Source: Skypix.ie

3.3 Strategic Planning and Development Context

3.3.1 EU Policy

The European Union (EU) Floods Directive (2007/60/EC) (Directive on the Assessment and Management of Flood Risks) came into effect in 2007. The overall aim of the Directive is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. The Directive also sets out the framework for the assessment and management of flood risks. The Directive sets out specific obligations which each member state must implement. These include;

- A Preliminary Flood Risk Assessment (PFRA) that identified the areas of potentially significant flood risk based on available or readily derivable information;
- The production of flood hazard and risk maps for the areas identified under the PFRA; and
- Preparation of Flood Risk Management Plans (FRMPs) at a catchment or river basin scale, setting out measures aimed at achieving objectives for the management of flood risks within the areas identified under the PFRA.

The need for the proposed scheme was identified as a priority scheme to be carried out in advance of the adoption of the FRMPs along the River Slaney.

3.3.2 National Legislation and Policy

3.3.2.1 Arterial Drainage Act (1945) as amended

The Arterial Drainage Act, 1945 is the primary piece of legislation with which the OPW have operated under for the last 70 years. The Act empowers the OPW to undertake catchment wide arterial drainage schemes to reduce flooding. The emphasis on the 1945 Act was on the improvement of agricultural land. The Act was amended in 1995 by the Arterial Drainage (Amendment) Act, 1995, when the focus of flood management activity included the protection of urban areas. The amendment empowered the OPW to undertake localised flood relief schemes to protect and reduce flood risk in individual urban areas. The proposed defence scheme in Enniscorthy will be carried out under the Arterial Drainage (Amendment) Act, 1995.

3.3.2.2 European Communities (Assessment and Management of Flood Risks) Regulations 2010 (S.I. No. 122 of 2010)

The EU Flood Directive (2007/60/EC) was transposed into Irish Law through the European Communities (Assessment and Management of Flood Risks) Regulations 2010 (S.I. No. 122 of 2010). The Regulations appoint the OPW in Ireland as the Competent Authority under the Directive, and the OPW has lead responsibility for devising and implementing measures to deal with flooding in Ireland.

3.3.2.3 National Flood Policy

In line with internationally changing perspectives, the Government adopted a new policy in 2004 that shifted the emphasis in addressing flood risk towards:

- A catchment-based context for managing risk;
- More pro-active flood hazard and risk assessment and management, with a view to avoiding or minimising future increases in risk, such as that which might arise from development in floodplains;
- Increased use of non-structural and flood impact mitigation measures.

3.3.2.4 CFRAM Programme

The national Catchment Flood Risk Assessment and Management (CFRAM) programme commenced in Ireland in 2011. The Programme delivers on core components of the National Flood Policy, adopted in 2004, and on the requirements of the EU 'Floods' Directive. The Irish CFRAM programme is being carried out in parallel with similar programmes across the European Union.

The CFRAM Programme is central to the medium to long-term strategy for the reduction and management of flood risk in Ireland. The OPW commissioned a number of Catchment Flood Risk Assessment and Management Studies in order to assess flood risk and develop Flood Risk Management Plans (FRMPs). These plans contain measures to manage the existing flood risk and also the potential for significant increases in this risk due to climate change, ongoing development and other pressures that may arise in the future.

Enniscorthy is identified within the South Eastern CFRAM study as an Area for Further Assessment (AFA). The Enniscorthy Flood Defence Scheme is identified by the OPW as a Major Flood Defence Scheme under the Flood Protection Capital Programme 2016-2021.

The FRMPs were finalised in early 2018 and approved by the Minister for Public Expenditure and Reform.

The measures identified by the OPW and proposed as part of the Enniscorthy Flood Defence Scheme will be carried out under the Arterial Drainage (Amendment) Act, 1995 The proposed scheme will also have due consideration for the recommendations set out in the Slaney FRMP.

3.3.3 Regional Policy

In 2010, the South East Regional Authority (now restructured as the Southern Regional Assembly), in which Enniscorthy is located, published its Regional Planning Guidelines (RPGs) for the period 2011-2022. Enniscorthy is listed as a Larger Town within the Guidelines. The Guidelines set out a series of recommendations to local authorities, which are clearly linked to and support national investment priorities and are designed to strengthen integrated approaches to policy making and planning at a local level, in line with regional and national planning frameworks. The South-East Regional Planning Guidelines 2010-2022 shall continue to have effect until a Regional Spatial and Economic Strategy (RSES) is prepared and adopted by the Southern Regional Assembly. The publication of the RSES is dependent on the adoption of the National Planning Framework (NPF), a date for the publication of these RSES is not known at this stage. The RSES must accord with the NPF and in turn, local authority development plan which address further detailed local matters such as zoning of land must be in accordance with the RSES when they become available.

Enniscorthy is listed as a "Large Town" within the Guidelines, which is defined as a town with a population more than 5000 persons. The objective is that more measured growth is desirable in a manner that allows community, social and retail development to catch up with recent past phases of mainly residential development. Large towns are also considered to be good locations for economic development in the region.

Section 9 of the Guidelines sets out the key policy recommendations regarding avoidance and management of flood risk within the South-East Region with the objective of promoting;

1. The identification of appropriate policy responses for priority areas, including areas that transcend administrative boundaries and where there appears to be significant flood risk;

2. Requirements on foot of the guidelines for co-operation, implementation and co-ordination of more detailed area level strategic flood risk assessment in City and Council Development Plans, and Local Area Plans.

The RPG recognises the importance of an integrated approach to river catchment management and that it is essential to manage and avoid increasing flood risk in the region. The Guidelines fully supports the completion of the CFRAM studies. Polices to deliver the RPGs with respect to flood risk are set out in Section 9 of the Guidelines. These include;

- PPO 9.2- Flood risk should be managed pro-actively at all stages in the planning process by avoiding development in flood risk areas where possible and by reducing the causes of flooding to and from existing and future development;
- PPO 9.3- New development should be avoided in areas at risk from flooding. Alongside this, the Regional Flood Risk Appraisal recognises the need for continuing investment and development within the urban centres of flood vulnerable designated growth towns and Waterford City and for this to take place in tandem with the completion of CFRAM studies and investment in sustainable and comprehensive flood protection and management.
- PPO9.4- Development Plans and Local Area Plans should include a Strategic Flood Risk Assessment and all future zoning of land for development in areas at risk of flooding should follow the sequential approach set out in the 2009 Development Guidelines on Planning and Flooding Risk Management.
- PPO 9.5- Local authorities should take the opportunities presented when including policies and actions
- PPO 9.6- Key infrastructure suppliers should assess current elements and stress test future projects against flood risk, where this has not been previously undertaken.

3.3.4 Other Relevant Government Policy

3.3.4.1 Ireland 2040- Our Plan (National Planning Framework) 2017

The National Planning Framework (NPF) was developed to succeed the National Spatial Strategy (NSS) which was long been considered outdated and ineffective. The NPF has legislative backing and is to be placed on a statutory footing. The NPF will be implemented through the planning system and will be overseen by the new Office of Planning Regulator. The NPF will seek to guide at a high-level strategic planning and development for the country over the next 20+ years, so that as the populations grows, that growth is done in a sustainable manner. The NPF with the 10-year National Investment Plan will set the context for each of Ireland's three regional assemblies to develop their Regional Spatial and Economic Strategies (RSES) 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.

The new framework set outs ten strategic outcomes:

1. Compact growth
2. Enhanced regional accessibility
3. Strengthened Rural Economics and Communities
4. Sustainable mobility
5. A strong economy supported by Enterprise, Innovation and Skills;
6. High Quality international connectivity
7. Enhanced amenity and living

8. Transition to a low carbon & climate resilient society
9. Sustainable management of water, waste, other environmental resources;
10. Access to quality childcare, education & health services.

The Framework is committed to planning for growth in a manner which responds to the sensitivities and requirements of the wider natural environment, whilst ensuring climate resilience in catering for future growth and can address planning and infrastructural needs required to facilitate projected population growth. The Framework iterates the governments national flood risk management policies and objectives and set out to ensure that flood risk management policies and infrastructure are progressively implemented. A companion document to the NPF is the National Development Plan 2017-2027 (NDP), a 10-year strategy for public capital investment of almost €116 Billion. €430 Million has been allocated for flood mitigation initiatives to protect threatened communities from river and coastal flood risk.

3.4 Consideration of Alternatives

3.4.1 Do-Nothing Alternative

If the flood defence scheme is not implemented in Enniscorthy, the possibility of future flood events, similar to those that occurred in 2000 and 2015, will continue to occur and the frequency of the flood events will increase with climate change predictions. This will result in continued economic and social implications for businesses, residents and key strategic transportation links (N30, N11 and main Wexford to Dublin Railway) which were affected by previous flood events.

3.5 Scheme Design Process

Under the Arterial Drainage (Amendment) Act, 1995, the OPW is required to follow the EIA process and prepare an EIAR to provide documented information about the potential environmental impacts associated with the flood defence scheme for Enniscorthy. As noted above, the development of the proposed scheme process has now been underway for in excess of 12 years. The deliberations of alternatives have been considered throughout the development of the scheme. The stages of the EIA process include;

- Constraints and Scoping Study;
- Detailed Appraisal of Technically Feasible Options; and
- Environmental Impact Assessment (EIA).

The summary outputs of these stages are summarised below.

3.5.1 Constraints and Scoping Report

The Constraints Report (Posford Haskoning, 2003) was produced in September 2003 and submitted to the OPW. The constraints study examined the issues within the study area upon which any flood defence measures could have an impact. The report was based on consultation with statutory consultees, a Public Information Day, and collection of a range of environmental and related data and information. The conclusions of the Constraints Report are reproduced in Table 3.1 and identified constraints were reviewed and considered and addressed as part of the scoping of the project EIS (Royal Haskoning, 2009).

Table 3.1: Issues Raised in the Constraints Report

Parameter	Key Comments/Issues
Protected Species	It will be necessary to undertake specialist surveys of those protected species that are known to be present in the constraints study area. This includes otter, and aquatic macrophytes. Any surveys should be carried out in the appropriate season. This additional information will provide much more detailed maps highlighting species distribution and areas within the study area.
Fisheries and Angling	It was noted within the constraints report that both commercial and recreational salmon fisheries on the Slaney were closed since 2007. The constraints study noted that this stretch of the river is known to have both salmon and trout spawning, it is not considered to be as important as the more recognised spawning grounds further upstream (ERFB, pers. Comm., 2003). Angling is popular in Enniscorthy, particularly downstream of the old bridge and any reduction in fishing access should be avoided. Anglers are worried about options that would reduce fish numbers in this stretch of the Slaney, such as increased flow rates and loss of in-river pools. The value of the pleasure fishing market should be quantified in terms of rod licences sold, day tickets sold upstream of the old bridge, club membership, catch data etc in order to ascertain the value of this resource.
Hydrology	Any alteration in flow regime, whether permanent as a result of channel alterations or temporary during in-river work could impact upon fish numbers. A reduction in fish numbers (reduced residence time) will directly impact upon angling (both commercial and recreational) and as a food resource for otters. Flow changes could also exacerbate the navigation problems experienced in the river.
Landscape	The study area is surrounded by landscape that is designated as “vulnerable” and “sensitive” within the Wexford County Development Plan (2001) and also contains areas of high visual amenity that the County Council want to ensure are conserved. The impact of walls or other works along stretches of the river may impact upon this conservation policy. There is also the potential to impact upon visual receptors, the character of the landscape (e.g. impact upon sites and monuments), conservation features, and socio-economic related values such as angling and tourism.
Cultural Heritage	There are a large number of both Recorded Monuments and Protected Structures throughout the study area. There are potential impacts directly to the structures themselves, such as Enniscorthy Bridge, and to the setting of several of them. In order to determine the potential impact upon any of these structures it will be necessary to determine the recognised boundary of these monuments in close liaison with Dúchas and the Department of the Environment.
Local Community	It is important that any proposed scheme is seen to be addressing the concerns of the local community. Whilst a solution to the flooding problem is seen as essential for most residents and interested parties, a minority would rather see the river left in its current state and therefore alternatives to flood containment should also be considered during cost/benefit analysis.

Source: Posford Haskoning, 2003

3.5.1.1 Public Information Day

A public information day was held in May 2003 at the Riverside Park Hotel. The purpose was to seek the initial views and comments from the public and interested parties of the key issues. Table 3. 2 below summarises consultation responses to the queries raised during the public information day. Where appropriate observations and comments were addressed within the project EIS (Royal Haskoning, 2009).

Table 3.2: Summary of key project constraints consultation responses (reproduced from the 2009 EIS)

Consultee	Comment
General	Most visitors recognised the importance of solving the flooding problem and felt that other issues that they see as important (e.g. fishing, landscape, tourism including navigation) are secondary to the flooding problem. Previous aggregate dredging industry in Enniscorthy was highlighted as controlling any low flow problems. Sand and gravel were dredged from the river and used in the building trade. At that time, there were no problems associated with low summer flows or large-scale winter flooding. Almost all visitors highlighted the new bridge (Seamus Rafter Bridge), as a structure that was seen to exacerbate the flooding problem. Residents with river views from their properties would be disappointed if these were lost due to the building of floodwalls etc.
Fisheries	Timing of in-river works must avoid sensitive times i.e. migration and spawning runs. Any dredging works should not lead to the formation of impassable barriers. Already during low flows there are large areas of exposed sandbanks and the lowering of the river channel in places may accentuate these exposed areas effectively creating in-stream barriers that would disrupt migration and spawning runs. Further to this, if a fish pass were then incorporated to overcome these areas it would then be illegal to fish within 100m of it causing problems to anglers. Some of the exposed sandy areas are utilised by spawning lamprey. If there were measures put in place to increase in-river flows, then these areas would be washed away. Downstream of the Riverside Park Hotel there are approximately 75 draft nets, fishing for salmon, each have the fishing rights to 1 furlong of river (8 draft nets per mile). Further downstream, there is drift netting for salmon in operation. Salmon moving upstream tend to keep moving until there is a slowing of pace e.g. at a natural in-river pool or in front of some barrier. If flood relief works effectively maintained a high-water flow throughout the town, salmon would not stay in the area for very long.
Island Road	Residents here are generally elderly and infirm and describe increased levels of stress associated with the whole flooding problem. Most residents reported that they could no longer get home contents insurance which is another worry. Several people suggested that residents could be relocated
Birdwatch Ireland	BWI hold winter bird counts datasets for the Slaney between Enniscorthy and Ferrycarrig, including 5-year summary tables for the stretch between Edermine Bridge and the River Urrin.
Slaney Search and Rescue	Concerned over the loss of the access boat slip into the river for their emergency work.
River Slaney Trust	A meeting was held following the Public Information Day, and the following concerns were raised and are to be addressed predominantly in the detailed design phase: Concern over the effect on migratory fish as well as the other fish species (such as lamprey) that move up and down the river. Concerned over excessive fishing as a result of holding areas. Concern that increased flows would affect fish movement and habitat.

Source: Royal Haskoning 2009 EIS

Feedback from observations received during the previous iteration of the project development in 2009 and 2012 were considered as part of the current EIAR scoping exercise.

3.5.2 Alternatives Considered

All aspects of the project were considered on environmental, technical and economic grounds.

The design standard investigated by the Office of Public Works (OPW, 2009) for flood alleviation at Enniscorthy provides protection from flooding up to and including a 1 in 100-year event; there is a 1% chance of a flood of this magnitude, occurring in any given year. The OPW considered several non-structural and structural engineering measures:

1. Do Nothing (i.e. no new flood alleviation measures)
2. Non-Structural Measures;
   a. Installation of an early warning flooding system;
   b. Local measures such as individual property protection.
3. Relocation of properties and/or infrastructure;
4. Reconstruction of properties and/or infrastructure to a higher level;
5. Flow reduction;
   a. Upstream catchment management (i.e. reduce runoff);
   b. Upstream flood storage (single site or multiple sites);
6. Flood Containment through Construction of Flood Defences
   a. Permanent Walls or embankments;
   b. Demountable Walls;
7. Increase Conveyance (upstream, through and/or downstream of the town);
   a. Remove or reduce local key constraints (e.g. bridges, bends, throttles, infill material on a floodplain etc);
   b. Reduce the roughness of the channel /floodplain (remove vegetation, lining, etc)
   c. Specify ongoing channel /floodplain maintenance;
   d. Change the channel section (re-grade the riverbed by dredging and/ or widen the channel by excavation)
   e. Change the floodplain section and/or grade by excavation;
8. Flow diversion (around and just downstream of the town)
   a. Diversion of entire river;
   b. Flood flow bypass channel
9. Sediment deposition and possible sediment traps;
10. Pump storm waters from behind flood defences; and
11. Measures specific to the Study Location.

The detail evaluation of each of the options considered above is set out in Chapter 3 of the Royal Haskoning EIS (2009). A summary of the findings of this evaluation is outlined below:

Option 1 - Do Nothing

If the Flood Defence Scheme is not implemented in Enniscorthy, the possibility of future flood events, similar to those that occurred in 2000 and 2015, will continue to occur and the frequency of the flood events will increase with climate change predictions. This will result in continued economic and social implications for businesses, residents and key strategic transportation links (N30, N11 and main Wexford to Dublin Railway) which were affected by previous flood events.

The cost of the 'Do Nothing' decision is the net present value of the flood damages that would be expected over the specified project time-horizon (50 years), if no scheme were to be implemented. This has been estimated at €51 Million (M). Furthermore, there are the respective health and safety, and social impacts arising from doing nothing.

Option 2 - Non- Structural Measures

A flood warning is not issued in relation to the peak of a flood rather it is issued in relation to the onset of flooding. At Enniscorthy, large floods on the River Slaney take about 18 to 24 hours to produce their peak, however, flooding starts many hours ahead of the peak. For example, in November 2000, flooding from the river was already severe enough to stop traffic in the night (at 01:00am) yet the flood peaked at 18.45pm on the following evening (i.e. significant flooding was occurring 18 hours ahead of the peak). Under present-day unprotected conditions, a flood warning system would need to provide, at least, a 6-hour forecast to the Local Authority and/or Emergency Services. The tight amount of available time makes it very difficult, but not impossible, to provide such a service.

The protection of properties on an individual basis by erecting barriers at doors, windows and air-vents, etc., can be a viable option for reducing flood damages where flood levels rise slowly and reach levels not significantly greater than 1.5m above floor levels. The River Slaney's flood levels, however, rise quickly and extreme events at some locations can be metres above low-lying floor levels. Retaining these heights of water by domestic walls is not feasible on structural grounds.

Option 3- Relocation of properties and/or infrastructure

Relocation of residents and commercial properties can be a viable option for reducing flood damages. It is, however, generally viable in rural areas with a low-density of residential or commercial properties, or in urban areas with extreme flood risk and/or no technically, economically or environmentally viable engineering solution. The relocation of all properties within low-lying areas would be extremely costly financially, though, and would also incur additional environmental and social costs, such as impact to habitat from new construction.

Option 4- Reconstruction of properties and/or infrastructure to a higher level

It may be more cost effective to demolish some properties and reconstruct to a higher level in the same location rather than defend them as presently constructed. This option avoids the additional environmental and social costs and increases unmeasurable costs, often associated with relocation. For a small number of properties this may be cost-effective, but for a large number of properties, as in the case of Enniscorthy, it would be very costly to rebuild at this scale.

Option 5- Flood reduction

For a complete flood relief scheme for Enniscorthy, a minimum storage estimate can be found by assuming the 100-year design flood to be free from significant preceding and following floods (i.e. a clean peak). The Flood Studies Report (FSR) Unit Hydrograph methods have been applied and an estimate made of the hydrograph for the 100-year design flood. The total volume in excess of the 15-year flood (the maximum safe flow in Enniscorthy) has been calculated as 6.66Mm^3. Therefore, it would be necessary to store 6.66Mm^3 (megametre cube) to upstream of Enniscorthy in order to protect the town (and, as stated, this is a minimum estimate). In addition, this value would rise by about 80% to 12Mm^3 under the 2050 Climate Change scenario. Upstream of the town, the Slaney catchment with its high-gradient, narrow floodplains (and long flood durations) does not lend itself to this type of solution (or partial solution). No suitable area (or a sufficient number of sub areas) has been identified with the potential to store such a

volume of water. The following paragraph describes the flood storage available at Scarawalsh which is 7km upstream of Enniscorthy Town.

An in-line storage area north of Scarawalsh Bridge would need a 315m long impounding embankment (dam) across the downstream floodplain and, by including a 0.5m freeboard, its height would be just over 5m above ground level. The permanent loss to agriculture (under the embankment) would be 2.2ha (5.5 acres). This In-line solution would hold back 1.17Mm^3 of flood water, but only 0.34Mm^3 of this represents additional storage (i.e. additional to the natural storage that the floodplain currently provides). This volume amounts to 5.15% of the complete upstream storage requirement so, averaging up, it would take 19.4 equivalent areas totalling 1,035ha (2,557 acres) to be set aside for flooding and need about 2.15 km of embankments with a permanent loss to agriculture (in embankment footprints) of 14.7ha (36 acres). The River Slaney and River Bann floodplains are largely prime agricultural land and obtaining large area for storage would be difficult and costly. Even using the Scarawalsh area alone would be ineffective.

Option 6- Flood containment through construction of flood defences

A commonly considered option in flood relief is to contain floodwaters within a designated floodable area through the use of floodwalls or embankments. At present, floodwaters utilise the riverside roads and this results in lower flood levels. Shutting off these temporary flow paths by constructing walls (permanent or demountable) would force all floodwater to remain within the river boundary. For this engineering measure, it would also be necessary to raise the parapet level of Enniscorthy Bridge and undertake significant works at Seamus Rafter Bridge. Flood walls would also be required throughout much of the town. The use of containment may also affect flood flows, as well as the erosion and deposition regime. However, containment is a technically feasible option and is investigated in more detail below.

Option 7- Increase conveyance

Local obstructions to flow (such as under flood containment solutions, natural rock weirs or restricted sections) can constrict the flow in the river (or floodplain), increasing levels upstream. Removal of, or alterations to, such obstructions can often provide a complete (or partial) reduction in flood levels. Though there is no single option that would provide a suitable scheme, the combined effects of a number of these measures could form part of a possible Flood Defence Scheme.

River excavation measures comprise either re-grading the riverbed by dredging or widening the channel. These measures increase conveyance capacity (i.e. permit the river to carry a greater flow for a given water level). Rehabilitation works (planting, landscaping, etc.) would form part of any excavation work. River excavation measures are a catch-all that takes a global approach to individual measures by establishing policies for both riverbed level and gradient along with channel widening. As with local measures they may not provide a complete flood protection, but in combination with other actions, where appropriate, they may form part of a viable Flood Defence Scheme.

Option 8- Flow Diversion

Diverting floodwaters away from the affected area can mitigate a flooding problem. This can be achieved by excavating a new channel as either a re-alignment of the existing river (a full river diversion), or as an additional relief channel designed only to carry excess flood flows. In the case of Enniscorthy, therefore, these solutions must deal with either the full 100-Year flow of 516m^3/s, or the difference of about 186m^3/s between the 100-Year and the 15-Year peak flow of 330m^3/s (i.e. the maximum safe flow that will pass without flooding the town). Rehabilitation (i.e. environmental integration and aesthetic works) would form part of such a solution. A minimum

diversion length of 2km would be required to bypass the at-risk urban area. On both sides of the river, the ground level is very high throughout the full length of the town, and this would therefore require excavation depths in the order of 25m or more. In addition, much of this would be through rock. The combination of these conditions completely precludes, on physical impact and economic grounds, the construction of any form of diversion option that could allow flood flows to bypass the town.

In specific reaches, there is the possibility that a diversion channel can be constructed which would result in reduced impact to a length of river particularly during construction. As with local measures and increased conveyance, diversion may not provide a complete flood protection, but in combination with other actions, where appropriate, it could form part of a viable Flood Defence Scheme.

Option 9- Sediment deposition and possible sediment traps

Movement of river gravel is a key feature of the River Slaney and it must be considered in the design of a flood alleviation scheme. Deposited gravel could cause a significant decrease in the protection afforded by a scheme and possibly lead to failure and flooding in the town. Though not forming a separate option, this activity of controlling deposition could form a vital part of a Flood Defence Scheme.

Option 10- Pump Storm waters from behind flood defences

If the water level in the river is above the outfall levels, storm water may not be able to discharge to the river and may build up behind any flood defence structures put in place. At Enniscorthy, significant floods maintain high water levels for one to two days. It would, therefore, be necessary to cater for the storm water that would otherwise flood the protected area. Though not forming a separate option, this activity of managing storm water flooding would form an important part of a flood defence scheme which included flood walls and or embankments.

Option 11- Measures specific to the study location

Various indirect measures may arise during the development of a flood defence scheme often to provide a solution to environmental or social impacts that would otherwise occur. For example, raising the road level above the flood protection level is a location specific measure. These will be described within the preferred option details.

Summary

Of the 11 key measures to provide flood relief to Enniscorthy, the OPW determined that Option 6 – Flood Containment is the preferred option, but that it should be supplemented by additional measures. Increased conveyance, sediment deposition control, stormwater pumping stations and road raising should supplement flood containment to provide a holistic Flood Defence Scheme for Enniscorthy Town.

3.6 Appraisal of Technical Feasible Options

The following feasible options were examined in detail to provide the basis for preferred design option for the Flood Defence Scheme in Enniscorthy. Three possible options were identified and these, along with a do-nothing situation comprise the four alternative options assessed in detail for their potential effects on the environment. A summary of the evaluation is provided hereunder;

- Option A – Do Nothing;
- Option B- Flood Walls (Demountable)
- Option C- Flood Walls, Local Alleviation Measures and Limited Dredging; and

- Option D- Flood Walls, Local Alleviation Measures and Dredging.

Drawings of each of the options are provided in Appendix B. Details of the evaluation process are also provided in Appendix A. A summary of the potential impacts is reproduced from the EIS (2009) and are provided in Table 3.2 and Table 3.3.

Table 3.2: Summary of Impacts (Part A)

Description of Impact	Option			
	Do Nothing	B	C	D
Human Beings				
Residential property and community	xxxx	✓✓✓	✓✓✓✓	✓✓✓✓
Local employment	xx	✓✓	✓✓	✓✓
Local economic effects	xxx	✓✓✓	✓✓✓✓	✓✓✓✓
Health and safety	xxx	✓✓	✓✓✓✓	✓✓✓✓
Angling access (construction)	O	O	O	O
Angling access (operation)	O	O	O	O
Recreational navigation	O	O	O	O
Emergency access	xxxx	✓✓	✓✓✓	✓✓✓
Amenity (construction)	na	xxx	xxx	xxx
Amenity (operation)	xx	✓✓	✓✓	✓✓
Visual amenity (construction)	xx	xxx	xxx	xxx
Traffic (construction)	na	xxx	xxx	xxx
Traffic (operation)	xxxx	✓✓	✓✓✓✓	✓✓✓✓
Fauna				
Otters (construction)	na	x	xx	xxx
Otter habitat (operation)	O	xxx	O	✓✓ - ✓✓✓
Badgers (construction)	na	O	O	O
Badger habitat (operation)	O	x	O	O
Bat roosts (construction)	O	O	O	O
Fish and their habitat (construction)	na	x	x	xx
Fish and their habitat (operation)	O	xxxx	✓✓ - ✓✓✓	✓✓✓
Birds and their habitat (construction)	na	O	O	O
Birds and their habitat (operation)	O	O	O	O
Freshwater pearl mussel	O	O	O	O
Re-suspended sediments (construction)	na	O	?xx	xxx
Contaminant mobilisation effects (construction)	na	?x	?x	?xx
Contaminant mobilisation effects (operation)	?xx	?xx	?xx	?xx
Flora				
Designated sites (construction)	na	xx	xxx	xxx
Designated sites (operation)	na	?xxxx	x	✓✓
Terrestrial habitat (construction)	na	xx	xx	xx
Terrestrial habitat (operation)	O	O	xx	xx - xxx
Aquatic habitat (construction)	na	xx	xx	xxx
Aquatic habitat (operation)	O	?xxx	✓✓✓	✓✓
Protected species	O	O	O	O
Soils and Geology				
Geomorphology	O	xxx	x - xxx	✓✓✓
Drainage	O	x - xx	✓✓	✓✓
Geological deposits	O	O	O	O

Source: Reproduced Table 3.1 from Royal Haskoning EIS (2009)

Table 1.3: Summary of Impact (Part B)

Description of Impact	Option			
	Do Nothing	B	C	D
Water				
Hydrological regime	O	x	xx	xx
Accidental spillages	O	O	O	O
Re-suspended sediments (construction)	na	x - xx	?xx	xxx
Re-suspended sediments (operation)	O	O	O	O
Contaminant mobilisation (construction)	na	?x	?x	?xx
Contaminant mobilisation (operation)	?xx	?xx	?xx	?xx
Abstractions/Discharges (construction)	na	x	x	x
Abstractions/Discharges (operation)	O	O	O	O
Air, Noise and Vibration				
Air, noise and vibration (construction)	na	xx	xx	xx
Air, noise and vibration (operation)	O	O	O	O
Climate				
Climate change	O	?	?	?
The Landscape				
Urban/riverside landscape character	O	xxx	xxx	xxx
Floodplain landscape	O	x	x	x
Material Assets				
Railway lines (including bridges)	?	O	O	O
Roads (including bridges)	?	✓✓✓✓	✓✓✓✓	✓✓✓✓
Soil resources	O	O	?	?
Water resources	O	O	O	O
Navigation	O	O	O	O
Cultural Heritage				
Historic monuments	xx	x	x	O
Unknown heritage resource	O	O	O	O

Key:

✓✓✓✓	Positive Impact (major)	xxxx	Negative Impact (major)
✓✓✓	Positive Impact (moderate)	xxx	Negative Impact (moderate)
✓✓	Positive Impact (minor)	xx	Negative Impact (minor)
✓	Positive Impact (negligible)	x	Negative Impact (negligible)
O	No Anticipated Impact	?	Potential Impact
na	Not applicable		

Source: Reproduced Table 3.1 from Royal Haskoning EIS (2009)

The OPW also identified options from the viewpoints of their functionality (i.e. ability to relieve flooding to the stated standard of protection), technical integration (i.e. issues such as Health and Safety and sediment erosion, transportation, and deposition), economic viability and climate resilience.

One of the key causes of flooding within Enniscorthy is the low level of the Seamus Rafter Bridge, which reduces the river cross section in the centre of Enniscorthy. Removing or mitigating this obstruction was a critical element of all the options.

The potential impacts that would arise from failure of the defences provided by the three do-something options (Options, B, C and D) were also examined. Each option was designed to protect from up to and including the 100-year design flood. A natural failure event was considered on all options. A natural failure scenario considers in this appraisal are those greater than the 100-year 'design flood' and less than 500-year event. The impact of the resulting flooding for each option was assessed against the degree of flooding that the same event would cause under the do-nothing condition over a period of 50 years.

Recommendations

It was noted that the economic and social costs of doing nothing (Option A) are of such significance that this would be unacceptable in terms of a sustainable flood defence option for Enniscorthy. Options B, C and D prevent the negative social and economic effects of doing nothing but all result in potential human and environmental impacts. Many of the disturbance impacts associated with the construction phase of the three options were considered short-term in nature and would cease on completion of the works, so the dominant aspects in the characterising the sustainability of the options are the long-term impacts, except for the historic environment. Options C and D have the potential to disturb features of archaeological and historical interest due to the works to the bridges, dredging and river widening.

In terms of the long-term effect on the human environment, Option B results in a significantly greater visual impact due to the necessity for higher flood walls and embankments, though some of these are demountable and therefore temporary in nature. Option D results in the least visual impact.

In terms of the effects on the river as a feature (and linked with its associated habitats, and species), Option C and D were considered to have a significant potential to affect the hydrology and geomorphology of the river, such that potentially significant impacts could occur on the Natura 2000 sites. Option B was also considered to have some potential to affect the hydrology of the river, however, the extent to which this could occur is significantly less for Options C and D. Whilst detailed engineering designs of each option were not developed for the purpose of the appraisal and therefore the potential effects were not quantified for each option, it was stated in the engineering report that design features would be incorporated into the design to avoid alteration to the hydrological regime, thereby limiting the impact on the natural environment to the construction phase impacts and footprint of each option. Consequently, Option D would reduce the potential visual impact of the scheme and create additional river and bankside habitat, to a greater degree than Option C. Similarly, Option C provided benefit but not at as - great a scale of Option D, but greater than Option B. Furthermore, Option D could also incorporate measures that would alleviate potential impacts resulting from the physical alteration arising from climate change effects.

When the natural failure scenario was incorporated it was established that Option D would result in less risk to the built and human environment and provide an adaptive approach to climate change effects.

The recommendations of the option appraisal concluded that Option D was the preferred scheme and this option was progressed to next stage of design development by the OPW.

3.6.1 Bridge Location Selection

As part of the Bridge options study for the scheme, three possible locations for the proposed new road bridge structure required to convey the traffic carried by the Seamus Rafter Bridge were identified by the OPW and Wexford County Council. These are outlined below;

- An online option at the existing Seamus Rafter Bridge,
- An offline option close to the same bridge; and
- An option to the south of the Riverside Park Hotel.

Following an options appraisal carried out in 2008, the preferred location for the structure emerged as approximately 600m downstream of the Seamus Rafter Bridge.

A review of the proposed bridge location was also re-examined in 2016 by Roughan & O'Donovan. In addition to the three options outlined above, a fourth option was also assessed.

The fourth option included moving the bridge further south to tie into the existing junction at Parnell Road. The examination of the bridge options re-confirmed option 3, south of the Riverside Park Hotel, as the preferred location.

In this location the proposed bridge will span over the existing Dublin to Rosslare Railway Line. New junction tie-ins will also be required on the N30 New Ross Road and the N11 Wexford Road.

3.6.2 Environmental Impact Statement

The OPW developed an outline design for the preferred scheme for the town of Enniscorthy. This outline design was completed by internal Engineering staff within the OPW in consultation with Enniscorthy Town Council and Wexford County Council. At this stage external Consultants, Royal Haskoning were appointed to produce an Environmental Impact Statement for the proposed scheme.

The statutory public exhibition of the proposed scheme was held in Enniscorthy in March 2009. As required under the Arterial Drainage Act, landowners and the general public were invited to view the proposed scheme and make observations. The observations made arising from the public exhibition were compiled and considered by the OPW.

The preferred scheme option for Enniscorthy includes:

- River dredging, widening and diversion works;
- Construction of flood defence walls including stretches of glass walls;
- Demolition of the Seamus Rafter Bridge;
- Construction of a new Pedestrian Bridge over the River Slaney; and
- Construction of a new Road Bridge over both the River Slaney and the Dublin to Rosslare Railway.

3.6.3 Environmental Impact Statement Addendum

Although the requirement for the scheme is evident due to a history of flooding in the town, the scheme proposed in 2009 met with objections. These predominantly related to visual impacts as the proposed scheme prescribed in 2009 was not felt to represent a visually acceptable solution. In particular, many objections related to the aesthetics and the loss of the views of the River Slaney due to the construction of high walls. In addition, the public feedback noted that the scheme would remove the connectivity between the quays and would impede access to the river for recreational use. It was also noted that the proposed scheme could have an adverse impact on the passing trade in the town.

In responding to the issues raised in the submissions, Wexford County Council recommended that measures be considered to reduce the visual intrusion and impact of the scheme. Subsequently, it was proposed that glass walls be incorporated in the design, reducing the adverse visual and landscape character impacts associated with the scheme. Several other minor design amendments were also proposed. The design of the scheme was subsequently refined and in 2012, an Addendum to the River Slaney (Enniscorthy, Drainage Scheme Environmental Impact Statement, was produced by Royal Haskoning). The refined scheme was put on public display in 2012.

3.6.4 Hydraulic Modelling

The development of the proposed scheme process has now been underway for in excess of 12 years. Throughout the preparation of the previous Environmental Impact Statement and EIS

addendum and in preparing the current EIAR the design of the proposed scheme has been revised and refined to the current proposed design. Subsequent river modelling was carried out to reflect the development of the scheme design.

River modelling was undertaken by the OPW to determine the return periods of past flooding events, the levels of future flooding and in order to test the efficacy of various flood risk management measures for Enniscorthy. A numerical model of the River Slaney and its catchment was developed from the Edermine Bridge (5km downstream of Enniscorthy) to The Blackstoops (a kilometre upstream of the town). The model was developed using the numerical hydraulic modelling package HEC-RAS (i.e. The US Army Corps of Engineers' **H**ydraulic **E**ngineering **C**entre's **R**iver **A**nalysis **S**ystem). This model was chosen as it was considered suitable for use for conditions experienced in Enniscorthy. The model requires the following information;

- A physical survey of the river, its flood plains and structures; and
- Calibration information.

The OPW carried out a survey of the river from Edermine Bridge to the Blackstoops. Cross sections were taken approximately every 200 metres throughout the downstream 4km then increased to every 100m and finally every 25m through the town. The survey detailed the river structures along this stretch of the river. An aerial (Light Detection and Ranging; LiDAR) survey of the floodplain was also undertaken and provides the river survey cross sections across the full length of the floodplain. This data was used to create the numerical model.

The flood profile information for the model was established from the flood levels at Edermine Bridge and throughout the length of the town for both the 1965 and 2000 floods. In addition, two within river bank profiles were also recorded and their associated flow measured for use in calibrating the model. While the 1965 flood is estimated to be greater than the 100-year event, several intervening changes (such as infilling at the swimming pool, and along the Promenade) along the river corridor preclude its use as the primary calibrating event. As such, the November 2000 flood was selected as the primary floodplain calibrating event.

The River Slaney is subject to tidal influences as far as the Enniscorthy bridge. The OPW have a Hydrometric Station upstream of Enniscorthy Bridge but it was not possible to separate out the fluvial and tidal components to flows, consequently the process as stated in the Flood Studies Research Manual of using a nearby catchment was undertaken. The OPW Hydrometric Recording Station at Scarawalsh has over 60 years continuous record of water levels. Furthermore, the contributing catchments of the River Slaney are down to Scarawalsh, 1036km^2 and 1277km^2 to Enniscorthy Bridge.

The OPW modelling and feasibility study showed that while the tidal component at Enniscorthy is significant, it does not impact on the events with a return period greater than 15 years. As such, it is concluded that the tidal effects on the River Slaney are not expected to impact on any feasible flood alleviation scheme that protects to the proposed design standard of 100-year event. The model was updated to consider a 20% increase in peak flows as a result of climate change. The hydraulic model of the present-day river condition shows an increase flood levels of 0.55m downstream of the Seamus Rafter Bridge and due to the restrictions imposed by the three bridges in the town, this rises 0.95m upstream of the railway bridge.

When the allowance for climate change is considered the frequency of flooding in Enniscorthy doubles and the model outputs noted Enniscorthy would expect to be flooded every five years. As a result, climate change is a significant factor to be addressed throughout the entire design process. Table 3.3 & Table 3.4 below details the updated return event flows considering with

and without climate change respectively. Figure 3.20 presents the estimated extents of 10, 100 and 1000-year flood envelopes.

Table 3.3: Return Period Flood Flows for Enniscorthy under the expected 2080 climate change scenario

Return Period (Years)	Estimated Peak Flows at Enniscorthy (m^3/s)
1	201
2	247
5	295
10	330
25	296
50	467
100	**565**

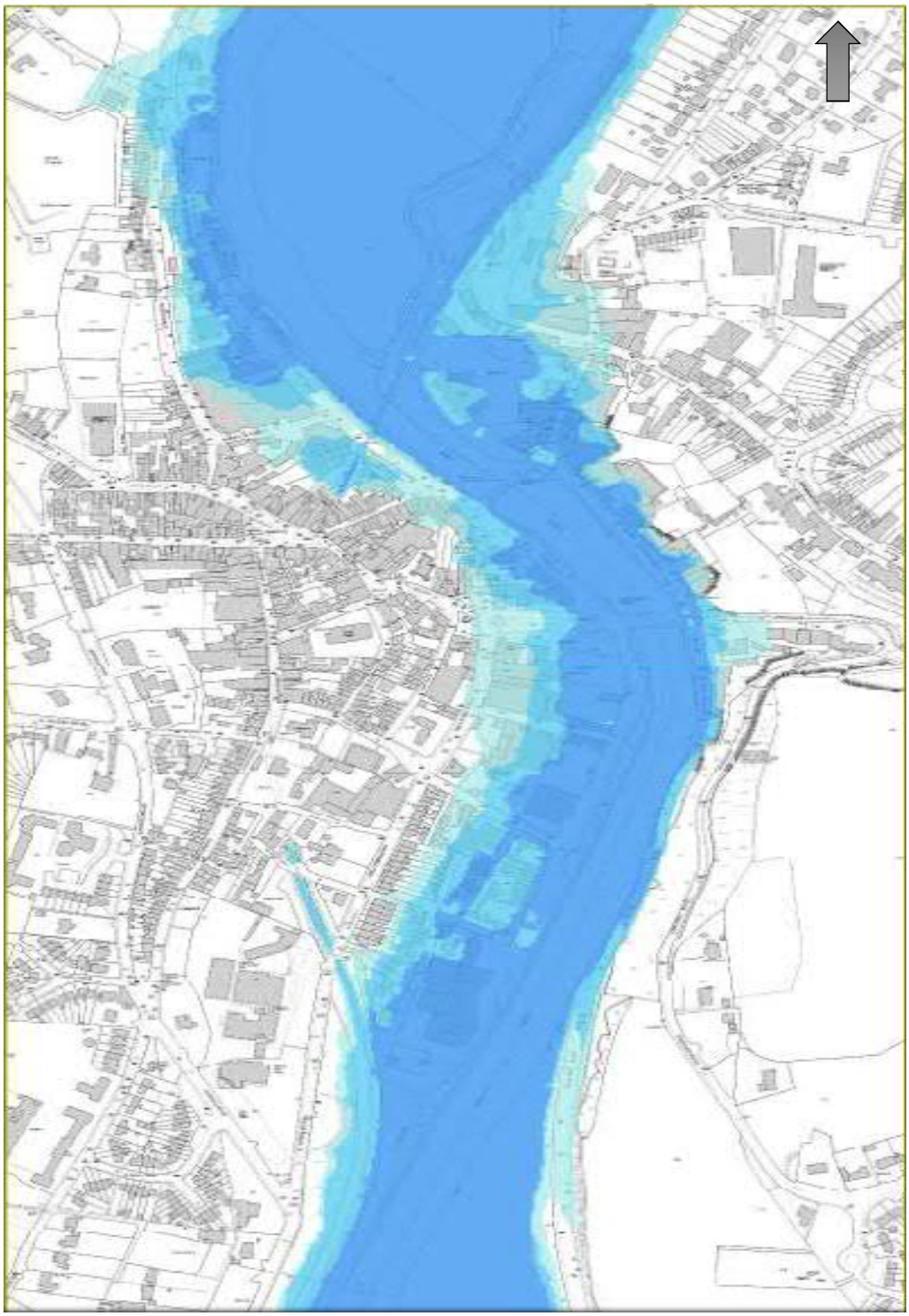
Source: Engineering Report on the Proposed River Slaney (Enniscorthy) Drainage Scheme, OPW 2015

Table 3.4: Return Period Flood Flows at Enniscorthy under the expected 2080 without climate change scenario

Return Period (Years)	Estimated Peak Flows at Enniscorthy (m^3/s)
1	195
2	238
5	249
10	312.8
25	372.3
50	434.2
100	515.9

Source: Engineering Report on the Proposed River Slaney (Enniscorthy) Drainage Scheme, OPW 2015

Figure 3.20: Estimated flood extents for 10, 100 and 1000-year flood envelopes (1 in 10 dark blue, 1 in 100 is aqua blue, 1 in 1000 year is light blue)



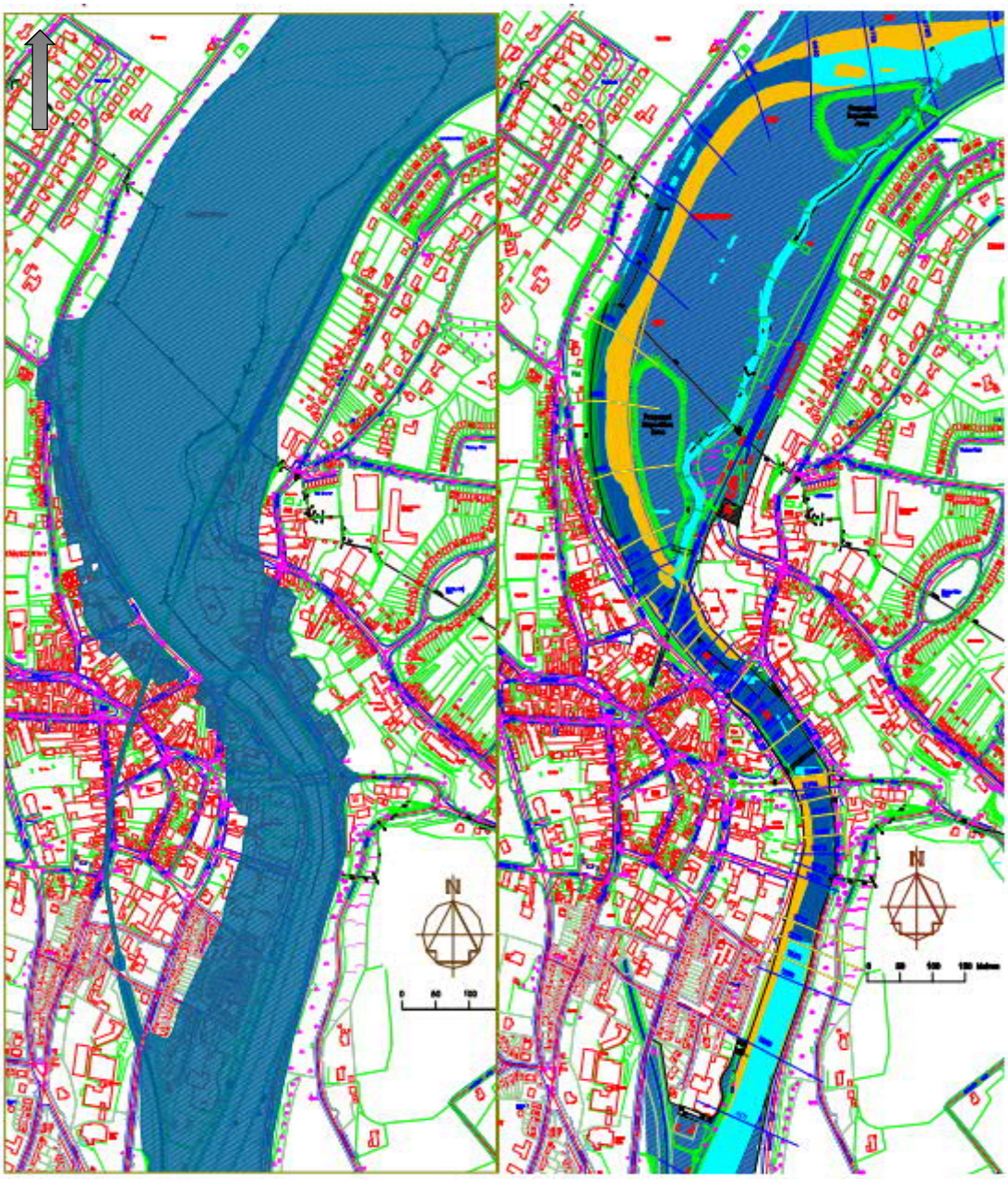
Source: Engineering Report on the Proposed River Slaney (Enniscorthy) Drainage Scheme, OPW 2015

The present-day hydraulic model was modified to represent and test the effectiveness of the proposed measures. This was done by altering the river cross sections to represent the

widening and dredging and by inserting flood defences at various locations throughout the model. The model was also altered to represent the removal of Seamus Rafter Bridge, the inclusion of the new pedestrian bridge and the inclusion of the new road bridge across the Slaney downstream of the Riverside Hotel. This model also included a bypass channel through the bare meadows.

Following the completion of baseline ecological surveys, it became apparent that the construction of the bypass channel through the Bare Meadows could have a detrimental impact on the birds that use this area. For this reason, the bypass channel was removed from the proposed works. The required channel capacity in this area is provided by the inclusion of a compound channel connected to the main river channel. The compound channel is located on both the right and left banks. The hydraulic model was altered to remove the bypass channel and include the compound channels in this area. The model was run for a range of flows from the 1 in 2-year event to the 1 in 500-year event. The output of the model was used to determine the heights of defences required to provide protection from the 1 in 100year fluvial flood event. On the basis of the above study, the proposed works have been designed to provide protection for peak flows during a 1 in 100-year event. The proposed works are adaptable to a future climate change scenario with a 20% increase in flows. Figure 3.21 below provides the estimated extent of flooding in the 100-year event with the proposed scheme in place. The difference between the two images is the benefiting area. The proposed scheme will also have positive impacts on flow velocities and on sediment stability issues within the Town.

Figure 3.21: The Protected 100 Year Flood Event (image on left is estimated extent of 100-year Flood and image on right is the protected 100-year flood extent)



Source: Engineering Report on the Proposed River Slaney (Enniscorthy) Drainage Scheme, OPW 2015

3.6.5 Alternative Bridge Location and Alignment

3.6.5.1 New Road Bridge

On appointment Roughan and O'Donovan (ROD) completed a detailed Project Review Report which provided an independent review of the options previously considered both in respect of

location and bridge typology. This report was issued to key stakeholders including Transport Infrastructure Ireland (TII), WCC, Irish Rail, and the OPW and presented locally.

The bridge alignment and structural arrangement options were assessed and an agreed multicriteria analysis (MCA) was used to determine the preferred structural arrangement under key criteria including:

- Aesthetics;
- Vehicular, Cycle and Pedestrian Traffic Aspects;
- Environmental Impact;
- Durability and Maintenance Needs;
- Hydraulic Considerations;
- Feasibility of Construction;
- Impact on the Railway;
- Economic;
- Disruption During Construction;
- Integration with the Flood Scheme;
- Safety; and
- Impact on Utilities.

Following this evaluation an alternative to the previous presented cable stay bridge form is now proposed. The proposed bridge alignment also seeks to address the key observations raised by the statutory authorities in relation to potential visual impacts, bird strike collision and ecological considerations. The preferred option is an architecturally designed slender 3 span steel composite bridge supported on reinforced concrete end supports and piers. A direct means of pedestrian access is provided from the bridge to the west riverside walk. Ramped access is provided immediately to the north of the bridge on the N30 to the riverside. Refer to Photomontages in Appendix F. The bridge main span crosses the river with west bank span spanning the railway and east bank span spanning the floodplain and woodland.

3.6.5.2 Pedestrian Bridge

Following appointment by WCC, Mott MacDonald carried out a review of the structural options available for the pedestrian bridge and its approach structures. The crossing location is limited to the area in the immediate vicinity of the existing Seamus Rafter Road Bridge between Shannon Quay and Abbey Quay. The existing road bridge is used for pedestrian and cycle access, so the replacement option will be used to maintain these traffic flows. Six bridge options and six approach structures options were considered, and each were evaluated in accordance with the following criteria

- Capital Cost;
- Whole Life Cost (Capital and Maintenance Cost);
- Aesthetics;
- Design Costs and Programme;
- Constructability;
- Disruption to Public During Construction;
- Disruption to Public During Maintenance;
- Hydraulics;
- Approach Structure Scale;

- Accessibility and Security;
- Services;
- Environment and Carbon Footprint; and
- Health and Safety.

Following this evaluation an alternative to the original bridge design was recommended. The proposed pedestrian bridge now presented in the EIAR and consists of a Bow String Arch Bridge with step and ramp access approach structures. Photomontage of the proposed bridge is provided in Section 4.4.4.

3.7 Scoping of the EIAR for the Proposed Enniscorthy Flood Defence Scheme

The advancement and refinement of the proposed scheme was carried in a systematic and iterative process. The collation and assessment of environmental data and predicted impacts were essentially linked to the progress of the scheme including inputs from key stakeholders and interest groups. Section 3.5 to Section 3.7 of this report outlines the processes that led to the development of the proposed scheme that is described in Chapter 4 of this EIAR.

As noted above in Section 1.2, the design for the Enniscorthy Flood Defence Scheme was developed by the OPW in 2009. A project EIS was produced by Royal Haskoning in 2009. In responding to observations and comments raised by submissions the design of the scheme was subsequently amended in 2012. An Addendum to the River Slaney Enniscorthy, Drainage Scheme Environmental Impact Statement (EIS), was produced by Royal Haskoning in 2012. Throughout the preparation of the previous Environmental Impact Statement and EIS addendum and in preparing the current Environmental Impact Assessment Report the design of the proposed scheme has been revised and refined to take account of the findings of all site investigations and from public consultation and stakeholder feedback which have brought the design from its first initial design to the current proposed design.

As noted in the EPA Guidelines (2017, draft), the scoping process can be an informal process. The scoping process identified likely environmental receptors and provided a preliminary evaluation of sensitivity, where possible.

As part of this process the scope and methodology for future consultation, investigation and assessment for each environmental topic were also considered. Following appointment by Wexford County Council, Mott MacDonald carried out a desktop review of publicly available information and available project information provided by the OPW (including the Project Constraints, Scoping Report and Project EIS, Addendum EIS) on the proposed scheme. Submissions and observations raised by the public and key stakeholders to date were also considered.

The scoping was carried out by a team of specialists working in close collaboration with the design engineers as part of an iterative design and consultation. The key characteristics of the proposed scheme and relevant issues associated with the works were set out and a team workshop was carried out. Our team of specialists also carried out site walkovers in order to understand the environmental features and resources likely to be significantly impacted by the proposed scheme. The process also considered the potential for alternative design features or techniques. Where appropriate these alternatives became part of the final design.

The process also stimulated reengaging discussions with the key stakeholders about the extent of information and analysis required by them to make an informed review of the proposed scheme. A series of site meetings were also arranged with NPWS, IFI and Irish Rail and the OPW. The scope of the EIA and timing of baseline surveys required for each of the key

environmental receptors were discussed. In the instance where a formal response was provided by a key stakeholder, these were disseminated to the project team. Table 3.4 below summarises the key points from the scoping process and responses received from various bodies and identifies where such points have been addressed in this EIAR.

The historical observations and submissions received as part of the previous EIS were also considered in line with the present proposed scheme characteristics and where appropriate these observations were addressed in the appropriate sections within the EIAR. Having regard to Table 3.1 and 3.2, a summary of how these historical observations and concerns were addressed in the scope of this EIAR is set out in Table 3.3.

Table 3.3: Historical observations addressed in the present EIAR

Observation	Key comments as addressed in this EIAR
Protection	A comprehensive scope of ecological surveys was defined and set out in consultation with the NPWS. All surveys were carried out in appropriate season. The scope of the ecological surveys and assessment are set out in Chapter 6 Biodiversity of this EIAR. The proposed flood protection resulting from the scheme was welcomed by the majority of residents in the Town. Concerns were raised in the ongoing river rescue services in the Slaney. The proposed scheme design also ensures the continued river safety access, the design facilities river rescue services and use of safety ladders from the river.
Fisheries and Angling	The importance fisheries resources and angling access to the River Slaney was considered throughout the design of the proposed scheme. Access arrangement and flow deflectors include retaining undisturbed margins, reprofiling with suitable sediments were set out in consultation with IFI and local interest groups. The description of the access arrangements is set out in Chapter 4 of this EIAR. In addition, concerns raised over the potential loss of the access boat slip into the river for their emergency work. It is noted that boat access to the river will be provided and additional emergency rescue life buoys will be provided on the Promenade. The timing of the proposed works and construction approach (i.e. use of dry works areas) have been set out in Chapter 4 and an CEMP has been appended to this EIAR. All specialist technical contributors to this EIAR have reviewed the design of the proposed scheme and the information contained in Chapter 4 *Description of the Development* and identified potential for likely significant impacts based on their experience and expertise
Hydrology	The proposed scheme will alter the flow regime of the River Slaney. Hydraulic modelling was undertaken to reflect such refinement and modification in the design. The modelling ensured technical acceptability of the proposed scheme. The potential impacts resulting from the temporary and permanent changes in the flow regime are set out in Chapter 7 of this EIAR. The potential impacts on the fisheries and associated habitat resources are addressed in Chapter 6 of this EIAR. The programme of the proposed works and construction approach to the Scheme are set out in Chapter 3 of this EIAR.
Landscape and visual	In response to queries and observations on the potential significant impact on the landscape character and visual amenity of the Town. A high-quality 3D flyover of the proposed scheme was generated and shown at the public display events. In addition, high quality visual imaging (computer generated photomontages) have been provided using selected key viewpoints as agreed with Wexford County Council. These montages included the selected viewpoints previously shown in the 2012 iteration of the scheme. The montages also include additional viewpoints used to ensure a comprehensive and comparable landscape assessment. The potential impact upon visual receptors, the character of the landscape, conservation features, amenity features is set out in the scope of Chapter 9 of this EIAR.
Cultural Heritage	The scope of Chapter 10 Archaeology, Architectural and Cultural Heritage was set out having regard to the key concerns raised by the public and consultation response provided by the National Monuments Service and other appropriate departments. The potential visual impacts on archaeological cultural and architectural heritage features in the Town is addressed in Chapter 9 of this EIAR.
Local Communities	Community feedback to the scheme was critical to the development of the scheme as assessed in this EIAR. Observations and feedback were considered

Observation	Key comments as addressed in this EIAR
	in the appropriate environmental topic within this EIAR. In addition, a public display event was held in June/July 2018.

Given the lapse in time from the project EIS and EIS addendum (2012), the structure of the EIAR was considered having regard to the Article 3(1) of EIA Directive (2014/52/EU), this is set out in Table 1.2. The activity of scoping continued throughout the EIA process, the scope of work was amended appropriately in light of any key issues identified or new information gleaned from consultation or as a result of design changes and were subsequently addressed in the EIAR.

Table 3.4: Review of EIA scoping responses

Consultee Name	Key Responses	Comment
Planning Services- Wexford County Council	No formal response was received from the planning department.	However, a Project Steering Group was established, which included Wexford County Council and Enniscorthy Municipal District. This Group provided for the input of the members to guide the project program and acted as a forum for communication between the design team and OPW and Wexford County Council. The Project Steering Group typically met once a month. The group also provided updates on observations made by key interest groups or the general public. In response to queries and observations on the potential significant impact on the amenity and landscape and visual of the Town. A high-quality 3D flyover of the proposed scheme was generated and shown at the public display events. In addition, high quality visual imaging (computer generated photomontages) have been provided using selected key viewpoints as agreed with Wexford County Council. These montages included the selected viewpoints previously shown in the 2012 iteration of the scheme. The montages also include additional viewpoints used to ensure a comprehensive and comparable landscape assessment.
Dept. of Communications, Climate Action and Environment	No response was received	N/A
Dept of Housing, Planning Community and Local Government	No response was received	N/A
Dept. of Finance	Department replied and had no comment to make	N/A
Dept. Jobs, Enterprise and Innovation	No response was received	N/A
Dept. of Agriculture, Food and Marine	No response was received	N/A
National Monuments Unit	A formal pre-application consultation issued by the DAU on behalf of the department in 2015. Archaeology - The EIS is dated to 2009 and therefore needs to be updated to include a detailed Cultural Heritage Section that is current, that presents, discusses and makes further recommendations on results obtained to inform on the known and previously unknown cultural heritage and any potential impact on it from the proposed works. The	Follow up consultation was carried out with the department to define the scope of the archaeological impact assessment surveys and subsequent ground and under water investigations. The results of these investigations were discussed with the department and a copy of archaeological investigations was provided to the department. the scope of the baseline surveys

Consultee Name	Key Responses	Comment
	EIS as submitted, by its own statement, is a baseline study and it concluded, with regard to Cultural Heritage, that there is to be no perceived negative impacts by the proposed flood relief works on known or previously unknown archaeological sites. The previous statement cannot stand up without having carried out a proper, full and detailed archaeological assessment (comprising both terrestrial and underwater archaeological assessment) to update the EIA. It is the policy of The Heritage & Planning Division and the Underwater Archaeology Unit that proposed developments, due to their location, size, or nature, that may have implications for the archaeological heritage shall be subject to archaeological assessment. The underwater cultural heritage is not addressed adequately in the report nor is the potential that these watercourses hold for previously unrecorded cultural remains. The EIS needs to address the potential that such watercourses have for the underwater cultural heritage and the potential impact on such environments from flood relief and defence works (including changes or increases in hydrology due to flood works, dredging works, bank/embankment replenishment, bridge works, etc. As the majority of the works have a riverine context, it is advised that the applicant(s) shall engage the services of a suitably qualified underwater archaeologist to carry out a detailed assessment of all proposed works within the Catchment areas – both within the town of Enniscorthy itself and its surrounding areas, including in-river underwater archaeological survey. A detailed Impact Statement shall be included, and this shall seek to readdress terrestrial and underwater archaeology and the various options proposed and shall put forward specific recommendations for the protection of known cultural heritage and the protection of potential, previously unrecorded archaeology, including underwater heritage. The archaeological assessment shall be licensed to this Department. The Archaeological Assessment Report shall be submitted to the National Monuments Service as Further Information and for comment on the next phase of the proposed Enniscorthy Flood Relief Scheme	and investigations were set out in the scoping of this Chapter. Refer to Chapter 10 Archaeology, Architectural and Cultural Heritage
National Parks and Wildlife Services	A formal pre-application consultation response issued by the DAU on behalf of the department in 2015. The letter noted the key issues that the department would request to the address in the new EIA/NIS. - Appropriate Assessment- The project details were modified in 2012 as described in the EIS addendum but no new information for the Appropriate Assessment has been provided to the Department. The AA information therefore needs to be updated to produce a NIS using the most up to date conservation objectives and the detailed design. - Cumulative Impacts- It is also noted that cumulative impacts should be considered and that plans and projects within the SAC will need to be considered. - Loss of Habitat- the NIS and EIA should clearly note loss of habitat and whether it's within the SAC boundary.	These comments were considered in the scoping of the biodiversity Chapter within this EIAR and the NIS. Following a view of the baseline information gathered for the study area a programme of ecological surveys was compiled on the key ecological receptors within the study. This process also ensured seasonality constraints associated with each species. A series of follow up meetings were also held with the Department at a regional and divisional level inter alia to discuss the scheme progression, characteristics of the works and baseline information and analysis of key ecological features and the need for appropriate mitigation and monitoring protocols. The project team also provided a comprehensive summary of the survey works undertaken in relation to all ecological surveys and the

Consultee Name	Key Responses	Comment
	- Potential impact on lamprey and Callitriche truncate is unclear in the appropriate assessment. This need to be clarified in any ecological impact statement and NIS. - CMP- details on the construction approach need to be provided in order to allow for adequate assessment. - Ecologist Clerk of Work- A project ecologist should be available at construction stage due to the sensitivity of the site - Ecological Surveys – The distribution of both plants and animal species can change over time and this Department recommends that a new survey is carried out particularly for bats, otters and the protected plant Callitriche truncate. - Suspension bridge- With regard to the proposed new suspension bridge, it should be noted that stays for suspension bridges form a flight hazard for bird species such as swans. - Sand Martins - the potential impacts and mitigation proposed on the sand martin populations is unclear from the EIS addendum - Invasive plant species – two invasive plant species are known to be present. Best practice should be followed in preventing spreading of these species. - Biodiversity issue- The species and provenance of grass, trees and shrubs used in planting needs to be specified and suitable native species of local provenance used as appropriate. - Recommendation on retention or remedial plant of the “Cotton Tree” if feasible. - Licence requirements- the Department noted licenses may be required under the wildlife acts or derogations under the Habitat Regulations.	main findings. Details on the proposed construction approach are set out in Chapter 4 of this EIAR and appended to the NIS. The proposed mitigation and monitoring protocols where relevant are addressed in Chapter 6 of this EIAR or Nis were appropriate. Landscape planting has been proposed as part of the landscape mitigation measures in Chapter 9 of this EIAR. The suspension bridge design was subsequently redesigned however detailed bird flight surveys were carried out within the study area to inform the potential collusion risk associated with the new bridge design. A preliminary Invasive species management plan was prepared which identified the presence and location of invasive species and outlines proposed management of these species and is appended to this EIAR. Confirmation of the cotton tree removal within Enniscorthy however, it is proposed to plant suitable native species of local provenance on the North Island.
Inland Fisheries Ireland	A formal pre-application consultation response was issued by the IFI. The letter noted the key issues and significance of the River Slaney Catchment. The comments were considered in the scoping of this EIAR. A series of follow up meetings were held with the IFI at a local and regional level to discuss the scheme progression, characteristics of the works and baseline information and analysis of key ecological features, fisheries resources and the need for appropriate mitigation and monitoring protocols. Where appropriate these are addressed within this EIAR. Details on the overall construction approach were also discussed, where appropriate the construction approach and design of the fisheries and angling access were incorporated into the design of the scheme.	The comments were considered in the scoping of the Biodiversity Chapter. A series of follow up meetings were held with the IFI at a local and regional level to discuss the scheme progression, characteristics of the works and baseline information and analysis of key ecological features, fisheries resources and the need for appropriate mitigation and monitoring protocols. Where appropriate these are addressed within this EIAR. Details on the overall construction approach were also discussed, where appropriate the construction approach and design of the fisheries and angling access were incorporated into the design of the scheme. Description of the proposed project is set out in Chapter 4 of this EIAR.
Irish Rail	No formal response was received	Discussions were held with Irish Rail to outline the characteristics of the proposed development and construction approach to facilitate the works. Irish Rail were also consulted in order to scope the detail of the site investigations required to inform the design and the potential impacts associated with these works

Consultee Name	Key Responses	Comment
		and crossing requirements on their network. Observations from Irish rail include site-specific requirements were incorporated into the design of the scheme and in the programme of the proposed works. Discussions included clearance requirements of the new road bridge over the network to ensure and facilitate existing operation on the network and the future expansion needs of Irish Rail. The potential for significant impact on the Enniscorthy Town traffic and transportation was assessed in Chapter 13 of this EIAR.
An Taisce	No response was received	N/A
Irish Water	A response was provided by IW and they noted IW assets within the study area. IW provided general water services to be considered in the scope of the EIS where relevant.	The potential impact on IW water services and management of surface water was considered throughout the development of the design process and the potential for significant effects are considered in the appropriate sections in this EIAR e.g. description of the works, biodiversity and material assets
Southern Regional Assembly	A written response was provided by the Assembly, they referred to the South East Regional Planning Guidelines 2010-2022. In particular, Section 8 and 9 address the heritage and environment policy and Flood Risk Assessment. The SERPG are statutory regional planning policy for the South East and will remain in force until time as a Regional Spatial and Economic Strategy has been adopted. The Assembly recommended consultation with NPWS and EPA and OPW and should comply with relevant legislation and guidance.	Reference to the national and local planning development context are set out in the Chapter 3.3 of this report.
Dept. of Transport, Tourism and Sport	No response was received	N/A
Transport Infrastructure Ireland	TII issued a response to note general guidance in relation to matters that may affect the National Road Network and may form part of the scoping exercise. The authority noted the M11 Gorey to Enniscorthy Bypass currently under construction. The authority noted the scheme should assess impacts on existing road network, should identify method/techniques proposed for any works traversing national road, early consultation with TII is recommended. The authority noted their publications in conducting the scoping of this EIAR and should have regard to the NRA guidelines where appropriate.	The project road engineers and bridge designers have been in ongoing consultation with the authority throughout the development of the scheme included the traffic management and design of the new road bridge. The potential for significant effects on the national transport network are dealt in Chapter 13 of this EIAR. Refer to Chapter 11- Air Quality and Climate, Chapter 12 Noise and Vibration and Chapter 13 Traffic and Transportation.
The Health and Safety Authority	No response was received	N/A
The Arts Council	No response was received	N/A
Fáilte Ireland	A formal pre-application consultation response was issued by Fáilte Ireland. They referred to their Guidelines on the treatment of tourism in Environmental Impact Statement.	The potential effects on tourism are dealt within the scope of this EIAR in the appropriate individual chapters, i.e. tourism and recreational is dealt within in a number of chapters depending on the impact identified i.e. human health, landscape, visual, cultural heritage, angling, business and amenity values

Consultee Name	Key Responses	Comment
Heritage Council	No response was received	N/A
Marine Institute	No response was received	N/A

Source: Mott MacDonald 2018

Following the scoping process and a review of the baseline information gathered for the study area, several scheme refinements from the OPW outline design were proposed. Such 'embedded' mitigation is evident in the high level of ecological and environmental consideration given to the design of the proposed scheme as well as the proposed construction approach for the Enniscorthy Flood Defence Scheme. The key modifications are summarised below;

- The scheme now includes for a compound channel along the river channel. It was found that the proposed by-pass channel through the Bare Meadows had the potential to cause significant direct habitat loss of Alluvial Woodland listed as Priority Annex I habitat and loss of forage habitat on the Bare Meadows;
- The road bridge arrangement has also been revised. Confirmation of the presence of Alluvial Woodland also resulted in the relocation of the road bridge abutments and adjustment of overall elevation and design of the road bridge design, design and junction arrangements onto the N11 and the N30;
- Modifications and refinements to the design of the instream conveyance works to mitigate direct and indirect impacts on the Qualifying Features of the River Slaney SAC;
- Redesign of the Pedestrian bridge to improve accessibly and visual effects of the bridge in the town;
- In response to public feedback, the road level along the Promenade was raised to reduce the height of the wall relative to the footpath level. The scheme also includes the use of additional number of glass panels in this area. The loss of car parking spaces was also refined; and
- Alternative construction process including facilitation of dry works areas and reduction of works areas.

As noted in above section, the development of the proposed scheme process has now been underway for in excess of 12 years. Throughout the preparation of the previous EIS (2009) and EIS addendum (2012) and in preparing the current EIAR the design of the proposed scheme has been revised and refined. The above modifications have also been incorporated into the design of the proposed scheme that is currently assessed in this EIAR. Hydraulic modelling of the proposed scheme was revised to reflect such refinement and modification in the design. The modelling ensured technical acceptability of the proposed scheme. A full description of the proposed scheme and accompanying detail are set out in Chapter 4 of this EIAR.

3.7.1 Consultations

3.7.1.1 EIA Consultation and Stakeholder Engagement

As noted above extensive consultation as part of the scheme development has been undertaken. In 2015, Wexford County Council appointed a Project Resident Engineer for the scheme based in in Enniscorthy. Every effort has been made by the project team to provide relevant information to the public to ensure a thorough understanding of the project and an opportunity for meaningful comment during the scheme development and assessment. The Project Resident Engineer has been engaging with the local landowners, residents, businesses, and interested parties on an ongoing basis and he has provided information on the development and progress of the proposed scheme. The scheme was put on public display in June 2018 and a project website has been established (www.enniscorthyfds.ie). As noted in Section 3.8 above, as part of the project scoping assessment process, consultation with key statutory bodies was reengaged by letter or email in April 2017. Each were invited to comment and provide observations and input into the scope of the EIA. In addition to those listed in Table 3.4,

extensive consultation has also been undertaken since 2015 with NPWS, TII and IFI, The Slaney Trust and Irish Rail to discuss the proposed scheme design elements and the programme and constructability of the proposed works.

3.7.1.2 Public Information Events

As described above, the design for the Enniscorthy Flood Defence Scheme was developed by the OPW in 2009, extensive statutory consultation was undertaken at various stages within the design development. A public exhibition of the proposed scheme was held in Enniscorthy during early 2009. Following the exhibition in response to the issues raised by interested parties, the scheme was refined and revised and an addendum to the earlier EIS was compiled in 2012. The refined scheme was put back on public display in 2012. In 2015, Mott MacDonald and Roughan & O'Donovan were appointed by the OPW to develop the detailed design of the proposed scheme.

Given the lapse in time since the last public information event, a public display event was held in between 11th June and 7th July 2018. The Display was opened by the Minister with responsibility for the OPW, Kevin Boxer Moran. This event was also attended by Minister Paul Keogh, elected members of the Enniscorthy Municipal District of Wexford County Council, officials from Wexford County Council and members of the Enniscorthy Chamber of Commerce. The event was also attended by members of the press.

The Public Display was advertised in the local press and on local radio. Notices were also posted in the Wexford People, Gorey Guardian, Enniscorthy Guardian & New Ross Standard. A radio campaign extended over the same six-week period.

In advance of the Display, advertising Posters & Leaflets were also displayed in public buildings and numerous locations throughout the Town.

Between 11th and 17th June the Display was held in the Athenaeum on Castle Street. Between 18th June and 7th July, the Display took place in Enniscorthy Library.

Information available for the duration of the event included the following:

- Drawings;
- Photomontages;
- 3D Video Flythrough of the proposed scheme;
- Video footage of the 2015 flood event in Enniscorthy;
- Photographs of the 1965 flood event in Enniscorthy;
- Scheme Information Posters & Leaflets; and
- Feedback Forms & Stamped Addressed Envelopes.

All attendees were invited to provide feedback by completing a feedback form and returning this to the team. The display was attended by approximately 400 people and was generally well received. Attendees at the event raised the following key concerns:

- Concerns on the height of the proposed wall along the Promenade;
- The potential loss of car parking; and
- The potential impact that the proposed scheme would have on traffic flows in the future.

Figure 3.22: Public Display Boards

Source: Mott MacDonald 2018

Figure 3.23: Public Display Boards

Source: Mott MacDonald 2018

In response to the feedback provided, the design of the scheme was refined. The road level along the Promenade was raised to reduce the height of the wall relative to the footpath level. The scheme also includes the use of additional number of glass panels in this area.

The loss of car parking spaces was also readdressed. The loss of a number of parking spaces along Abbey Quay is now being partially offset by additional parking being provided at Abbey Square (14 no. additional spaces). 5 spaces will be retained along Abbey Quay in front of the commercial premises. The loss of car parking on Shannon Quay is limited to the 2 spaces on the river side of the road immediately adjacent to The Old Bridge. The remainder of the car parking along Shannon Quay is to be retained.

In terms of concerns raised relating to the traffic management in the Town, traffic management solution as part of this scheme is discussed in detail in Chapter 14 of this EIAR.

3.7.1.3 The Proposed Enniscorthy Flood Defence Scheme Development

Since the Public Display held in 2012, the scheme design has been refined and updated, in addition, the EIA Directive (2014/52/EU) has subsequently been amended. Therefore, it was determined that the scheme environmental impact assessment would be reviewed and updated appropriately. At the time of writing this EIAR, the transposition of the new EIA Directive has yet to be transposed into Arterial Drainage or Flood Risk Regulations however they have been transposed by the Department of Housing, Planning and Local Government into the Planning and Development Regulations (2018) This EIAR has been updated to consider the key changes to the EIA Directive as within the Planning and Development Regulations (2018) and the EPA draft Guidelines.

Table 2: Approach to EIAR requirements as set out in the Annex IV EIA Directive 2014/52/EU

Requirement	Approached in EIAR
Description of the project	This is address in Chapter 4 and further detail on the proposed construction methodology is summarised in the project CEMP in Appendix A
Description of reasonable alternatives	The development of the proposed scheme process has now been underway for in excess of 12 years. The development of the scheme and environmental evaluation of the reasonable alternatives was carried out and have been summarised in Chapter 3 of this EIAR. A copy of the Royal Haskoning 2009 Chapter 3 is also provided in Appendix B.
Description of relevant aspects of the current state of the environment (Baseline Scenario) and outline of the likely evaluation thereof without implementation of the project	The description of baseline environment as relevant to environmental topic is addressed in Section 3- Receiving Environment of the respective environmental topics of this EIAR

Requirement	Approached in EIAR
A description of factors specified in Article 3 (1) likely to be significantly affected by the project - Population - Human Health - Biodiversity - Land - Soil - Water - Air - Climate - Material assets - Cultural heritage including architectural and archaeological - Landscape - The interactions between factors	Each topic is addressed in the approach section of this EIAR. Refer to Table of Contents Chapter 5 Population and Human Health, land is addressed in this Chapter in the context of land use. Human health is also addressed under various topics through which effects on human health could be caused. E.g. air quality, climate, noise and vibration, traffic etc. Chapter 6 Biodiversity Chapter 7 Hydrology and Geomorphology Chapter 8 Geology and Soils Chapter 9- Landscape and Visual Chapter 10- Archaeology, Architecture and Cultural Heritage Chapter 11 Air Quality and Climate Chapter 14- Material assets. Land is addressed here in the context of availability of lands for the proposed scheme. Chapter 15- Interactions between topics
Description of likely significant effects on the factors listed in Article 3(1).	The description of likely significant effects on each relative environmental topic are addressed in Section 4 of the respective Chapter of this EIAR.
Description of the forecasting methods or evidence used to identify and assess the significant effects on the environment	The methodology used is set out in the relevant environmental topics. Any areas of gaps in knowledge were scoped and necessary information and evidence was provided and addressed in the appropriate environmental topic
Risks from vulnerability of the project from major accidents and/disasters	This is considered in the development of the scheme design and construction approach. It is set out in Chapter 4 and 5 of this EIAR. This EIAR also takes into account any potential vulnerability of the project to risks of major unforeseen events or disasters. These are considered in the design of the project and where appropriate, regard is provided in individual Chapters
Description of measures and monitoring arrangements envisaged	Substantial mitigation by avoidance and reduction has been achieved through the consideration of alternative sites and design solutions and processes. As described in Chapter 3. Mitigation measures that have been defined for each environmental topic are set out in the individual Chapters of this EIAR. These mitigation measures relate to both the construction and operational phases of the project. The mitigation measures and where appropriate proposed monitoring are set out in the relevant environmental topic in this EIAR.
EIA Quality/ Competent Expertise	The team of specialist contributors of this EIAR are all appropriately qualified, experienced and experts in their respective fields. These contributors are set out in Chapter 2 of this EIAR.
A non-technical summary	This is provided as a separate summary to this EIAR

4 Description of the Proposed Scheme

4.1 Introduction

The proposed scheme that is assessed in this EIAR includes works which improve flow conveyance, and containment measures to prevent flooding in Enniscorthy Town. The proposed scheme also contains several localised measures including: the removal of Seamus Rafter Bridge and construction of a replacement bridge downstream of the Riverside Park Hotel and the construction of a new pedestrian bridge in the town. The design as presented in this report has been developed in sufficient detail to confirm the positions and dimensions of all of the principal elements including the earthworks, structures, road pavements, and drainage.

The locations of the proposed works are illustrated in the accompanying drawings found in Appendix A (Ref: 355741-MMD-00-XX-DR-N-0400 to Ref: 355741-MMD-00-XX-DR-N-0406). The proposed scheme features, and layout are described based on the type of works proposed, and these are then broken down into discreet sections of the river, running from upstream (River chainage[2] 6900) to downstream (River chainage 3800).

Due to the complexity and the wide range of features proposed over the scheme, this chapter has been structured as follows to consider the following key design themes: increase conveyance measures, flood defences, and bridge and associated traffic management arrangements. The remaining Section 4.5 deal with the Construction, Operation and Maintenance of the Proposed Scheme:

- **Section 4.2**- Increase Conveyance;
  - River Dredging
  - River Widening /infilling including a new Compound Channel
  - Instream works including Flow deflectors, Instream Sediment Trap, Debris Trap
  - Permanent Deposition Zone
  - Restoration of North Island Back Channel
- **Section 4.3-** Flood Defences;
  - Flood Protection Walls
  - Glass-Wall Flood Protection Walls
  - Raising Roads/Ground Levels
  - Underpinning of the Enniscorthy Railway Bridge and Old Bridge
  - Stormwater Pumping Stations
  - Access to the River Banks
- **Section 4.4**- Bridges and associated Traffic Management Arrangements;
  - Seamus Rafter Bridge Removal and Construction of a new Road Bridge
  - Traffic Management
  - Road Bridge Drainage
  - New Pedestrian Bridge in the Town
- **Section 4.5**- Construction, Operation and Maintenance of the Proposed Scheme
  - Incorporated Environmental Control measures imposed on during the construction process;
  - Construction Programme and Sequencing of Proposed Works;

[2] River Chainage- A horizontal distance used to establish a plan of the river length between the upstream extent of the scheme to the downstream extents of the scheme.

- Description of the Construction Overview;
- Temporary Construction Works Facilities;
- Construction Access and Traffic Movements;
- Preventions for controlling spread of Non-Native Invasive Species; and
- Operations and Maintenance of the Proposed Scheme.

4.2 Increase Conveyance

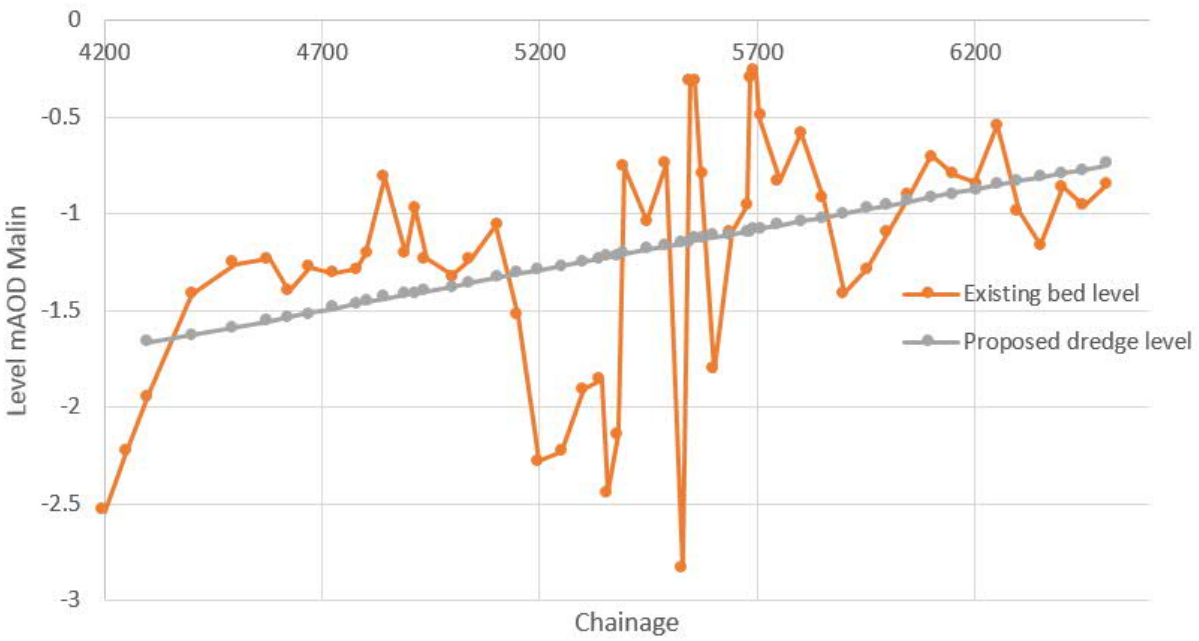
4.2.1 River Dredging

A key part of the scheme involves dredging (deepening) and/or widening and filling along various sections of the river in and adjacent to Enniscorthy Town. These river works are necessary to improve the conveyance of water and reduce flood water levels which reduces the height of the flood defence walls which will be required. The river bed will be reinstated with some variability, to enable river bed habitats to develop over time following the completion of the works.

A profile of the minimum bed levels from the River Urrin to 1.2km upstream of Enniscorthy is provided in Figure 4.1. It can be seen in the figure below, currently the existing minimum bed for approximately half of the proposed works length is between 0.25 and 1.5m lower than the Design Bed Level while the remainder bed levels will need to be deepened by approximately 0.25m to 0.8m to achieve the Design Bed Level.

The proposed works will form a river bed that falls 1.25m over a river length of 3km. The river dredging works will commence approximately 1km upstream of Enniscorthy Town (chainage 6600) and will continue to where the Urrin joins the Slaney (chainage 4400). This is a total length of 2.2km. An area of the east side of the channel downstream of Seamus Rafter Bridge, at river chainage 5556 to river chainage 5125, is below the design bed levels and is therefore does not require dredging.

Figure 4.1: Profile of Minimum Bed Levels from river chainage 4200 to river chainage 6150 upstream of Enniscorthy town (along the centreline of the channel)



Source: Mott MacDonald

4.2.2 River Widening/Infilling

4.2.2.1 River Widening

The location of the proposed river widening works are shown on the accompanying drawings provided in Appendix A (Ref: 355741-MMD-00-XX-DR-N-0400 to Ref: 355741-MMD-00-XX-DR-N-0406).

River widening serves three functions, it:

- Reduces flood levels at Island Road;
- Facilitates the construction of the flood defences on the western extent of channel at the back of Island Road; and
- Reduces the flow velocities downstream of the railway bridge.

The proposed river widening works will generally comprise three different approaches which are carried out in consideration of the bank conditions encountered. These approaches are noted as Type 1, Type 2, and Type 3. Typical cross sections of each type are shown in Figure 4.7. The extent and nature of widening/infilling works are illustrated in the accompanying drawings provided in Appendix A and summarised in Table 4.1.

Table 4.1: Approximate Location of River Channel Works

Approximate Chainage	Location	Length of Bank Widening/Fill	Details
6785-6670	Eastern Extent (Left Bank of River) North Island	128m	River Widening Type 3
6670-5735	Eastern Extent (Left Bank of River) North Island	843m	River Widening Type 1
6125-5750	Western Extent (Right Bank of River) Island Road	392m	Bank In-fill Works
5710-5556	Eastern Extent (Left Bank of River) Leisure Centre	154m	River Widening Type 2
5735-5556	Western Extent (Right Bank of River) Island Street	183m	River Widening Type 3
5544-5500	Western Extent (Right Bank of River) Abbey Quay below Enniscorthy Br.	36m	River Widening Type 2
5375-4893	Western Extent (Right Bank of River) The Promenade	480m	River Widening Type 2
5180-4930	Eastern Extent (Left Bank of River) Wexford Road	255m	River Widening Type 3
4930-4765	Eastern Extent (Left Bank of River) West of Wexford Road	164m	River Widening Type 2
4765-4100	Eastern Extent (Left Bank of River) West of Wexford Road	620m	River Widening Type 1
4200-3830	Western Extent (Right Bank of River) At WWTP	347m	River Widening Type 1
3915-3750	Eastern Extent (Left Bank of River) At Hospital	172m	River Widening Type 1

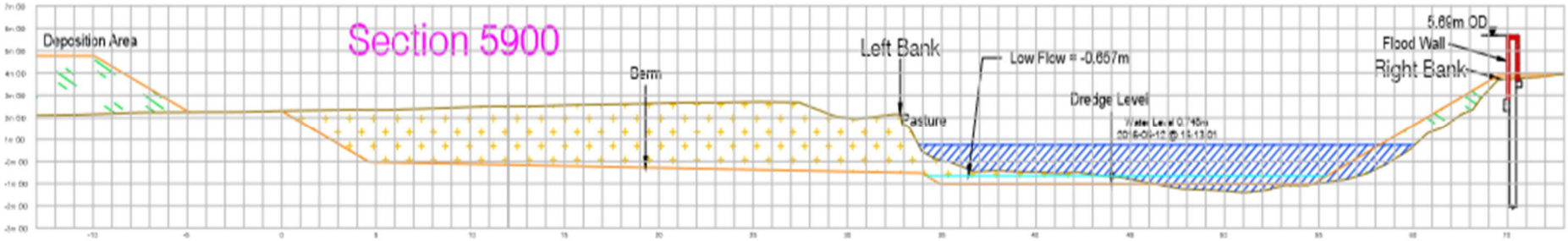
Source: Mott MacDonald, 2017

The eastern extent of the river will be widened from river chainage 6785 to 5725 immediately upstream of the Railway Bridge. The channel will be widened by between 7m and 33m in width. A new Sand Martin nesting wall will be constructed along this reach of the bank.

River widening is also proposed on either side of the river channel between the Railway Bridge and the Enniscorthy Bridge at river chainage 5690 to 5556. The channel on the western side of the river will be widened by between 2 and 4.5m, and the channel of the eastern side will be widened by between 6 and 9m. The river widening will continue downstream of the Seamus Rafter Bridge on the western side of the river chainage 5356 to the Riverside Park Hotel at river chainage 4960. The widening will be between 2.5m and 14m.

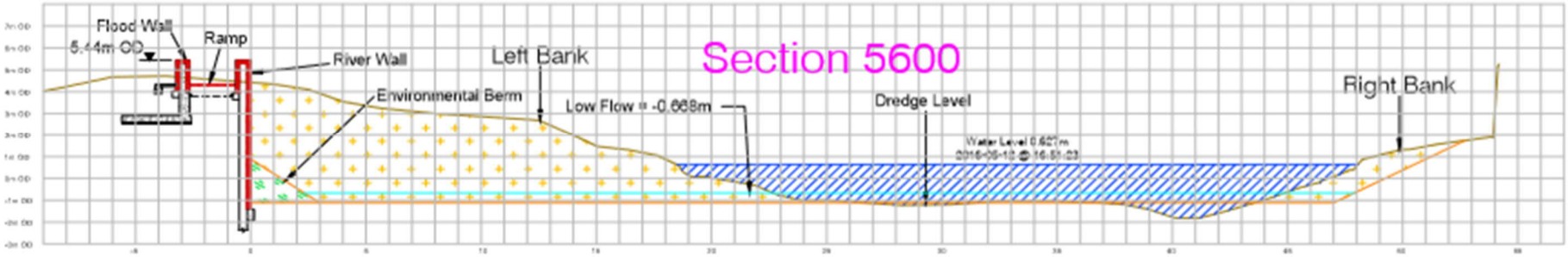
Downstream of the confluence between the Slaney and the Urrin widening will take place on the eastern bank between river chainage 4200 and 3850.

Figure 4.2: Typical Cross Section at River Crossing 5900 (upstream of the Rail Bridge)



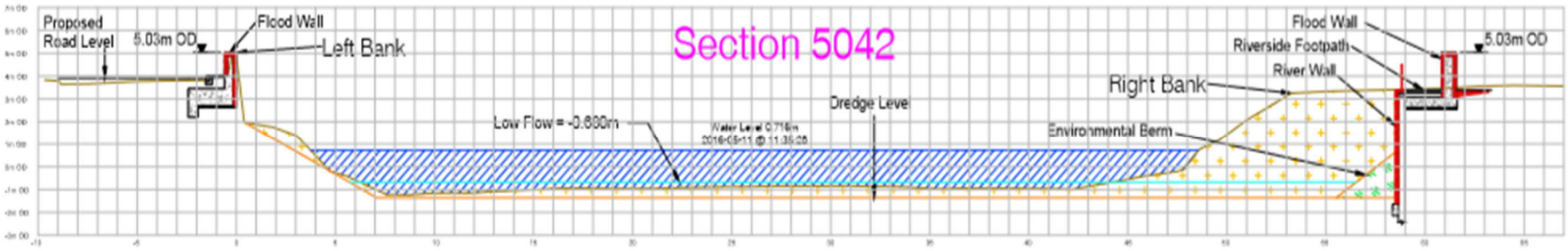
Source: Mott MacDonald 355741-MMD-00-XX-DR-N-0410

Figure 4.3: Typical Cross Section at River Crossing 5600 (upstream of Enniscorthy Bridge)



Source: Mott MacDonald 355741-MMD-00-XX-DR-N-0411

Figure 4.4: Typical Cross Section at River Crossing 5042 (upstream of the Riverside Park Hotel)

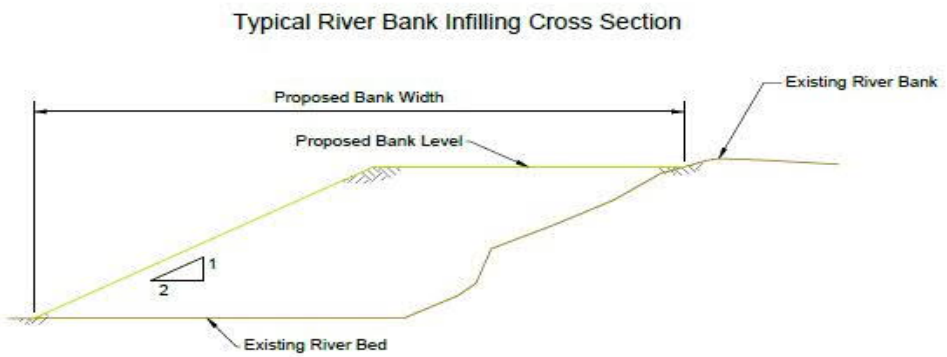


Source: Mott MacDonald 355741-MMD-00-XX-DR-N-4012

4.2.2.2 River Infilling

River infilling is proposed on the western side of the river upstream of the Railway bridge between river chainage 5775 to river chainage 6175 (approximately 400m). The location of the proposed works is shown on the accompanying drawings provided in Appendix A. The infill works would result in approximately 3900m^3 of river being infilled. Where possible, material excavated within close proximity will be reused to infill the channel at this location.

Figure 4.5: Typical River Bank Infilling Cross Section

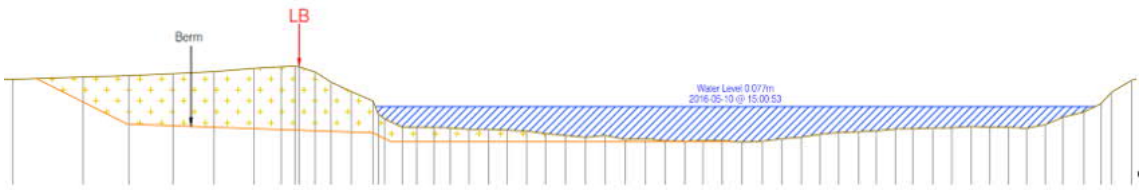


Source: Mott MacDonald

4.2.2.3 Bare Meadows Compound Channel

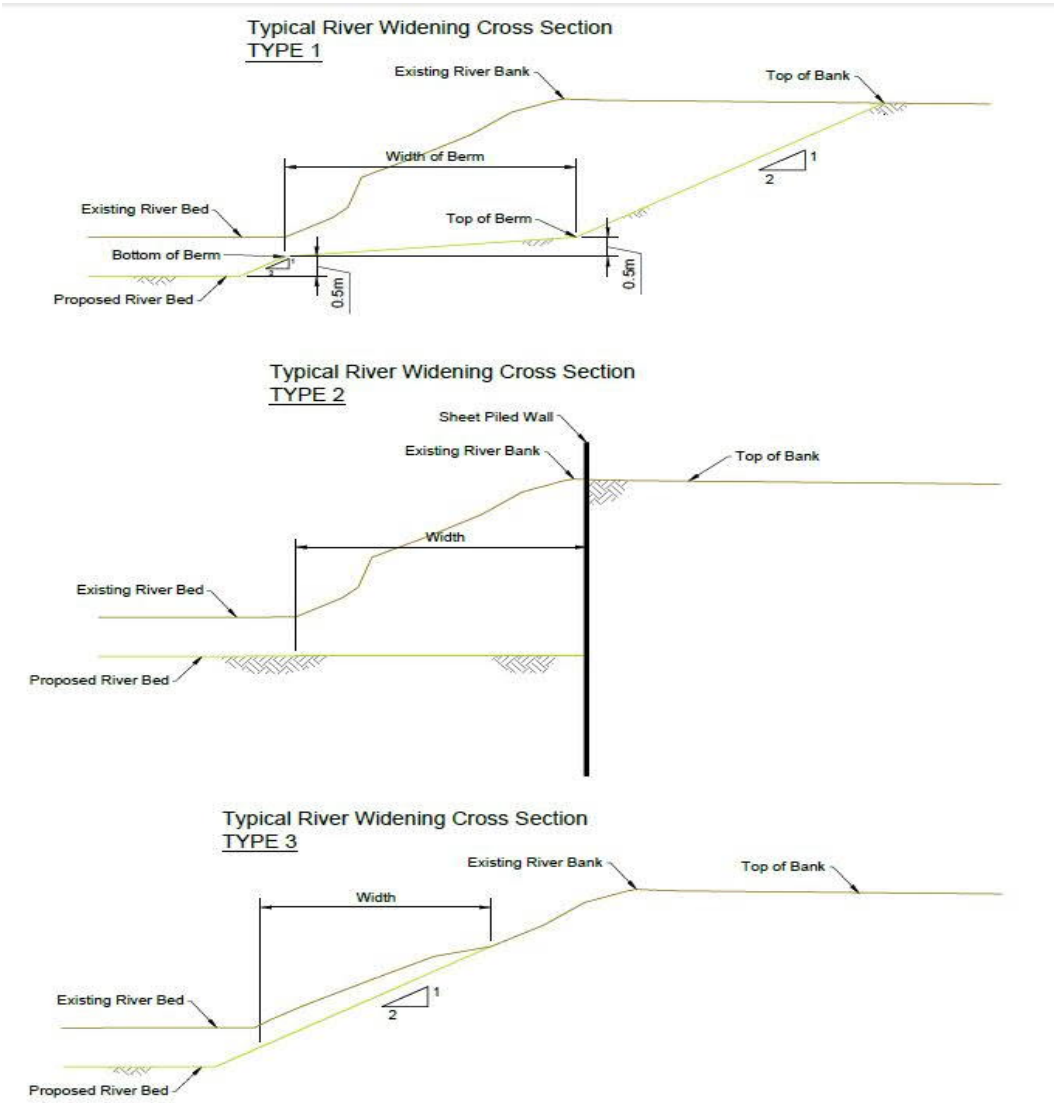
A two-stage, or a Compound Channel, will extend along the eastern side of the bank of the river downstream of the proposed road bridge along the Bare Meadows. The channel will run south for approximately 940m. The main channel will be between 0.5m and 1.4m below existing river bank level. A typical cross section of the proposed channel is illustrated in Figure 4.6 below. The compound channel consists of two parts: the main channel and the overflow. The overflow will only convey water during periods of high flow. The purpose of this channel is to convey additional flow during a flood scenario than the existing channel while not reducing the low flow depth of the River Slaney during low flow conditions. The proposed riparian edge will be reprofiled in consultation with the Environmental Clerk of Works (EnCoW) and NPWS to match the general physical and vegetative characteristics which currently exists.

Figure 4.6: Typical Cross Section of the proposed Bare Meadows Compound Channel



Source: Mott MacDonald

Figure 4.7: Typical River Widening Cross Sections



Source: Mott MacDonald 2017

The locations of the river channel widening works are set out in Table 4.1 above.

4.2.3 Instream Works

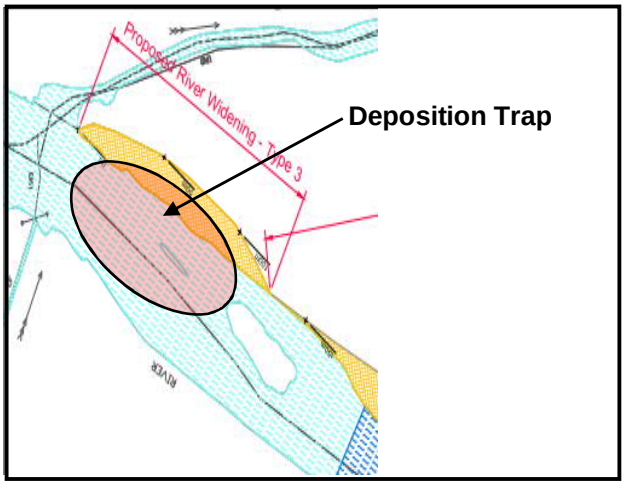
4.2.3.1 Flow Deflectors

Following consultation with Inland Fisheries Ireland (IFI) a series of flow deflectors and reprofiling of the river bed to create favourable flow conditions for invertebrates and fish are proposed within the River. These deflectors will be positioned approximately 200mm above the design bed level. Indicative locations for these deflectors are shown in the accompanying drawings provided in Appendix A (Ref 355741-MMD-00-XX-DR-N-0400 to Ref: 355741-MMD-00-XX-DR-N-0406). Reprofiling will be carried out as part of the Instream rehabilitation / enhancement programme. This programme will be carried out in consultation with the EnCoW and IFI. Refer to Chapter 6 for further details on the specific ecological mitigation measures proposed, these include retaining undisturbed margins, reprofiling with suitable sediments.

4.2.3.2 Instream Sediment Trap

Through the town the river is a low to moderate energy system. Due to the depositional nature of the river at this stage there is a risk that on-going dredging would be required. To mitigate this risk the proposed scheme includes the construction of a sediment deposition zone or trap at the upstream end of the scheme. There is an existing mid-channel gravel bar on the north island (river chainage 6750), which has formed in an area where the existing channel is approximately 10m wider than the existing channel immediately up and downstream. The gravel bar is partly vegetated, which indicates that it is quite stable. The shape of the bar is approximately 30m long and 3m at its widest, with deep and quite fast water flowing on both sides. These features indicate that the bar has grown by deposition length-ways, and there is potential to increase deposition by further channel widening. It is proposed to accentuate this natural process by further widening the channel to create a gravel trap. This area will encourage much of the sediment arriving from upstream to be deposited, greatly reducing the requirement for future dredging within the town. Sediment removal from the deposition zone will be achieved from the east bank of river only and it will be undertaken in dry working conditions. The design of the sediment trap eliminates the need for regular maintenance dredging of the entire reach of the river channel in Enniscorthy. Figure 4.8 below illustrates the location and design of the sediment depositional trap. The trap is located upstream of the Town adjacent to the North Island.

Figure 4.8: Location of the proposed Instream Sediment Depositional Trap Design (Type 3 Widening)

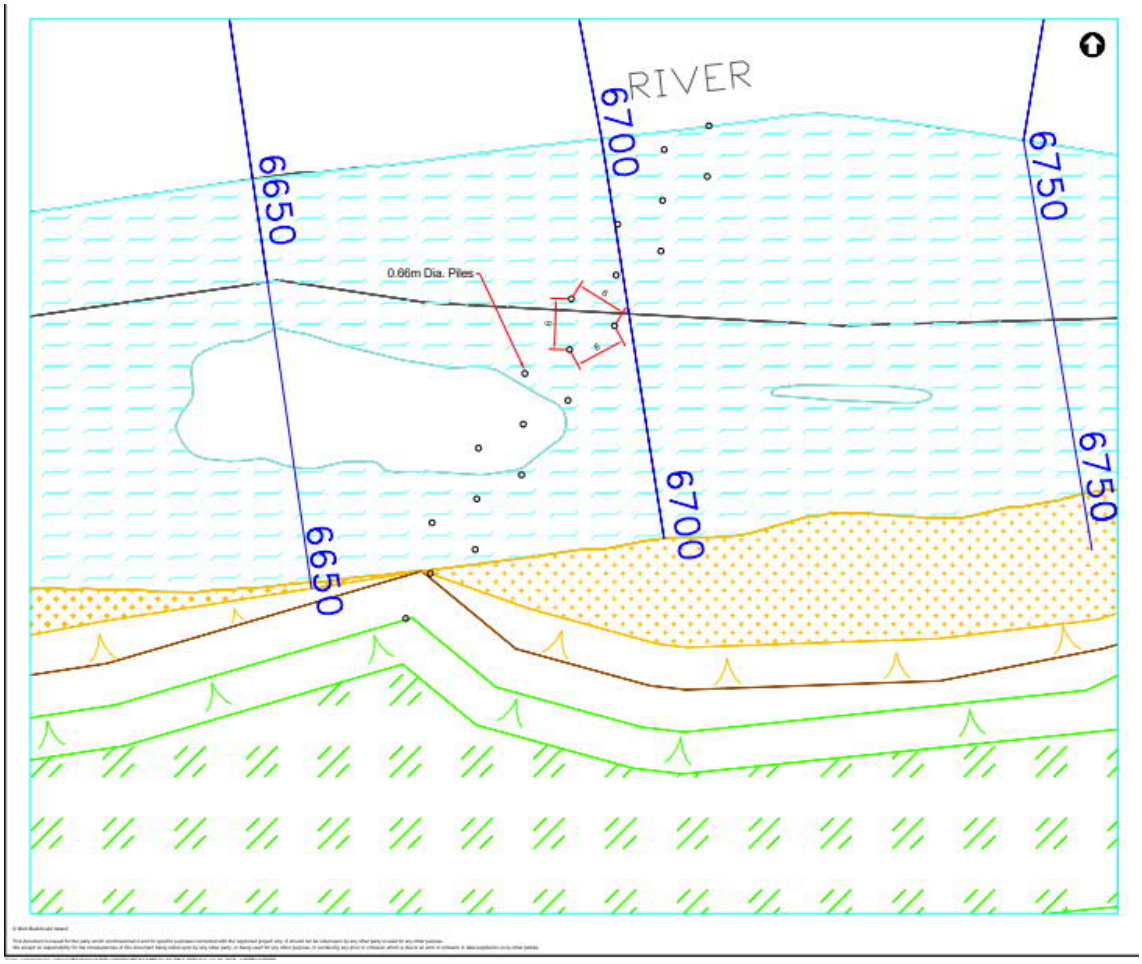


Source: Mott MacDonald 2016

4.2.3.3 Instream Debris Trap

The proposed scheme design includes construction of a debris trap upstream of the bridges at river chainage 6620. The location of the trap is illustrated in Figure 4.9. The purpose of the debris trap is to trap large floating debris i.e. trees, that could block the openings of the Rail Bridge or the Old Bridge in Enniscorthy. Trapped debris will periodically be removed as required by a long reach excavator from the river bank on the North Island.

Figure 4.9: Proposed Design for the Proposed Debris Trap



Source: Mott MacDonald 2017

4.2.4 Permanent Depositional Zone

The calibration process of the numeric model showed that a considerable amount of floodplain flow takes place on the North Island. The numeric model noted that following an extreme flood event this floodplain flow re-entering the river upstream of the Railway bridge, at an almost right angle to the river, greatly reduces the river's flow capacity.

A small proportion of the material excavated through dredging and river bank widening may be used to construct the proposed embankment at Island Road but most of the material excavated upstream of the existing Seamus Rafter Bridge will be transported via the dry works haul route upstream to the North Island where it will be deposited. To facilitate the permanent deposition of material on the North Island, topsoil from the designated area will be removed in a phased

approach and placed in temporary stockpile. Depositional material will be placed on exposed subsoil and compacted in layers. Topsoil will be reinstated, and the area will be rotovated and reseed. The deposited material will be set back approximately 5m from the proposed river bank.

4.2.5 North Island Back Channel Restoration

A key ecological benefit of the proposed scheme is the proposed restoration of the North Island Back Channel. It is apparent from historical mapping that this was previously a functional distributor channel, however it has silted up and is dry in some sections and in other is contains stagnant or very low flow water. Currently it is only in high flow conditions that water exits the main channel and flows in the back channel. The proposed reprofiling will encourage water to exit the main channel but the flow will be controlled by a flow control structure at the head of the channel. The proposed back channel will cater for minimum 5% of ambient flow in the existing main channel of the River Slaney c. 0.24m^3/ s at 95%ile flow; c. 1.55m^3/s at mean flow. The proposed channel is approximately 945m long and flows from north-east to south-west.

The proposed restoration of this channel will provide a rich biodiversity for species and habitats. Care has been taken to identify the benefits and characteristics of naturally functioning rivers and these characteristics have been applied to the design of the proposed Back Channel.

The channel design will create River/Brook Lamprey ammocoete and spawning habitats. The channel will also be utilised by salmonids and other fish species and it will benefit bats, birds and otters. River lamprey are also likely to migrate through this channel once constructed. The design of the channel has also ensured that this channel is not an alternative to the main River Slaney flow rather will create an interesting habitat that may also be used.

The design of the channel has been undertaken in collaboration with the project ecologist. in accordance with the River Restoration Centre “Manual of River Restoration Techniques” and the extent and nature of restoration works are illustrated in the accompanying drawings found in Appendix C.12. Some of key design features proposed on the channel are summarised below;

- Meanders to replicate the natural flow of a river which promotes oxygenation and ensures a good range of flow currents, substrates and banks forms are sustained throughout the year;

  The proposed banks will be formed with a gentle slope and root wads and brushwood mattresses will be installed as bank protection measures as required;
- Fencing will be installed to further protect the banks from erosion and it will be at least 5m back from the channel;
- New tree planting will also aid in holding banks together and reduce the potential for erosion of banks;
- 3no. fish refuges at approximately 310m, 627m and 730m downstream of the exit from the main channel have been encompassed in the design;
- 5no woody deflectors to provide a barrier to the main channel behind which silt will deposit to create suitable lamprey ammocoete habitat. The flow deflectors will also provide variations in flow that will last all year round;
- 2 no. spawning areas will be designed specifically for lamprey and Salmonid;
- A rock armouring control structure will be constructed at the upper extent of the back channel; and
- An island feature will create interesting habitat that may be used by otter and bats or birds foraging and commuting along the channel.

Full details on specific design characteristics of the Back Channel are provided in Chapter 6-Biodiversity in this EIAR.

4.3 Flood Defences

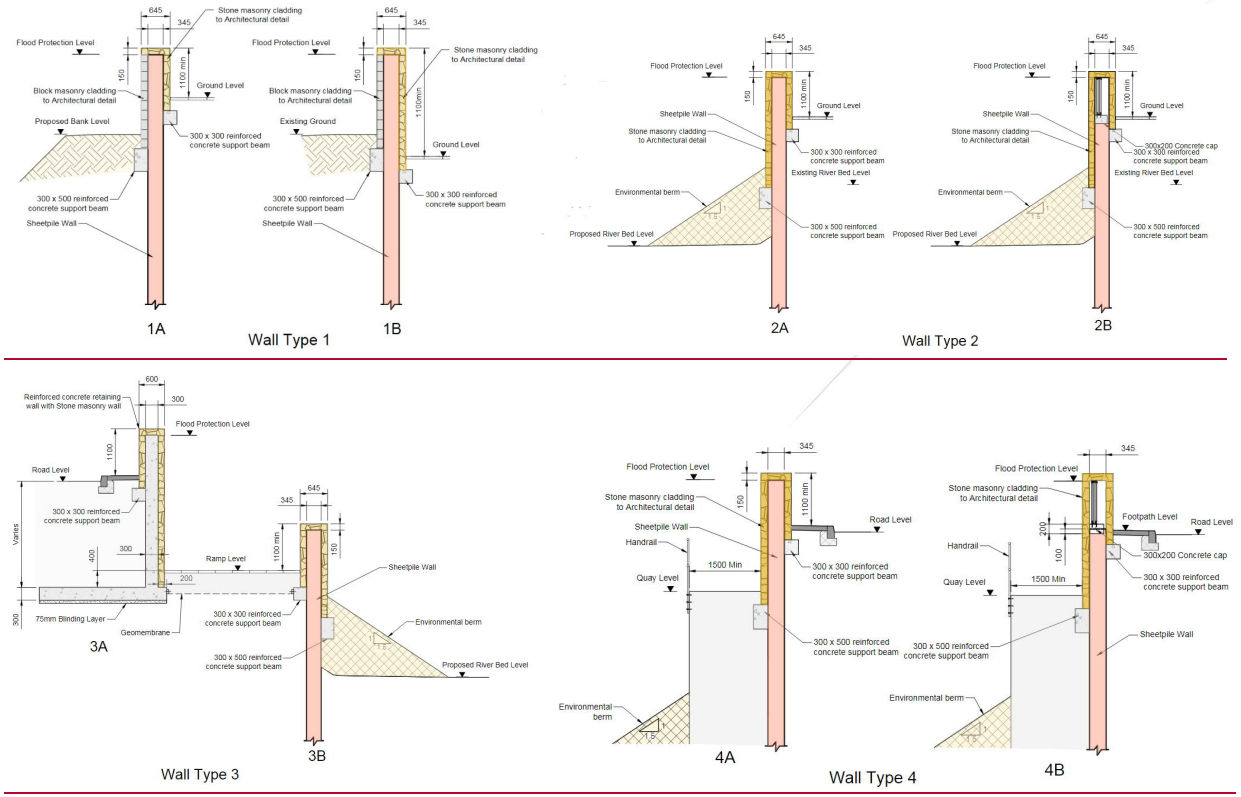
4.3.1 Flood Protection walls

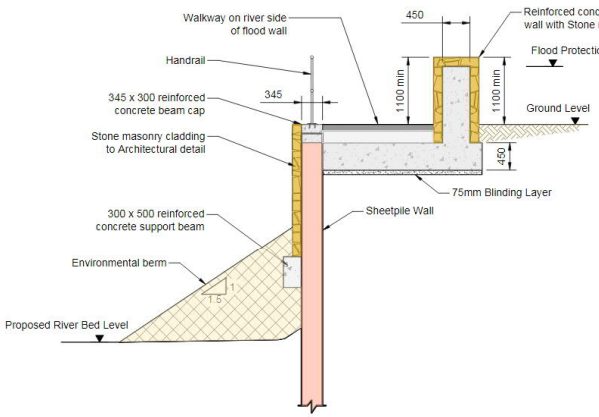
The proposed scheme includes the construction of new flood walls within Enniscorthy Town. The location and extent of the walls are illustrated in the accompanying drawings found in Appendix A. A summary of the proposed works is provided in Table 4.2 below.

Table 4.2: Summary of proposed flood defences

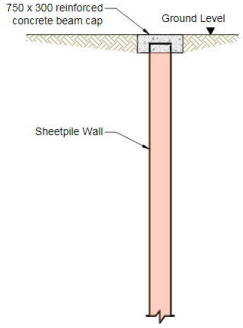
Approximate Chainage	Location	Length of Wall	Details	Top of wall Levels (mOD)
6089-5740	Western Extent (Right Bank of River) Island Road	355m	Flood Wall to 1.200m above proposed ground level	5.810-5.900
5696	Western Extent (Right Bank of River) Along North Side of Rail Line	56m	Flood Wall ranging from 1.330m to 1.230m above existing ground level	5.630
5682	Western Extent (Right Bank of River) Along South Side of Rail Line	54m	Flood Wall ranging from 1.330m to 1.130m above existing ground level	5.630
6000-5750	South side of train station	164m	Flood wall ranging from 0.22m above existing ground level to 0.42m below existing ground level	5.490
5530-4893	Western Extent (Right Bank of River) Enniscorthy Bridge to South end of Hotel	626m	Flood Wall ranging from 0.330m to 2.192m above existing ground level. 61.5m of 1.25m high Glass Wall Panels on Abbey Quay (Approx. River Chainage 5500-5435). 79m of 1.25m high Glass Wall Panels on The Promenade from Seamus Rafter Bridge down to shopping centre car park entrance (Approx. River Chainage 5365-5295). 15m of 1.25m high Glass Wall Panels on The Promenade (Approx. River Chainage 5240-5220). 15m of 1.25m high Glass Wall Panels on The Promenade opposite Mill Yard Ln (Approx. River Chainage 5115-5100). 30m of 1.25m high Glass Wall Panels on the promenade opposite Riverview Ct (Approx. River Chainage 5080-5050)	5.480-5.152
4980-4885	Western Extent (Right Bank of River) Wall around Hotel	158m	Flood Wall ranging from 0.150m to 2.950m above existing ground level.	3.294-5.500
4980-4875	Western Extent (Right Bank of River) Wall at back of Hotel/along Rail Line	129m	Flood Wall ranging from 0.000m to 2.810m above existing ground level.	4.350-5.152
5544-4930	Eastern Extent (Left Bank of River) Enniscorthy Bridge - Wexford Road	662m	Flood Wall Ranging from 0.000m to 2.870m above existing ground level.	4.975-5.480

Figure 4.10: Drawing showing typical design on the walls

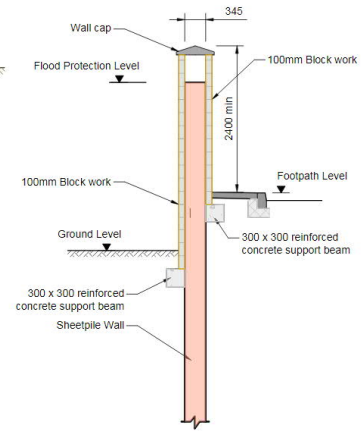




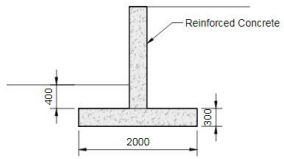
Wall Type 5



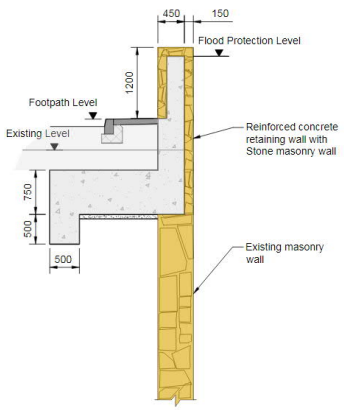
Wall Type 6



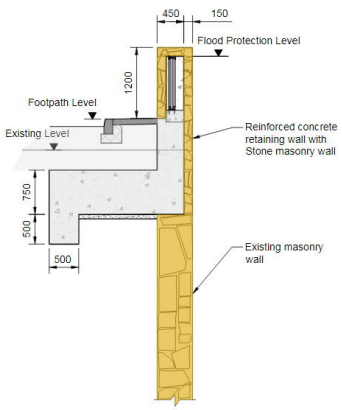
Wall Type 7



Wall Type 10

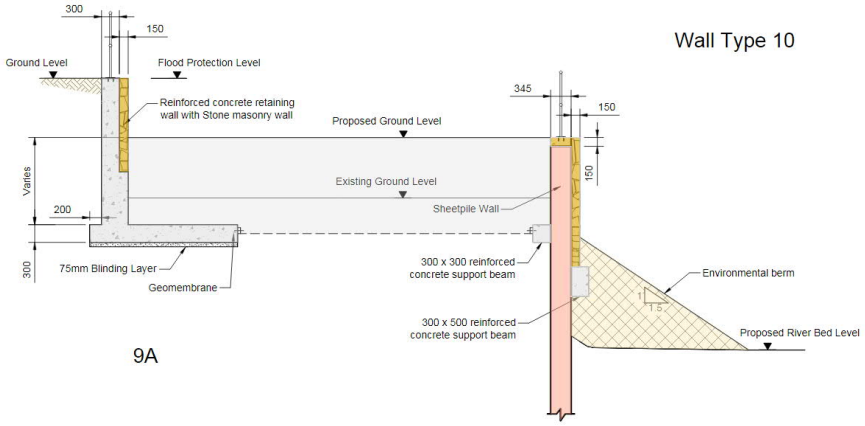


8A



8B

Wall Type 8



9A

9B

Wall Type 9

Source : Mott MacDonald

4.3.2 Glass Flood Protection Walls

To maintain a connectivity with the river, toughened glass panels are proposed to be included in the flood walls at many locations along the quays. The proposed locations are shown in the accompanying design drawings. In total, approximately 500 linear meters of glass panels are proposed:

- Leisure Centre – 30m;
- Abbey Quay – 72m;
- Abbey Square – 85m;
- Shannon Quay – 113m;
- Promenade – 82m; and
- Wexford Road – 118m.

4.3.3 Raising Roads/Ground levels

To maintain the connectivity with the river and curtail the potential visual impact of the proposed flood walls, it is proposed to raise the ground level on the land side of the flood wall at key locations. Along both Abbey Quay and the Promenade, the road and the footpath are proposed to be raised by over 1m. On Shannon Quay and for a section of the Wexford Road immediately downstream of the pedestrian bridge the footpath is proposed to be raised.

The road and footpath around the Riverside Hotel and the carpark at both the Train Station and 'The Bailey Bar & Eatery' are proposed to be raised to form part of the proposed scheme.

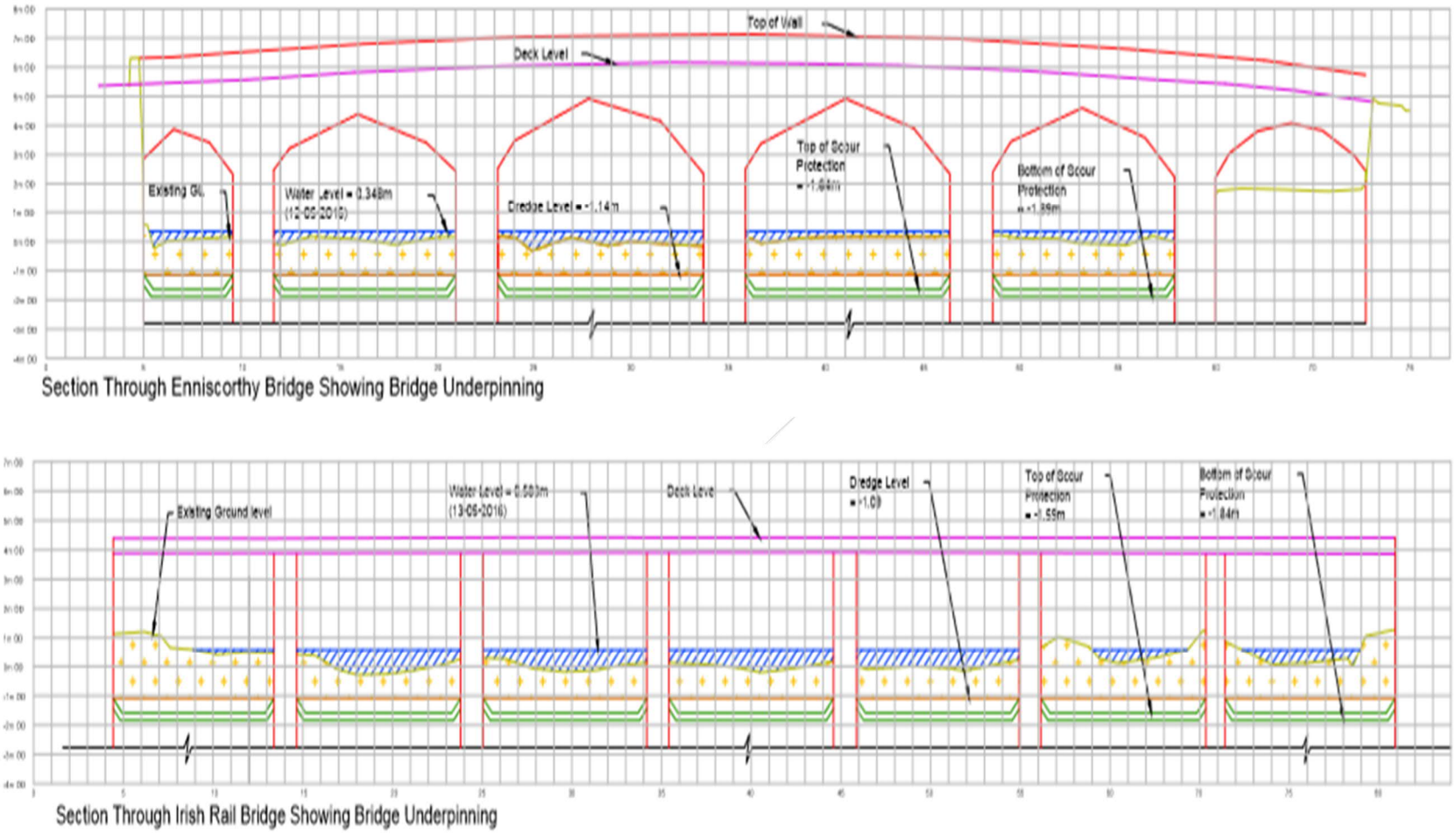
4.3.4 Underpinning works at the Enniscorthy Bridge and Railway Bridge

To ensure the structural stability of the existing bridges following the dredging of the river, interventions are required. The river bed level at these structures is being lowered by 1 - 1.5m exposing the piers and foundations of these structures to possible scour forces during high velocity flow events.

To mitigate this risk, it is proposed to construct concrete scour protection aprons to protect the piers and abutments and prevent high river velocities from scouring the river bed and exposing the foundations of the bridge to damage.

To prevent damage to the habitat within river, it is proposed to set the top level of the concrete apron at a depth of 500mm below the proposed dredge level. Downstream of the apron, a down stand beam of 250mm in depth will be constructed to ensure that scouring forces do not extend under the apron. A section of the west side of each bridge is provided in Figure 4.11.

Figure 4.11: Reprofiling works at the existing bridges

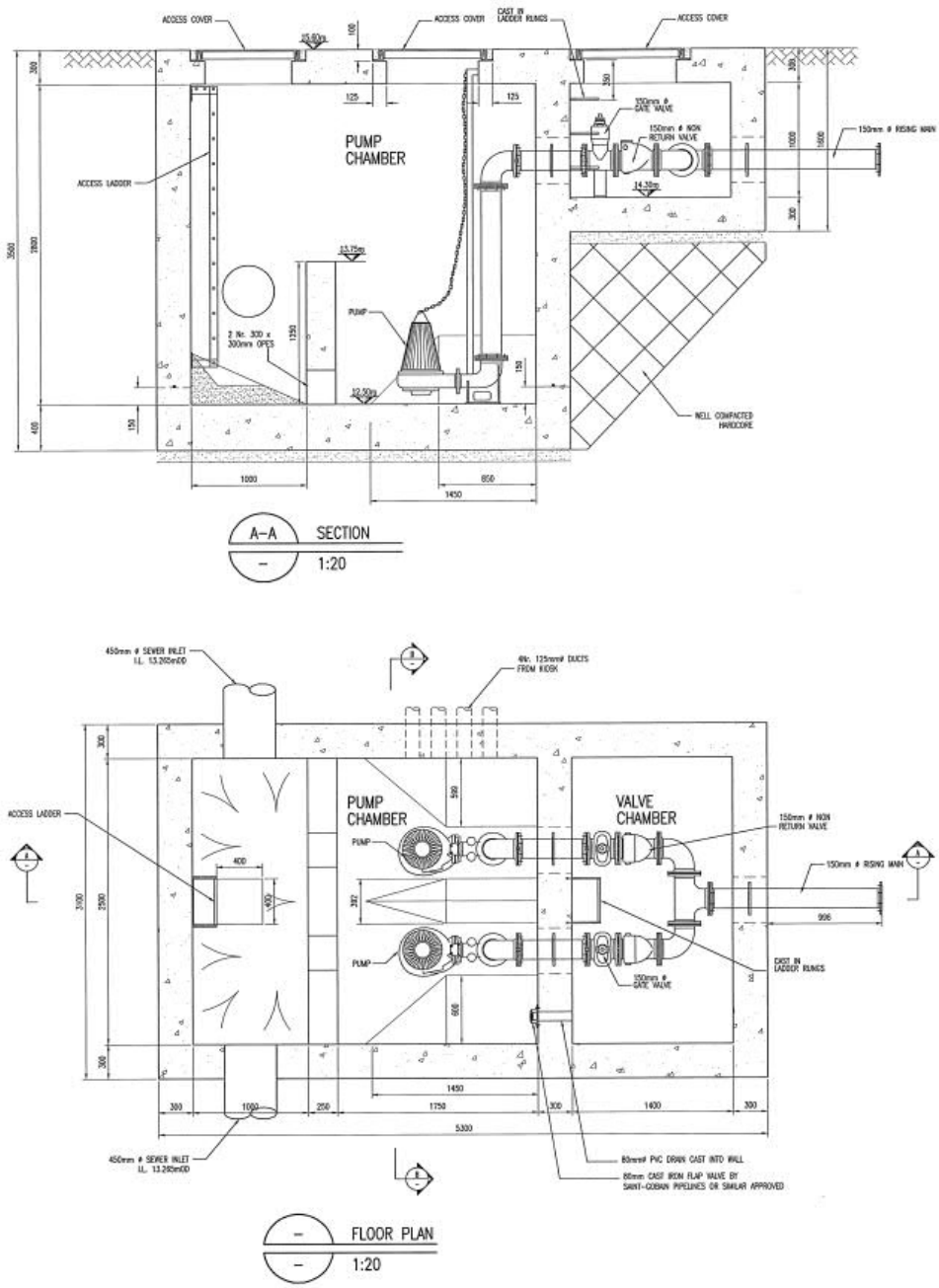


Source: Mott MacDonald

4.3.5 Pumping Stormwater from Behind the Flood Defences

The management of stormwater on the land side of the defence walls is a key component of the scheme. During a flooding event, where existing storm water outfalls are below the flood level the flow through the storm water outfall will be greatly restricted. The network could back up and flooding will occur within the town with the provision of the pumping stations it will not occur. The scheme includes for the provision of 14No. pumping stations, each varying in size due to the various catchment sizes. A typical general arrangement is shown in Figure 4.12. The locations of these stations are set out in the accompanying design drawings found in Appendix A.

Figure 4.12: Typical Pumping Station Design at river chainage 5650 adjacent to the Leisure Centre



Source: Mott MacDonald 2017

4.3.6 Access to the River Banks

The reach of the River Slaney at Enniscorthy is the only fishing on the entire River Slaney that is open to the public. This is a valuable resource and an important amenity for both the town and wider environs. Upstream of Enniscorthy Bridge, there is currently access to the river along both the east and west banks. On the east side of the river, there is access from the swimming pool

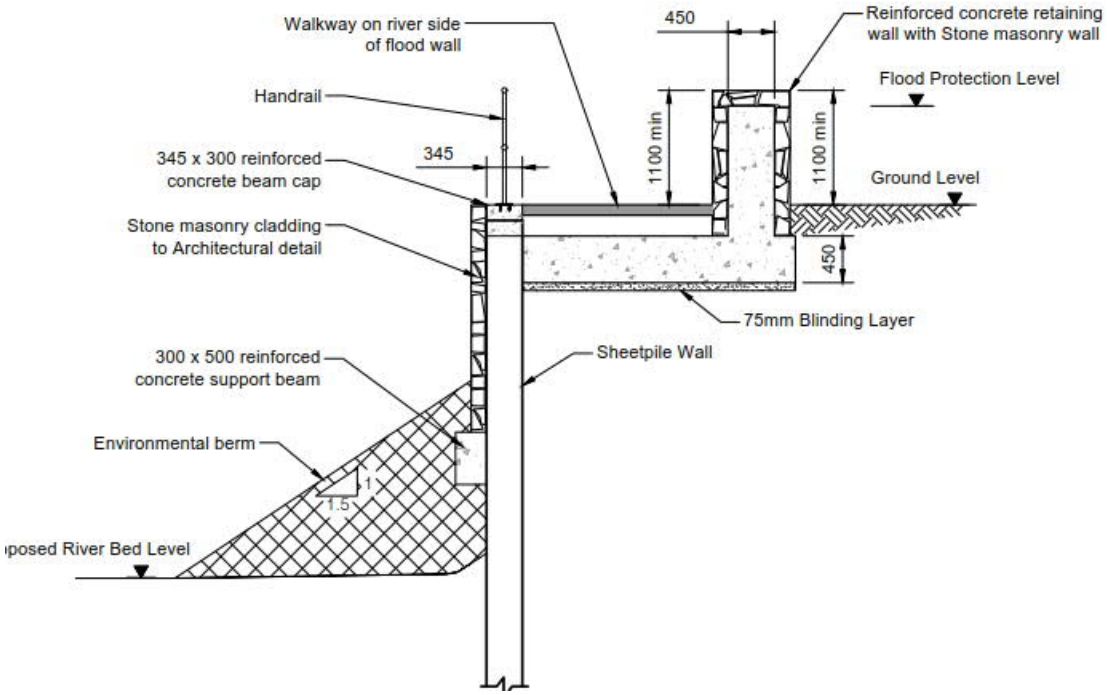
car park and via the dry arch of the bridge. On the west side of the river, there is access to the river bank via steps.

Downstream of Enniscorthy Bridge, there is currently access along both Shannon Quay and Abbey Quay. A ramp immediately downstream of Enniscorthy bridge provides access to the dry arch of the bridge from Shannon Quay. On Abbey Quay there is access from the footpath to the old Quay Wall via steps. At the midpoint of both Shannon Quay and Abbey Quay there are steps from the top of the old Quay walls down to river bed level.

Downstream of Seamus Rafter Bridge access is provided from the footpath down to a narrow river bank by steps on the east side and there is access to the top of the old quay wall on the west side. The proposed scheme maintains direct access to the river within Enniscorthy, and details of the main access points are provided hereunder:

- Upstream of Enniscorthy Bridge a proposed ramp will provide access to the river on the east side and access will be maintained under the dry arch;
- On the west side the existing steps will be maintained;
- Downstream of Enniscorthy Bridge on Shannon Quay the existing ramp will be restricted by the proposed flood wall. However, steps will provide access up and over the flood wall. From the bottom of these steps, fishermen can turn back upstream and under the dry arch or proceed downstream along a 1.5m wide pathway along the top of the old quay wall on Shannon Quay and the existing steps from the top of the quay wall down to the river bed will be retained;
- Downstream of Enniscorthy Bridge on Abbey Quay proposed steps, similar to the existing steps, will provide access from footpath level to a 1.5m wide pathway along the top of the old quay wall. The existing steps from the top of the old quay wall to the river bed will be retained;
- The new proposed bridge provides a direct means of pedestrian access from the bridge to the riverside walk on the west bank of the Slaney with the existing ramp access to the north of the bridge to the N30 also providing access from the N30 to the riverside;
- The proposed bridge cross section provides facilities for pedestrians and cyclists to cross between the N11 and N30;
- Downstream of the new footbridge on the east side of the river, it is proposed that stepped access very similar to the existing steps will provide for direct access from footpath level to the river; and
- On the Promenade, a riverwalk on the river side of the flood wall will maintain a connection with the river and will facilitate angling. Details of this arrangement on the Promenade is shown on Figure 4.13.

Figure 4.13: River widening cross section on the Promenade from the existing slip to Riverside Park Hotel (River chainage



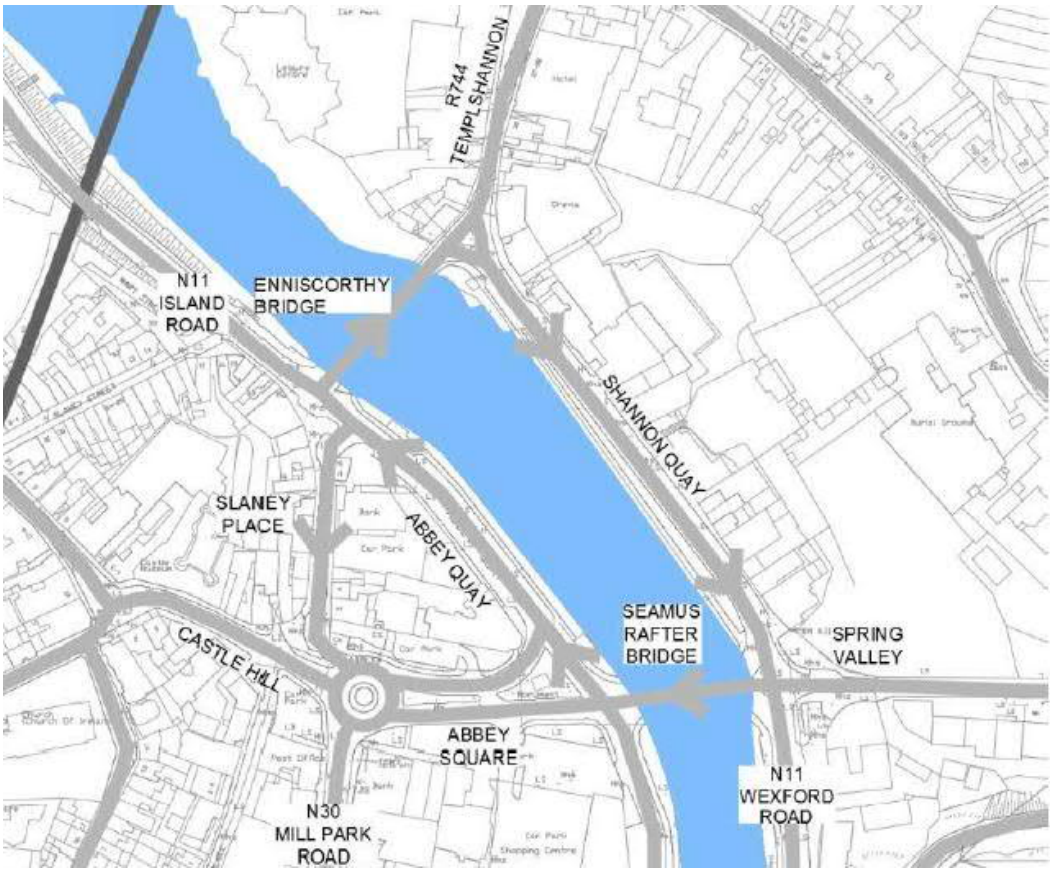
Source: Mott MacDonald 2017

4.4 Bridges and the Associated traffic Management Arrangements

4.4.1 Seamus Rafter Bridge Removal and Construction of a New Road Bridge

Enniscorthy is located along the current N11 National Primary road which is the main road connecting Dublin and Wexford Town. Several other strategic roads intersect the N11 in Enniscorthy, including the N30, the R702 and the R744. Other important local roads include Spring Valley, and the R890 Convent Road. An overview of the existing road network within Enniscorthy is provided in Figure 4.14.

Figure 4.14: Road Network within Enniscorthy



Source: ROD, Traffic Modelling Report, 2016

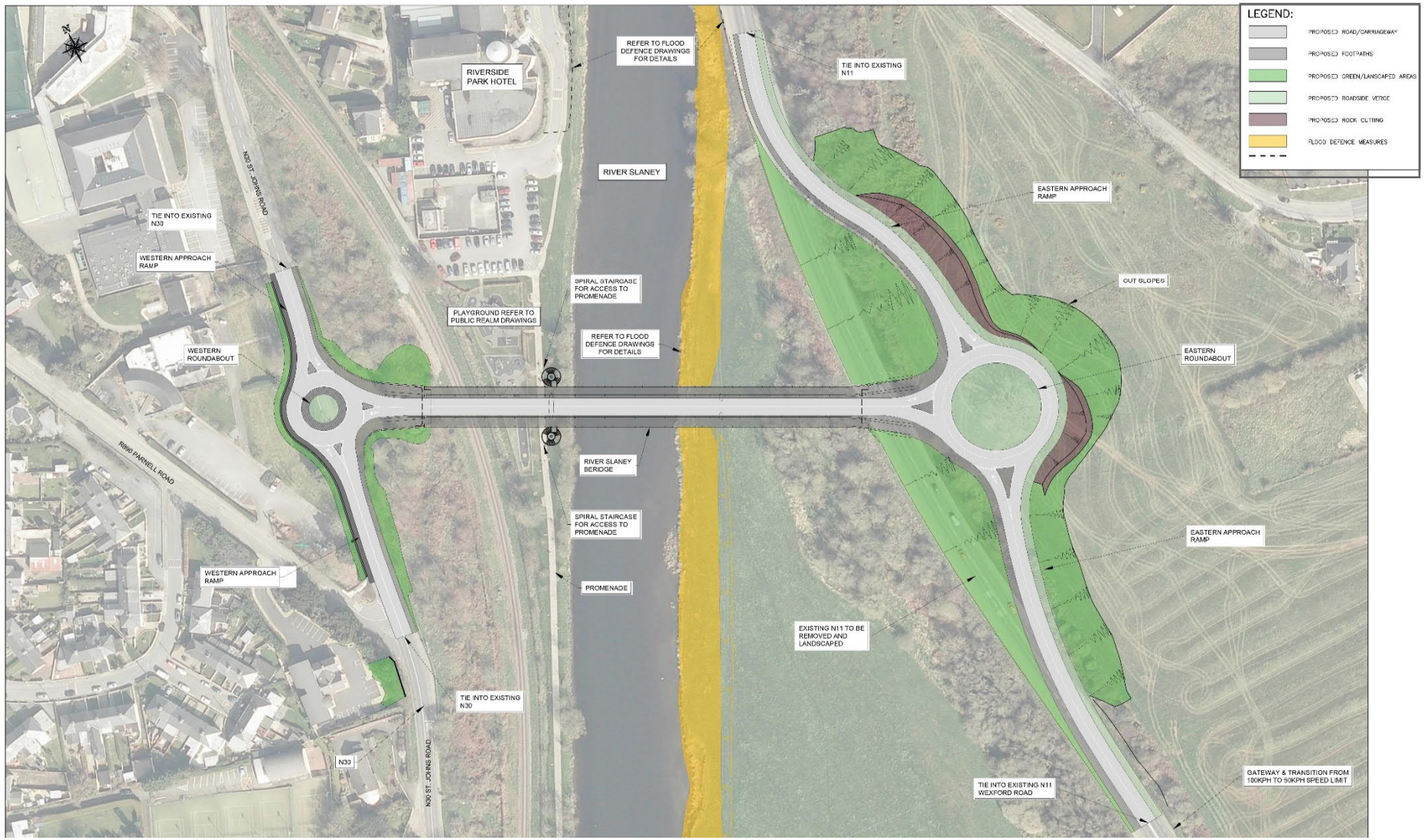
It is proposed that Seamus Rafter Bridge at Chainage 5356, which forms part of the N11 Dublin to Rosslare via a one-way traffic circulation system, be replaced with a new road bridge providing significant additional vertical clearance to the river. The Seamus Rafter Bridge will be completely removed, including the bridge deck, the abutments, and the piers within the river. It is proposed that a new road bridge be constructed at chainage 4800 some 100m downstream of the Riverside Park Hotel. The location of the bridge crossing and associated approach road tie-ins are shown in Figure 4.15.

The proposed bridge will be approximately 180m in length and 16.8m wide. The proposed bridge provides a direct means of access from the bridge to the amenity walkway and playground on the west bank. The new bridge will also span over the existing Dublin to Rosslare Railway Line. New junction tie-ins will also be provided between the N30 New Ross Road and the N11 Wexford Road.

The proposed bridge design comprises a pair of steel boxes with inclined webs made composite with a reinforced concrete deck slab, which will incorporate precast panels, thereby minimising the requirement for pouring concrete over the railway or the river.

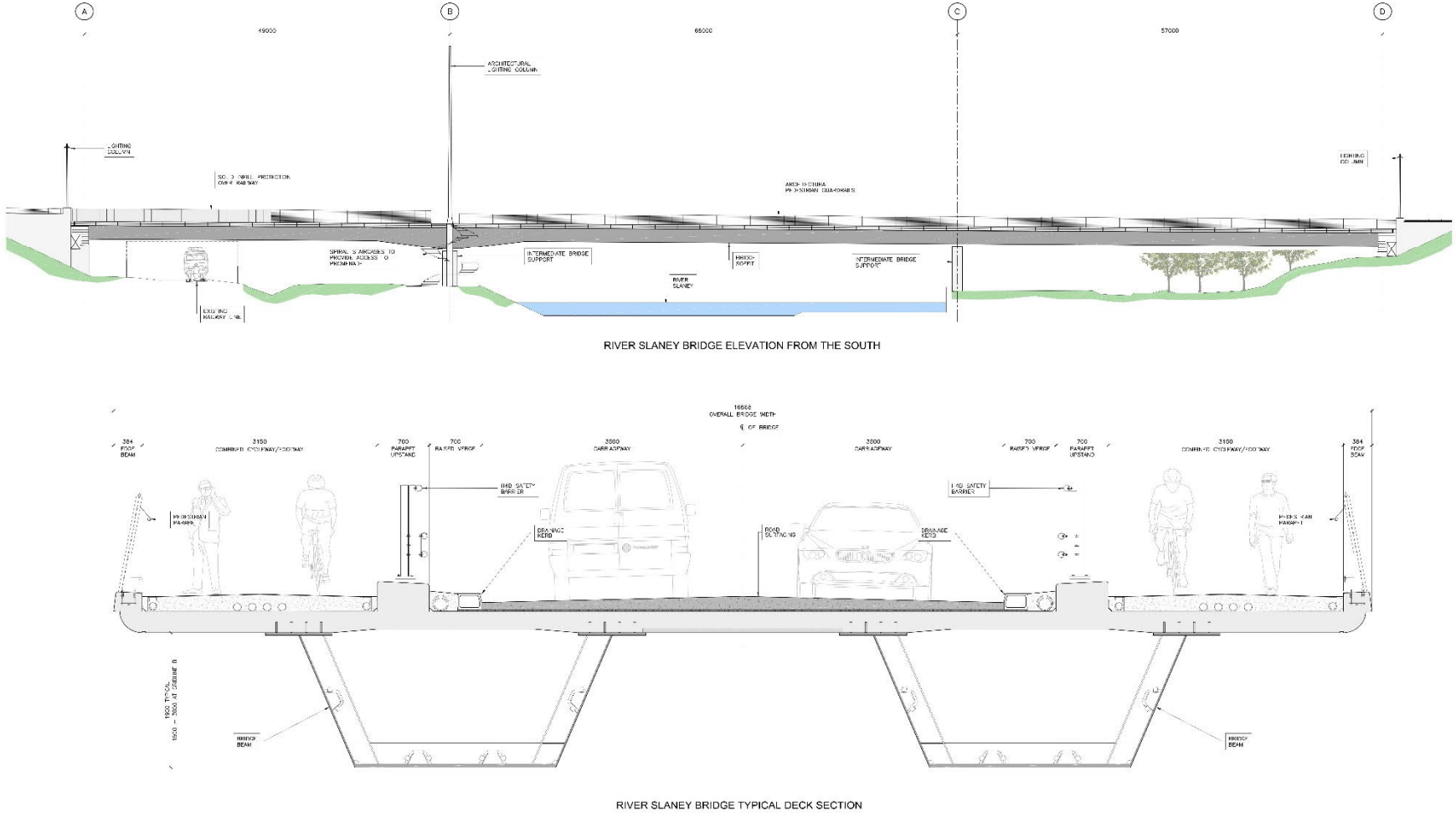
The preliminary lighting design has been developed and seeks to minimise requirements for street lighting over the river span and flood plain on the east side of the river. A long section and a cross section of the proposed bridge are shown in Figure 4.16 and a series of 3D rendered images are shown in Figure 4.17.

Figure 4.15: Location of the New Road Bridge Crossing



Source: ROD 2018

Figure 4.16: Preferred Bridge Arrangement



Source: ROD 2018

Figure 4.17: 3D images of the proposed new road bridge

RIVER SLANEY BRIDGE AERIAL VIEW FROM THE SOUTH

RIVER SLANEY BRIDGE NORTHERN ELEVATION

RIVER SLANEY BRIDGE SOUTHERN ELEVATION

RIVER SLANEY BRIDGE AERIAL VIEW LOOKING WEST

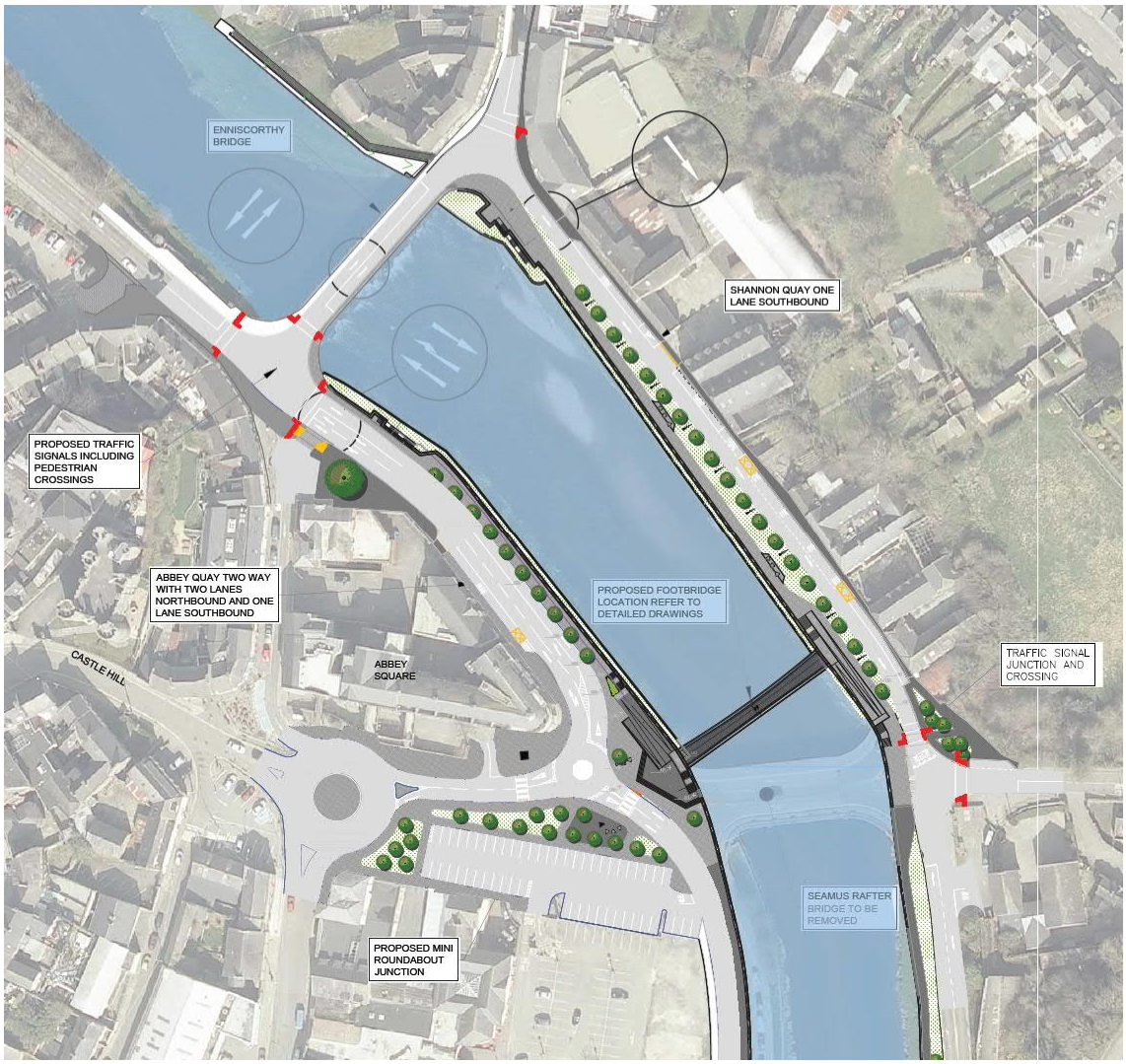
Source: ROD 2018

4.4.2 Traffic Management

Following the removal of the Seamus Rafter Bridge and to order to facilitate the movement of traffic in and around the town, many traffic management options were developed in consultation with key stakeholders, including Wexford County Council's Roads Department, Enniscorthy Chamber of Commerce and Enniscorthy Local Council Representatives. A brief description of the preferred road/traffic improvement measures is outlined below and illustrated in Figure 4.18.

- The proposed scheme involves making Enniscorthy Bridge and Abbey Quay two-way, while retaining one-way on Shannon Quay southbound from Enniscorthy Bridge to Spring Valley. This will enable traffic to cross from east to west across Enniscorthy Bridge and traffic travelling south on the N11 Island Road to continue south along Abbey Quay and on to The Promenade or Abbey Square without diverting to the new bridge located 600m to the south.
- The junctions either side of Enniscorthy Bridge will be upgraded to traffic signals to facilitate two-way movements and pedestrian crossing facilities will be incorporated.
- Abbey Quay will be made two-way with two lanes northbound and one lane southbound, and this will involve the removal of some on-street parking.
- Shannon Quay will be narrowed with one traffic lane in the southbound direction with the space reallocated to the riverside public realm and footpath. The reduced carriageway width will improve connectivity and safety for pedestrians.
- The junction of Abbey Quay, Abbey Square and The Promenade is to be changed to a mini roundabout to accommodate the turning movements and also maximise public realm space adjacent the proposed pedestrian bridge. Pedestrian crossings are proposed on the immediate approaches to the mini roundabout to facilitate improved pedestrian connectivity.
- It is proposed to retain two-way traffic on Templeshannon. It is noted that Templeshannon currently suffers from traffic congestion during peak periods. Congestion is likely to continue and get worse over time following the completion of the M11 Gorey to Enniscorthy Scheme and as the town grows. However, the proposed Enniscorthy Flood Defence Scheme will not exacerbate this congestion any further, and potential solutions to this will be considered by Wexford County Council following completion of the various road schemes when traffic redistribution to and through the town have settled.

Figure 4.18: Overview of the proposed traffic improvement works



Source: ROD, 2018

4.4.3 Road Bridge Drainage

The proposed road bridge falls longitudinally from west to east. A bridge deck drainage system will be provided on either side of the carriageway over the length of the bridge. An ACCO drain will be provided adjacent to the safety barrier upstand and pedestrian parapet upstand on the cantilevering footpaths/cycleways. Both systems will discharge to chambers at the low side of the bridge and tie into the N11 drainage network.

Subsurface drainage will be provided on the bridge and will discharge to the abutment gallery at the low end.

4.4.4 New Pedestrian Bridge in Enniscorthy

It is proposed to build a new bowstring arch pedestrian bridge immediately upstream of the existing Seamus Rafter Bridge at river chainage 5400. The new bridge will ensure that pedestrian detours are not necessary following the removal of the Seamus Rafter Bridge. The pedestrian bridge will greatly improve accessibility and safety for pedestrians. A section from a photomontage showing the proposed pedestrian bridge is shown in Figure 4.19 below.

Figure 4.19: Proposed New Pedestrian Bridge

Source: AECOM 2017

4.5 Construction, Operation and Maintenance of the Proposed Scheme

4.5.1 Incorporated environmental control measures imposed on construction activities

OPW are the lead agency for flood risk management in Ireland and will fund the Scheme. OPW will provide technical assistance to WCC through their participation in the Steering Group.

WCC are an agent of the OPW and as such will have powers to enter lands to carry out the works necessary for the construction of the Drainage Scheme.

In addition, Wexford County Council have appointed Mott MacDonald as their Employer's Representative (ER) during the construction phase. As such, the Mott MacDonald team have extensive knowledge of the environmental sensitivities encountered in the proposed study area during the environmental impact assessment process.

During the construction of the scheme the ER will administer the contract for the construction of the scheme. The ER will delegate his powers to the Resident Engineer and the EnCOW. The Resident Engineer will monitor the works on site and notify the Contractor of defects where the contractor has not carried out the works in accordance with the Works Requirements. When the ER notifies the contractor of a defect he is contractually obliged to rectify it.

The Works requirements, which will be contained in the tender documents for the construction of the Proposed Scheme, shall explicitly state that the Construction Contractor shall comply with the requirements of this EIAR in constructing the Proposed Scheme. Where the appointed Contractor proposes to deviate, or deviates from, the requirements of this EIAR they shall be responsibility for achieving approval from the appropriate consenting authority.

In advance of construction works Wexford County Council will ensure that there is a contractual obligation for the appointed Contractor to prepare and implement a Construction Environmental Management Plan (CEMP) and a Construction Traffic Management Plan (CTMP). The plans will contain the environmental commitments from the contract documents, Environmental Impact Assessment Report/Natura Impact Statement and scheme approval documentation (as issued by the Department of Public Expenditure and Reform).

The preparation of the CEMP must by necessity occur post-confirmation for two reasons: (a) it must have the ability to incorporate specific conditions of confirmation applied by the Minister of Public Expenditure and Reform; (b) it is prepared by the contractor appointed by WCC to undertake the work (such appointment only occurs when a project is confirmed) and to which the contractor can be bound.

A CEMP has been prepared by Mott MacDonald in advance of seeking confirmation for the scheme. A copy of the CEMP is provided in Appendix A. The appointed Contractor will be required to integrate the requirements of this CEMP into its project delivery CEMP.

The CEMP provides a framework for environmental protection measures which will be implemented prior to commencement of, and throughout the duration of, the proposed scheme works. The CEMP will also help to inform the Contractors associated detailed Method Statements. The Contractor's Method Statements will set out the detailed approach and methodology which they will follow in scheduling and undertaking the work. The Contractor's Method Statements may incorporate alternative construction techniques, but it must be demonstrated that the alternatives provide equivalent (or higher) environmental performance as those outlined in the CEMP and as assessed in this EIAR and Natura Impact Statement. The Plans will outline how such commitments will be implemented by the Contractor through

securing permits (e.g. derogation licences), securing agreements on construction method statements. The plans will be adhered to minimise the impacts on the sensitive environmental receptors in the proposed study area.

4.5.1.1 Environmental Clerk of Works

Due to the ecological sensitivities identified during the preparation and assessment of the proposed scheme, an Environmental Clerk of Works (EnCoW) will be appointed by Wexford County Council on behalf of the OPW to ensure that the mitigation measures outlined in this EIAR and any associated Method Statements are implemented in full. As noted above, the EnCoW will form part of the Employers Site Representative Team. The EnCoW shall have suitable environmental qualifications and the necessary experience and knowledge appropriate to the role. Wexford County Council will ensure that the EnCoW is delegated sufficient powers under the construction contract so that she/he will be able to instruct the Contractor to stop works and to direct the carrying out of emergency mitigation/clean-up operations. The EnCoW shall also be responsible for carrying out regular monitoring of the Contractors CEMP.

4.5.2 Construction Programme and Sequencing of Proposed Works

A Contractor will not be appointed until the scheme is confirmed by the Minister. In the interim a preliminary construction programme has been prepared by Mott MacDonald based on core working hours Monday-Friday 07.00 – 19.00 and Saturday 07.00-1300. The programme was used as a basis to provide an estimate of sequencing of the proposed works. The actual programme is dependent on the appointed contractor's proposals and the selected construction methods.

In the Gantt chart shown in Table 4.3 below a 36-month construction period is envisaged and the works have been broken in to seven tasks:

1. **Flood Defences** – Construction of flood walls;
2. **Road Bridge** – To maintain traffic flows the proposed road bridge must be operational before Seamus Rafter Bridge is removed;
3. **Removal of Seamus Rafter Bridge** – While still in place the existing bridge is a barrier to haulage. Its removal provides the opportunity to haul material along the river;
4. **River bank widening/infilling and dredging** – For safety and environmental reasons these works should be carried out in the dry;
5. **Widening downstream of Urrin-** to ensure the integrity of the conveyance works
6. **Pedestrian Bridge** – The pedestrian bridge must be built before Seamus Rafter Bridge is removed as there are services in the deck of Seamus Rafter bridge which are planned to be diverted to the deck of the pedestrian bridge; and
7. **Stormwater Pumping Stations-** management of stormwater on the land side of the defence walls.

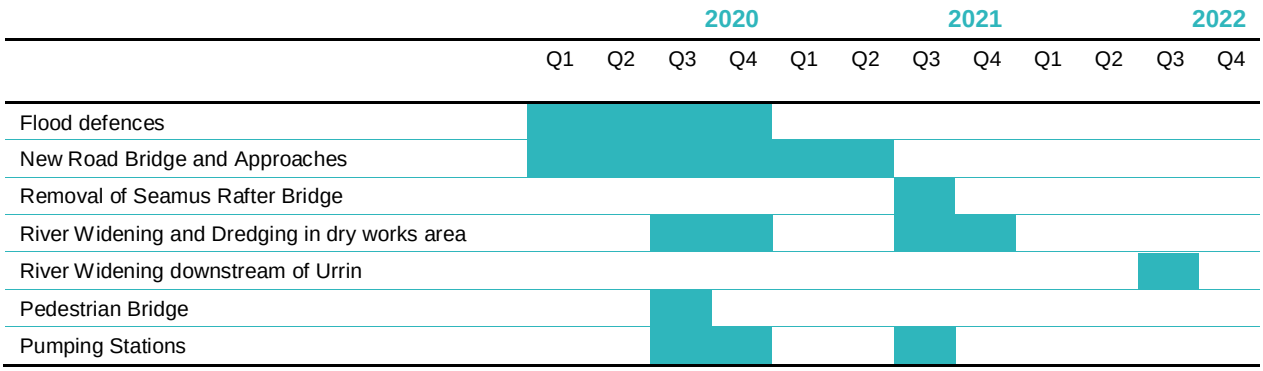
The construction activities are divided between three primary work streams, these are described hereunder:

- The construction of the new road bridge downstream of the Riverside Park Hotel will be carried out in parallel with the main flood defence scheme. The removal of the Seamus Rafter Bridge will only commence following the completion of the new road bridge, junctions onto the N11 and N30 and approach roads;
- Flood Defence Civil Engineering works- construction of flood walls, underpinning of Railway Bridge and Enniscorthy Bridge, construction of the new pedestrian bridge and construction of new flood defence walls; and

- River Slaney Instream Works- comprises dredging (deepening) and/or widening and filling along various sections of the river in and adjacent to Enniscorthy Town and associated measures such as the depositional zone and compound channel and regrading and reprofiling of the Back Channel on the North Island. For the purpose of this stage of works, it is necessary to isolate and de-water the work area to create dry working conditions. Dry works areas reduce the risk of pollution and significant sedimentation in the river. Further details on the dry works areas is set out below. It is also envisaged that the proposed Back Channel restoration works will be constructed in advance of the main channel works.

Flood Defences will also have to been constructed at the Promenade and the Leisure Centre and the construction of the new road bridge before the instream work can take place.

Table 4.3: Indicative Construction Programme



4.5.3 Description of the Construction Approach

4.5.3.1 Flood Defence Civil Engineering Works

The following sections describe how the various components of the design could be constructed.

Construction of Flood Walls.

The flood walls are to be constructed bankside only and access will be from defined access routes such as public road and the Leisure Centre carpark only.

To minimise the risk of seepage the flood wall in most locations is comprised of a sheetpile driven to the required depth, which is bedrock in most cases. In other locations the flood wall is comprised of reinforced concrete. Both wall types are clad above ground in local random rubble stone laid in layers. For the sheet pile wall, the stone cladding is built off a below ground reinforced concrete support which is fixed to the sheet pile. Examples of both flood wall types are shown below in Figure 4.9.

Where river widening and or dredging are required adjacent to the flood walls the widening and or dredging will take place after the construction of the walls are complete. This will minimise the risk of people and construction materials falling into the river during the construction process.

Removal of Seamus Rafter Bridge

The methodology for the removal of Seamus Rafter Bridge will be subject to a detailed structural demolition plan. In advance of the demolition works, a dry works area will be formed under one portion of the bridge. This will be formed by the installation of an impermeable barrier and sump pumps. Subject to the details contained in the demolition plan, the portion of the bridge over the dry works area will be demolished and removed from the dry works area and taken to a licensed

facility for disposal. When the demolition works in the dry works area are complete, the impermeable barrier will be removed, and another dry works area will be established to cover the remaining portion of the bridge structure. The remainder of the bridge structure will be demolished and removed. to a licensed facility for disposal. On completion of the demolition and required river widening, the dry works area will be removed and flow in the full width Slaney will be re-established.

The Proposed New Road Bridge

The construction of the new road bridge and associated approach roads are scheduled to commence in advance of the instream works. The construction programme is envisaged to be 18 months in total.

The bridge superstructure will require construction over the live railway and the main river channel. It is anticipated that the steel beams will be fabricated offsite, delivered in sections, and connected in a lay down area and lifted over the railway over the course of a weekend. The use of precast deck panels made monolithic with the steel beams are proposed to minimise the in-situ concrete construction over the railway and river. The construction activities will be sequenced into four primary work stages, which are summarised below:

Stage 1

Any vegetation will be removed, and the ground will be excavated to formation level for each of the piers/abutments.

Piles and pile cap will be installed at the location of each pier/abutment. Piers, abutments and wingwalls will be constructed and the pier/abutment excavations will be backfilled. Works under the bridge deck will be restricted to use of a mobile platform.

Stage 2

A works area is to be set up in the location of the playground, which is to be occupied temporarily, on the west bank. The western beams will be transported to this location. A crane will be set up in this works area to lift the western beams and bridge deck in to place. As these works are close to the railway line a possession will be required.

Similarly, a works area is to be set up on the eastern bank. The eastern and central beams are to be transported to this location. A crane will be set up in this works area to lift the eastern and central beams. Bridge deck precast panels shall be made composite with the deck in a sequenced manner.

Stage 3

Parapets, lighting and safety barriers will be erected on the bridge deck. The bridge deck will be surfaced and the stairs to provide access to the river walk will be installed.

Stage 4

The playground and other works areas will be reinstated.

The construction of the bridge will include the provision of prefabricated boxes, this allows the main beams to be lifted by crane in stages requiring temporary support adjacent to the haunched section at the west intermediate support and the pier at the east side of the river. It is anticipated that a crane could be provided adjacent to the river on the west side or on the area of flat ground adjacent to the N30 to lift the west backspan, the east backspan and mainspan. These would be lifted from the flood plain on the east side of the river.

The proposed bridge will span an area of Annex I priority habitat alluvial woodland. The presence of these species / habitats and the potential impacts that the works could have on them have to be considered very carefully in the planning of the works. It is planned that, with the exception of some local tree topping by a qualified arborist, no works will occur within this woodland. The area will be marked out under the supervision of both a woodland ecologist and the EnCoW and temporary fencing will be erected around it prior to construction. During tree topping, measures will be undertaken by the Contractor to ensure that there is minimal disturbance to the ground, field and shrub layers within the woodland. Tree topping, and associated works will be supervised by a woodland ecologist. This work will be carried out in the winter period only.

A Herras type safety fencing will be required to secure the perimeter at all bridge construction sites. In addition, visual screening may be required to reduce the risk of waterbird collision. This will be advised by the EnCoW.

Ingress and egress from the Bare Meadows will be limited to one designated point only which it the existing gate way at the north of the field. The identified access route will be clearly demarcated on site and checked by the EnCoW prior to site mobilisation. and will be followed by any crew engaged by the appointed contractor.

4.5.3.2 Proposed New Pedestrian Bridge

It is envisaged that the construction of the new pedestrian bridge will consist of the following stages;

- Driving of piles and construction of abutment foundations
- Construction of abutments and ramps
- Installation of the steel bridge structure;
- The placing and fixing of a precast concrete bridge deck;
- Placing of bridge parapets and other furniture; and
- Reinstatement of area.

4.5.3.3 Instream works

The proposed instream works consist of reprofiling the back channel, river bank widening and infilling, river bed dredging and underpinning the bridges. To facilitate the instream works in the main channel it is proposed to create a series of temporary dry works areas. To create these areas a partial cross section of the channel will be isolated and kept dry with the use of an impermeable barrier and if required a dewatering system (Pumps).

Where appropriate, dredged material will be deposited onsite to facilitate the construction of the permanent depositional zone and infilling along the North Island and sections of the river channel. Material that is removed from river banks downstream of the Seamus Rafter Bridge will be removed by truck to a licenced facility via the Bare Meadows and the N11. Where the excavation cannot be accessed directly from the Bare Meadows the excavated material will be placed in a floating barge and transported to the Bare Meadows where it will be loaded onto dump trucks for transportation off site.

4.5.3.4 North Island Back Channel

The proposed North Island Back Channel Restoration works will be carried out in advance of the main channel instream works. The proposed back channel will be constructed in dry conditions and will be shaped into the natural topography (as advised by the on-site lamprey

ecologist). A pre-construction ecological survey will be carried out in advance of site enabling works. Where required, and subject to licence, any species found will be translocated to a suitable alternative location. A detailed method statement of the proposed works will be undertaken in consultation with the EnCoW in advance of site mobilisation. The construction of the channel will be carried out by means of mechanical excavators. Works will commence at the downstream end of the channel and will progress upstream. Thereafter, the bed of the channel will be overdug in sections, in addition to all fish refuge areas. The excavation of the fish refuge areas will be agreed on site with the both the EnCoW and the specialist lamprey ecologist. Fish refuges will be located in low lying land.

New trees will be planted along the bank of the channel. These will include Willow, Alder, and Ash species. Fencing will be installed and will be set back at least 5m from the channel to allow riparian vegetation to grow and to prevent bankside erosion.

Two new spawning areas will be constructed using an introduced washed gravel /cobble mix. The only flow deflector to be used are woody deflectors placed along the flow of the back channel to aid in the accumulation of silt behind the woody deflectors to create suitable lamprey spawning areas. Root wads and brushwood mattresses will be used as necessary to stabilise banks.

4.5.3.5 Preparation of dry works area

The proposed in stream works control measures have been designed to prevent environmental pollution and minimise sedimentation on the River Slaney SAC. The measures prescribed will be undertaken as best practice and are proven technologies/methods, and to this end the main works contract will utilise temporary dry works areas. The instream works will be carried out in a manner which will not impair the biological function of the waterbody and not impede more than half the width of the River Slaney. Consideration has been given to the possibility that the impermeable barrier employed to create the dry works areas may cause or accentuate flooding in the town and so it is planned that the dry works areas will be created in the summer months only (June – September), when the probability of flooding is greatly reduced. It is envisaged that a 2-3m high impermeable barrier (above bed level) will be used. It is envisaged that the instream works will be carried out in 4 distinct phases in 4 separate dry works areas:

- North east – excavated material to be deposited on the North Island;
- North west – excavated material to be deposited on the North Island;
- South east – excavated material to be exported via the Bare Meadows; and
- South west – excavated material to be exported via the Bare Meadows.

Within each dry works area, the channel will be dredged to the required depth and any river bank filling or widening will be carried out. The earthworks will be carried out using mechanical excavators and the excavated material will be hauled along designated route by lorries and or dump trucks. This approach will ensure that flow will always be maintained within the River Slaney, and therefore should not impede upstream migration within the River Slaney. The dry works area shall be designed such that, when operational, all river flow is accommodated and that overspill into the isolated dry works area will not occur during normal flow conditions. Weather conditions will be monitored throughout the construction period by the Contractor. Works will not be carried out during extreme rainfall or high flow events.

If the method chosen by the Contractor to create the impermeable barrier is the driving of sheet piles, it is anticipated that approximately 1200m of sheet pile could be installed in 1 week.

The possible sequence of works is illustrated in the accompanying drawings (Ref: MMD-355741-C-DR-N-XX-0013 and MMD-355741-C-DR-N-XX-0014 in Appendix A detailed within

the CEMP. The proposed piling sequence is noted alphabetically (A-J) on the drawings. The progression of instream works areas are noted numerically on the drawings.

Depending on water levels within the river, the installation of the impermeable barrier will be carried out from a barge or the bank. The barge and the equipment used on them can be lifted into place in the river by a crane.

Once in the river, the barge is positioned with a boat. When the barge is in the required position, the position is held by slowly lowering three (or four) legs into position on the river bed. When the barge is standing in the river in this way the enabling works can commence.

The upper and lower extents of the river channel in the dry works area is closed off with the installation of an impermeable barrier from the river bank to the barrier at the centre line of the river. Within each dry works area, the channel will be dredged to the required depth along one side, maintaining an open river flow at all times. Dewatering will be carried out in a controlled manner to prevent environmental pollution. Fish, lamprey and other aquatic species will be carefully removed under supervision of a qualified ecologist and returned to the flowing section. The dewatering and electrofishing protocol will be prepared by a competent aquatic ecologist in consultation with the Inland Fisheries Ireland. Necessary derogation licences and consents will be sought from the appropriate statutory authorities and granted in advance of the works.

The water will be pumped out of dry area to allow works to take place, in a phased approach. Any disturbed sediment within the closed area will settle in advance of dewatering. The approach to dewatering is discussed in Section 4.5.3.6 below.

It is proposed that dredging/ widening and in filling works within dry area be carried out simultaneously by mechanical plant.

Figure 4.20: Example of typical steel piling impermeable barrier used within a river channel

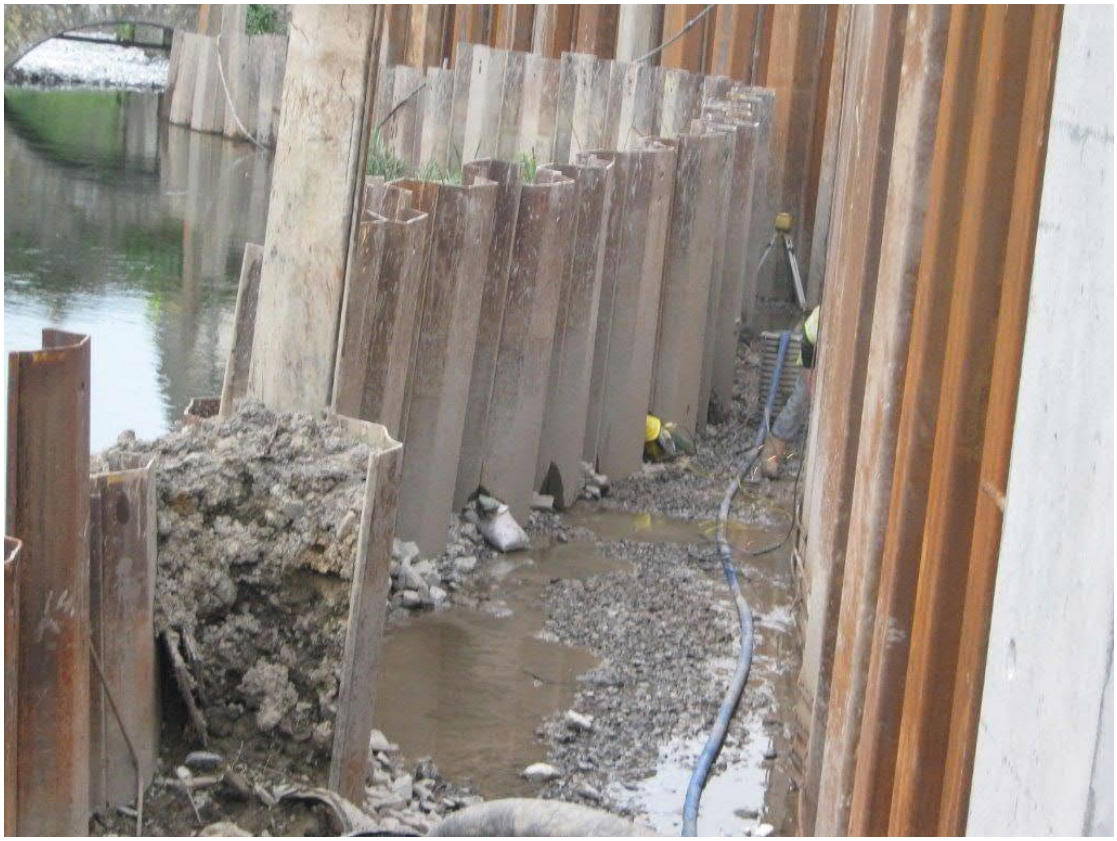


Figure 4.21: Example of typical examples of pump intakes, on the left is a submersible pump sump and the right is a pump located in a perforated barrel

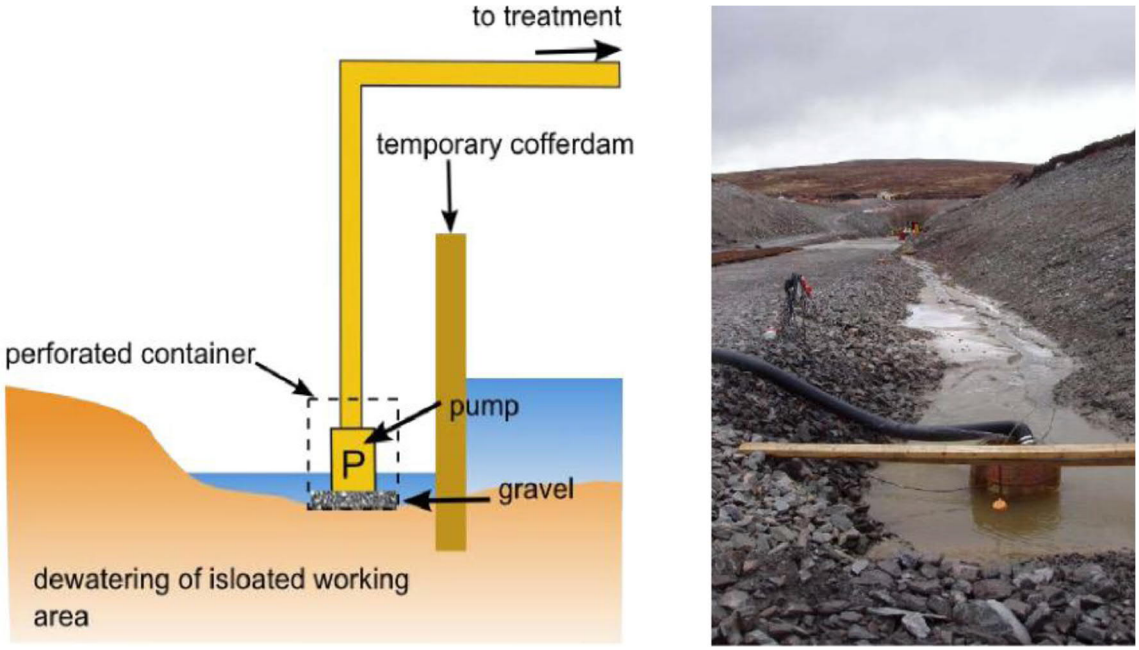


Figure 4.22: Typical river barge

4.5.3.6 Dewatering Works Area

The proposed impermeable barrier will tie into the upstream bank positions in the first instance, thereafter the downstream bank tie positions. Water will flow out of the dry works areas at the downstream end of the areas with the falling tide, therefore it is expected the majority of the flow downstream of the upstream barrier will clear prior to completing the downstream tie ins with the banks. There is still likely to be some level of water ingress therefore any remaining or inflowing water will be pumped out of the dry area to allow works to take place, in a phased approach. Further details on the typical approach taken in provided below.

Any disturbed sediment within the closed area will settle in advance of dewatering. Dewatering will be carried out in a controlled manner to prevent environmental pollution and minimise sedimentation.

A fish salvage programme will also be undertaken prior to isolation and dewatering of the required sections of the river. Necessary derogation licences and consents will be sought from the appropriate statutory authorities and granted in advance of the works. The EnCoW will consult with Inland Fisheries Ireland on the implementation and timing of the fish salvage programme. Fish, lamprey and other aquatic species will be carefully removed under supervision of a qualified ecologist and if appropriate, returned to the flowing section of the River Slaney. Specific ecological measures in relation to each species and habitat are discussed in Chapter 6 Biodiversity within the project EIAR.

Dewatering will involve two distinct elements 1) removal and collection of water from the area, and 2) treatment and disposal of the collected water. The dewatering technique used will aim to reduce the amount of sediment extracted at source e.g. by dewatering through a filter. The water removed from the areas will be treated to remove sediment to an acceptable level (less than 25mg/l suspended solids), before being discharged. The works area will never be de-watered directly into the main channel. De-watering will be carried out by mechanical pumping. Water levels are maintained in dry area by pumping from a sump in that area to the river, via an onsite water treatment system. The micro siting of the sump within each dry works area will be dependent onsite conditions encountered, and the siting of the sump area will be carried out in consultation with the EnCoW.

Daily monitoring of all control measures will be required and will carried out by the EnCoW to assess the effectiveness of the measures including onsite water treatment system, to carry out maintenance, and to determine if there has been any damage /breach to the control measure. Daily inspections of the impermeable barrier will also be carried out the Contractor.

When the instream works are complete in an area the impermeable barrier will be removed from the river and flow will be reinstated. Prior to removing the barrier, the new river beds will be scarified to minimise the de compaction of the river bed, this will be carried out by a toothed bucket of an excavator. In order to minimise the effect of sedimentation, a series of silt curtains will be spaced approximately 20m apart at the downstream of the works area. When the area is re-flooded, the levels of fine sediment in the re-flooded area would be monitored and when the sediment levels drop to an acceptable level, the silt curtains would be removed.

4.5.3.7 Underpinning of the existing Bridges

In order to ensure structural stability of the existing bridges, underpinning of the bridges will be required. These works will be carried under a dry works condition when the instream works are being carried out. The proposed works are likely to comprise:

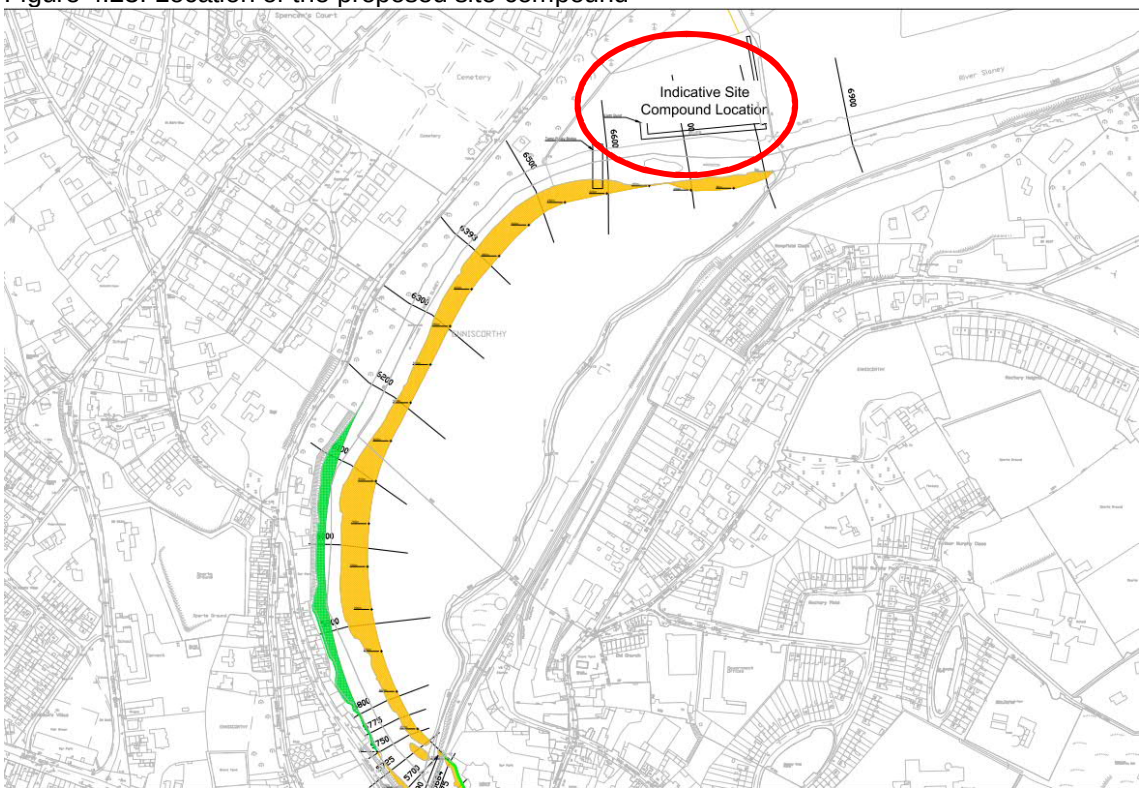
- Excavation to formation;
- Placing of a reinforced concrete slab under the bridge with a surface level 500mm below the proposed dredge level;
- Backfilling the reinforced concrete slab with as dug river bed material; and
- Placing rock armour at the downstream end of the slab to retain the river bed material in place.

4.5.4 Temporary Construction Works Facilities

The location of site compound facilities will be agreed between WCC and the appointed contractor. For the purposes of this application, there is one suggested location for the compound. A proposed location at The Blackstoops is shown below in Figure 4.23. This compound will include welfare facilities and office space as required. Any effluent generated from the welfare facilities will be discharged to the public sewer or stored on site and collected by a licenced contractor. Plant and machinery may also be stored at this location.

An ancillary site compound will be required close to the proposed road bridge in the Bare Meadows for the duration of the bridge build only. In addition to this an ancillary site works area will be maintained around the proposed new road bridge location, the purpose of this will be to store plant and equipment necessary for the works.

Figure 4.23: Location of the proposed site compound



4.5.5 Construction Access and Traffic Movements

As noted above, with the exception of the instream haul routes, site identified access points have been identified which will be used for site access and egress. It is anticipated that access will be as described below:

- For construction on the North Island which includes in river works reprofiling of the back channel and the deposition zone, access will be over the railway tracks north of the railway station. To minimise the impact, access to the river from the river bank for in river works will be restricted to a single location;
- For construction of the flood wall between the railway bridge and Enniscorthy Bridge access will be provided for the Leisure Centre carpark;
- For construction of the flood walls on the Quays, the removal of Seamus Rafter Bridge and construction of the proposed pedestrian bridge access will be provided from Shannon Quay and Abbey Quay;
- For the construction of the flood walls on the Wexford Rd one lane will need to be closed. This can be made possible by restricting this work until the proposed road bridge is operational;
- For the construction of the flood wall and road raising on the Promenade access will be from the Promenade. This can be carried out in phases and access can be maintained through the use of the link roads to the N30;
- For the construction of the proposed road bridge on the west side access will be from the N30 and the Promenade;
- For construction on the southern flood plain, which includes in river works and bridge construction, access will be through the existing gate at the north end of the floodplain only. A haul road may be established along the river bank but only in river works may be carried out south of Ch 4700. To minimise the impact, access to the river from the river bank for in river works will be restricted to a single location adjacent to the temporary bridge works area. No works on the Bare Meadows will be allowed downstream of this location; and
- For the construction of the roundabout and the approach road on the eastern side of the proposed bridge access will be provided from the N11. The roundabout and the approach roads will be built early in the contract. The traffic will be diverted from the existing N11 up the approach roads and around or straight through the roundabout to facilitate construction for the eastern abutment of the proposed road bridge.

Traffic on the N30 and N11 will be affected by regular site traffic, specialist large bridge component deliveries and the mobilisation and demobilisation of cranes required to install the bridge components. Access routes will be clearly demarcated and checked by the EnCoW on site prior to site mobilisation. Construction on or traffic passing through lands contaminated by invasive species will be strictly controlled in line with the Invasive Species Management Plan and will be followed by any crew engaged by the nominated contractor.

4.5.6 Preventions for controlling spread of Non- Native Invasive Species

The construction of the proposed works will disturb stands of non -native plant species, and/ or soils contaminated with Japanese knotweed, Himalayan balsam and Giant Hogweed. A Provisional Invasive Species Management Plan including a full site survey has been prepared by Envirico Ltd. The proposed works will be completed in accordance with the OPW's Environmental Management Protocols & Standard Operating Procedures which includes for the control of the spread of invasive species and consideration of the provisional Invasive Species Management Plan developed for the scheme. The Provisional Invasive Species Management

Plan will be updated by the Contractor to form the detailed Invasive Species Management Plan which will form part of the Contractors EOP for the proposed scheme.

If possible, the plant will be eradicated from works areas prior to construction works taking place. A treatment program is currently underway with regular spraying. If time constraints do not allow for the eradication of the species directly within the works area, it is planned that contaminated soils will be excavated and transported to a designated area on the North Island. Material shall be buried at least 0.5m deep and the Japanese knotweed material will be placed on a root barrier membrane layer before infilling it with inert fill or topsoil. The excavated rhizomes are provided with ongoing herbicide treatment programme until no further regrowth has been observed. The proposed burial site will be designed to be clearly fenced off and signposted. A fence that is clearly visible will mark out the area of infestation. Strict adherence to biosecurity measures will be implemented on site. Alternatively, the movement of invasive plant material off site requires a licence from the National Parks and Wildlife Services (NPWS) under Section 49 of the European Communities (Birds and Natural Habitats) Regulations, 2011 as amended. A certified Surveyor of Japanese Knotweed will be in place to supervise excavations within contaminated areas.

Prior to works commencing, the proposed study area will be resurveyed to confirm the location of invasive species., and where areas have been identified that no works are proposed, an exclusion zone will be established which will clearly demarcated by fencing and signage. No construction works requiring the movement of heavy machinery, ground disturbance or vegetation clearance will be permitted within these zones. An EnCoW will oversee the management of non-native invasive plant species on site.

4.5.7 Operation and Maintenance of the Proposed Scheme

4.5.7.1 Lighting during operation

The lighting for the proposed road bridge will be provided by two lighting posts approximately 10m above finished bridge deck road level on either side of the road at both ends of the bridge.

There will be approximately 25m high (above road level) lighting masts, adjacent to the bridge on both sides, located at the intermediate pier on the western side.

In addition, where required, lighting for the road will be complemented by lighting located in the rail of the road safety barrier. Lighting for pedestrians will be provided by the tall lighting masts and where required will be complemented by lighting in the handrail of pedestrian guardrail.

4.5.7.2 Maintenance during operation

The River Slaney through Enniscorthy is considered to be a low to moderate energy system. Given the depositional nature of the river through Enniscorthy, the proposed scheme design includes creating a sediment deposition zone in the upstream extent of the scheme. The design of the sediment trap eliminates the need for regular maintenance dredging of the entire reach of the river channel in Enniscorthy.

Gravel will have to be removed from the sediment trap periodically. Gravel will be deposited here when high velocity flows carry large sized sediment down the Slaney during a flood event. When the flow enters the sediment trap the velocity of the flow will reduce and the large sediment will drop out of suspension. It estimated that such a high flow event will occur on average once every 5-7years. The gravel will be removed from the left bank of the channel

during low flows in the summer when the gravel is exposed. Works will be carried out in dry working conditions only in consultation with Inland Fisheries Ireland.

The gravel trap and the debris trap will require maintenance as required using a long reach excavator from the North Island. Maintenance will be carried out in accordance with the latest OPW Environmental Management Protocols and Standard Operating Procedures which are currently being updated by the OPW.

During flood events floating debris will be collected by flood flows from the river banks and flood plains of the Slaney. Floating debris of a size that could cause a risk of blockage at the Irish Rail bridge will be trapped in the debris trap. Following each flood event, the debris trap will be inspected and if necessary trapped debris will be removed using a long reach excavator from the left bank.

All structures require regular inspection and routine maintenance during their life and TII have developed an EirSpan Bridge Inspection and Maintenance programme. The principles of the EirSpan system will be applied by TII and their agents to all structures on the proposed scheme. Environmental protection measures will be implemented in advance of maintenance works.

5 Population and Human Health

5.1 Introduction

This Chapter of the EIAR has been prepared with respect to population and human health with a specific focus on land use and demographic profile; housing; health and wellbeing; tourism, recreation and amenities; and economic activity.

In terms of human health, impacts relevant to the proposed scheme are those which arise as a result of interactions with environmental vectors (i.e. environmental components such as air, water, soil through which contaminants or pollutants, which have the potential to cause harm, can be transported so that they come into contact with human beings). Hazards or nuisances to human health can arise as a result of exposure to these vectors, for example, air quality impacts or potential for dust generation or noise and vibration nuisance during construction are discussed in their own respective Chapters in this EIAR.

The structure of the Chapter is presented below;

- **Section 5.2**- Outlines the assessment methodology and summarises the desktop review that was carried out;
- **Section 5.3**- Describes the baseline environment within the study area;
- **Section 5.4**- Provides information on the principal elements of the proposed scheme and examines the potential impacts on the population and human health arising from the construction and operation phases of the proposed scheme
- **Section 5.5**- Describes the potential for cumulative effects resulting from additional development projects ongoing and proposed in the project area;
- **Section 5.6-** Describes the proposed mitigation measures for many of the proposed elements of the development mitigation measures; and
- **Section 5.7**- Summarises the potential for significant residual effects.

5.2 Assessment Methodology

5.2.1 Guidance Used

To provide the background for the assessment of the impacts of the proposed scheme on the population and human health, a desk-based assessment was conducted to assess information in relation to land use and demographic profile; community; land use; and economic activity. The aim of the assessment was to assess the positive and negative impacts of the proposed scheme on the population and human health. Publications and other data sources that guided the preparation of this Chapter are listed hereunder:

- Wexford County Development Plan 2013-2019;
- Enniscorthy and Environs Development Plan 2008-2014 (as extended);
- Census 2016, Central Statistics Office www.cso.ie ;
- Census 2011, Central Statistics Office, www.cso.ie; and
- Fáilte Ireland, Guidelines on the treatment of tourism in an Environmental Impact Statement, Year Unknown.

The study area for this assessment considered the immediate Enniscorthy Town and its environs.

5.2.2 Baseline Assessment Criteria

The functional value of the study area is determined with reference to the importance and sensitivity of the area. Tourist facilities and sites are important because they define and add value to the character of an area. Recreational land uses are also important and include areas zoned as open space and/or recreational amenity areas. Community facilities such as schools, hospitals, and churches contribute to the community, educational, health and social quality of life. The quality and safety of the residential environment is perhaps the most important determinant of people's overall quality of life. Business and commercial activities are also important aspects of the local economy as they provide goods, services, and jobs to the local population.

Land use sensitivity can be described as the degree to which a land use can accept change of a particular type and scale without adversely impacting on its functionality. Residential properties in proximity to the River Slaney and at risk from flooding would be considered to be highly sensitivity to change. In addition, tourist and recreational facilities and community facilities (schools, churches and hospitals) at risk to flooding are also considered to be very sensitive to change.

The baseline evaluation of population and human health in the context of this assessment included;

- Desktop study of existing available information as set out in Section 5.2.1;
- Review of aerial photography for the study area;
- Review of historical mapping; and
- Consultations with relevant stakeholders as identified in Section 3.9 of this EIAR, including Wexford County Council, Enniscorthy Municipal District, and local interest groups and the general public.

5.3 Receiving Environment

5.3.1 Demographic Profile

Demographics are used to study the characteristics of a population at a specific point in time. In this assessment, demographics such as population, age, and housing were examined.

The results for the 2016 Census recorded a national population of 4,761,865 on census night. Comparison against the 2011 census figures indicates a 3.8% increase in the national population over the 5-year period. This national trend is reflected in the South East Spatial Planning Area, and the Southern Regional Assembly of 2.8% and 3.3% respectively. According to the final draft National Planning Framework, Ireland will be home to an additional 1 million people by 2040 and the Southern Region is estimated to have a population growth between 350,000 and 375,000 people.

The CSO reported in the publication "Population and Labour Force Projections 2016-2046, that the total population in Ireland is expected to increase to 5.3 million by 2046.

According CSO, the Wexford Local Authority area also recorded a population of 149,722, resulting in a 2.4% increase on the population recorded in 2011 Census. County Wexford experienced the 17th highest level of population growth of the 34 local authorities in the country.

There was a varied pattern of population change recorded across the county between 2011-2016. At a municipal district level, Enniscorthy Urban Municipal District recorded population growth of 3.5% to 35,613. The Enniscorthy Town and Environs (2008) Development Plan estimated that the population grew within the plan area to over 13,531. According to the Census

reports, the population for the Enniscorthy Urban Electoral Division[3] (ED) was approximately 14,000. The profile/age cohort breakdown of the 2016 census shows an aging population in the county shown to have a dependency ratio of 54.8% which is the 7th highest rate in the State. This suggests that the county has a very high proportion of its population dependent on the economically active population. Whilst the highest rates are predominately in the south of the county and in more peripheral and rural areas, there are also very high rates in the urban centres such as Enniscorthy. Enniscorthy Urban ED has a ratio of 40.2% compared with 38.8% in 2011, whereas Enniscorthy Rural ED has a ratio of 19.4% compared with 15.8%.

Table 5.1 below provides information of the demographic characteristics of Enniscorthy Municipal District, based on figures available from the 2016 census.

Table 5.1: Demographic characteristics of Municipal District Enniscorthy

	Enniscorthy Municipal District
Population	35,613 persons comprised of 17,940 females and 17,673 males
Age structure (in years of age)	14.7%are 0 to 9 13.6% are 10 to 19 10.8% are 20 to 29 14.1% are 30 to 39 14.1% are 40 to 49 12.8% are 50 to 59 10% are 60 to 69 6.3%are 70 to 79 3.3% are 80 +
Nationality	90.7% are Irish 2.78% are British (UK) 2.5% are Polish 0.23% are Lithuanian 2.2% are from elsewhere in the EU 0.6% are from elsewhere in the rest of the world 0.9% are not stated
Ethnic or Cultural Background	87.7% are White Irish 1.4% White Irish Traveller 7.3% are Other White 0.3% are Black or Black Irish 0.5% are Asian or Asian Irish 0.99% are Other 1.6% are not stated
Families	There are 9526 families 3719 are 2-person families 2153 are 3-person families 2121 are 4-person families 1077 are 5-person families 456 are 6 or more-person families
Housing	There are 12673 private households 12120 are houses/bungalows 361 are flats/apartments 6 are bed-sits 54 are caravans/mobile homes 132 are not stated

Source: Census 2016

5.3.2 Housing

As noted above, there are 12,673 private households within the Enniscorthy Municipal District. According to the 2016 Census, over 95% of those comprised house/bungalow, 2.8% comprised

[3] Electoral Divisions (EDs) are the smallest legally defined administrative areas in the State for which Small Area Population Statistics (SAPS) are published from the Census

flats/apartment. According to the Census, the total housing stock was 14,869, of which vacant household (excluding holiday homes) numbered 1,283.

5.3.3 Health and wellbeing

The 2016 Census asked respondents to indicate their general health, allowing the health and wellbeing of the population within the Enniscorthy Municipal District to be assessed. The levels were on a five-point scale, ranging from 'Very Good', at one end to 'Very bad' at the other. The general characteristics of the Enniscorthy Municipal District is presented below in Table 5.2.

Table 5.2: General Health of Population in Enniscorthy Municipal District

General Health	Male	Female	Total
Very Good	10485	10448	20933
Good	4921	5017	9938
Fair	1584	1738	3322
Bad	235	272	507
Very Bad	58	44	102
Not Stated	390	421	811

Source: Census 2016

Enniscorthy is an important market town for the wider rural hinterland, whilst there is no hospital facility within the town, the town does however provide considerable community and healthcare facilities for its population. These include but are not limited to, health centres, community centres, leisure centres and public services including employment centres, welfare offices and schools and churches.

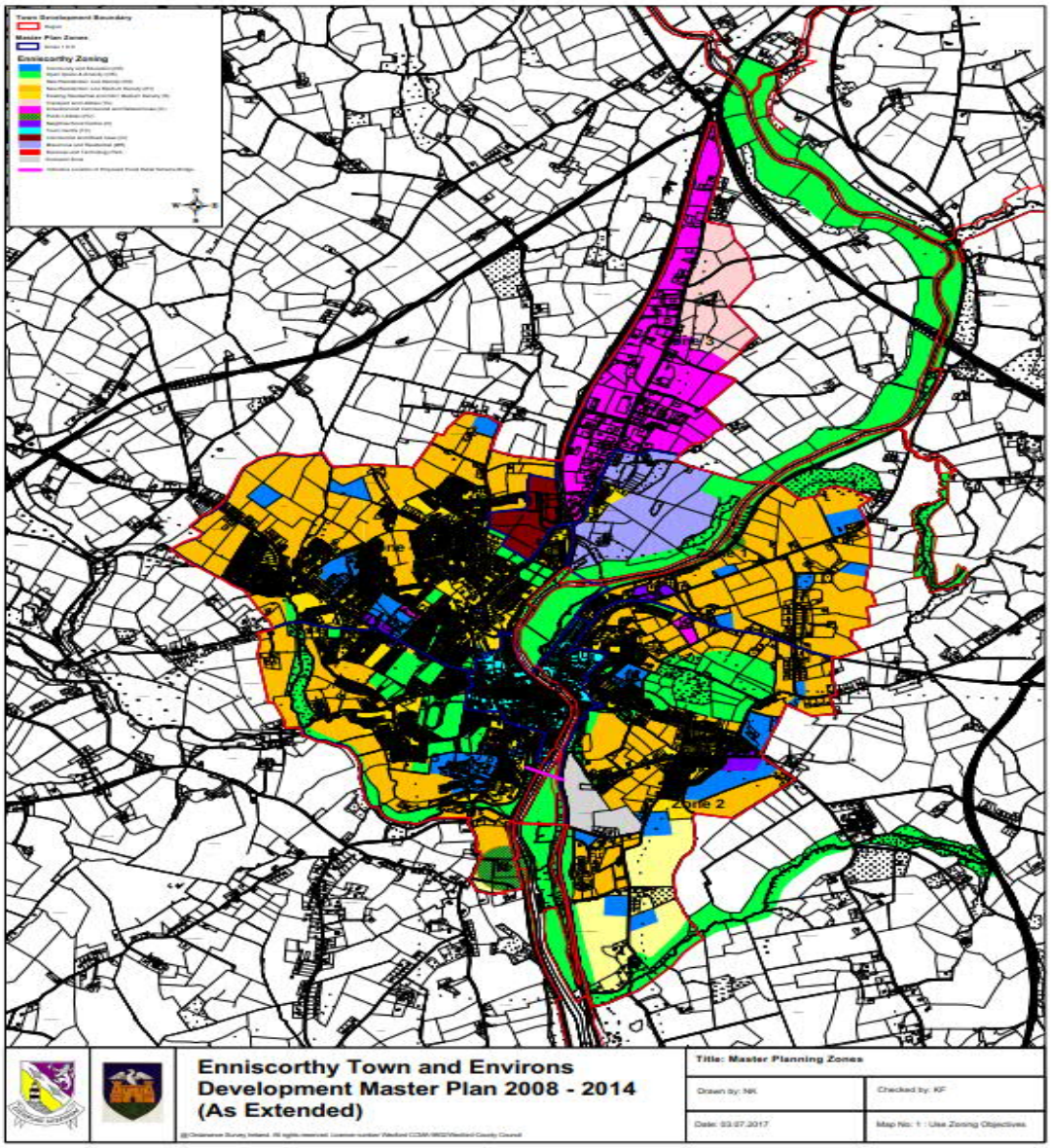
5.3.4 Land Use and Facilities

Enniscorthy is designated as a Larger Town by the South East Region Planning Guidelines 2010 (SERPGs) and plays an important economic role in the regional context. Enniscorthy is an important market town for the wider rural hinterland. Owing to the urban characteristic of the town centre there are limited business spaces or industrial areas within the town centre. The Enniscorthy Town and Environs Development Plan (2008, as extended) does include for areas zoned for the creation of enterprise and industrial. Land zoning objectives are shown in Figure 5.1. There is a large bank of lands on the northern approach of the town as "Industrial and Commercial and related uses". The Plan also sets out a bank of lands directly adjacent to the proposed scheme in the townland of Killagoley for the development of a new business and technology park. The Killagoley Wastewater Treatment Plant currently located on these lands is due to be decommissioned as part of the contract for the upgrading of the Enniscorthy Wastewater Treatment Plant at Lucas Park. The Lucas Park WWTP is located south of Enniscorthy Town on the western side of the River Slaney opposite the Bare Meadows floodplain. Access to the WWTP is from a local road next to St. Johns Villas via the N30. The existing pumping station to this WWTP is situated adjacent to the Riverside Park Hotel. The works are expected to be complete by the end of 2019.

According to the Enniscorthy Plan, lands along the either side of the River Slaney are zoned as 'Open Space and Amenity'. The plan also sets out several road objectives for the town including the new road bridge for the flood defence scheme. Enniscorthy Town is presently bisected by the N11 (Euro Route E010). The M11 Gorey to Enniscorthy (Enniscorthy Bypass) is currently under construction and is expected to be open in late 2019. According to the Enniscorthy Town and Environs Development Plan (2008-2014 (as extended), the existing national roadway will be reclassified removing its national roadway status on the completion of the bypass.

Enniscorthy is served by both bus and rail public transport. The rail service operates on the Dublin to Rosslare mainline intercity route. The railway line crosses the River Slaney via the Enniscorthy Rail bridge before connecting with the station situated in Templeshannon. The railway line runs along the eastern extent of the North Island. The Enniscorthy Plan emphasises the promotion and facilitation of the Enniscorthy Flood Defence Scheme within the town through its strategies and objectives set out in the Plan. It is worth noting that policy SW11, states all development proposals within Enniscorthy should have regard to the 'River Slaney (Enniscorthy) Drainage Scheme'.

Figure 5.1: Enniscorthy Town and Environs Land Zoning Objectives



Source: Enniscorthy Town Plan, 2008

5.3.5 Local Economy

Enniscorthy is a market town with a central triangular market square. The main retail streets radiate out from the square. According to the Enniscorthy Retail Strategy (2013), Enniscorthy is classified as a third-tier centre in the retail hierarchy of the Retail Planning Guidelines. The town serves a wide rural catchment area. The town centre predominately comprises independent retailers, although there are several large supermarkets serving the town.

5.3.6 Tourism and Amenity

Wexford County has a very strong tourism sector. According to the Wexford Local Economic and Community Plan (LECP), domestic expenditure is the primary source of tourism revenue for the county with Wexford being the fifth highest domestic tourism earner in the Country. As of 2016, Wexford County is now also included under the Fáilte Ireland umbrella destination known as 'Ireland's Ancient East'. Ireland's Ancient East is a touring guide rather than a specific route and is designed to offer tourist a region with 5000 years of Irish history. It is themed along four pillars; Ancient Ireland; Early Christian Ireland; Medieval Ireland; Anglo Ireland. An ancient Norman stronghold dominates the town of Enniscorthy, and this medieval origin is evident in its strategic location in an elevated location immediately west of and overlooking the River Slaney. The town centre follows a historic street layout, rising steeply from the river. Enniscorthy Castle is one of the largest single tourist opportunities in the town. The castle has been home to Norman knights, English armies, Irish rebels and prisoners, and local merchant families. The nearest large attraction is the National Heritage Park in Wexford. Other major tourist attractions include Vinegar Hill and St. Aidan's Cathedral.

The town hosts a number of well-known festivals during the year, which help draw visitors in from outside the county. These include the Strawberry Fair, the Blackstairs Blues Festival and the Enniscorthy Street Rhythms and Dance Festival.

The River Slaney is the town's most valuable resource in terms of amenity. The main public open spaces in the town, both natural and man-made include the river valley with its linear parks and riverside walks, Promenade Walk, Vinegar Hill, Turret Rock, Fairgreen, Pig Market, Abbey Square and Market Square.

The reach of the River Slaney at Enniscorthy is the only fishing open to the public on the entire River Slaney. This is a valuable resource for the town and important amenity for the town and wider environs. Upstream of Enniscorthy Bridge there is access to the river along both the east and west banks. On the east side there is access from the swimming pool car park and under the dry arch of the bridge. On the west side there is access to the river bank via steps.

Downstream of Enniscorthy Bridge, there is currently access along both Shannon Quay and Abbey Quay. A ramp immediately downstream of Enniscorthy bridge provides access under the dry arch of the bridge from Shannon Quay. On Abbey Quay there is access from the footpath to the old Quay Wall via steps. At the midpoint of both Shannon Quay and Abbey Quay there are steps from the top of the old Quay walls down to river bed level.

Downstream of Seamus Rafter Bridge access is provided from the footpath down to a narrow river bank by steps on the east side and there is access to the top of the old quay wall on the west side.

5.3.7 Do-Nothing Scenario

Major flood events affect a large percentage of the population and they cause displacement of residents and short-term severance of communities. If the proposed scheme were not to proceed, the existing river channel would remain as it is. Maintaining the present-day condition is to accept flood damages going forward in the Town.

5.4 Safety in Design

Having regard to the Article 2 of the Directive 2014/52/EU the expected effects deriving from vulnerability of the proposed project to risks of major accidents and/or natural disasters where relevant have been considered in the individual environmental Chapters. Climate change has the potential to cause extreme weather events and increased likelihood of flooding.

The proposed scheme has been designed to take cognisance of the Mid-Range Future Scenario that flood flows could increase by 20% and an estimated rise in sea levels by 500mm could result from as a result of Climate Change

The flood walls are designed to include for a 500mm increase in sea level and they are adaptable to the increase in flood level resulting from the 20% increase in flow.

The Pedestrian and Road Bridges are both designed so that their soffits are above the flood level predicted in the design event following climate change. That is, the underside of the bridges will be above the 100-year flood level including a 20% increase in flood flow and a 500mm increase in sea level.

PSDP

At the start of the detailed design of the Enniscorthy Flood Relief Scheme Wexford County Council appointed Mott MacDonald Ireland to act as the Project Supervisor for the Design Process (PSDP). ROD are performing the role of PSDP in relation to the new road bridge and junctions. By law, the PSDP is required to co-ordinate the activities of designers involved in the project to ensure that they design works that can be constructed, used, maintained and demolished safely. Designers involved in the project will design out risk where possible in their designs. Designers will record the decisions they make to mitigate risks in their design. These risk assessments identify those risks that could not be mitigated so that the people responsible for constructing, using, maintaining and demolishing the works can be informed of those risks.

Each PSDP will prepare a Preliminary Safety and Health Plan for the respective Contractor which will include in the background information issued to the Tenderers when the construction project goes to tender. This is to inform the tendering Contractors of the risks present on the site which are associated with the construction of the works.

On completion of the works the PSDP will compile the Safety File. The Safety File will be a comprehensive record of the completed scheme and will serve as a reference point for the future operation and maintenance of the works and any future upgrading works.

The following is an example of the contents of a typical safety file:

- Construction (As-built) Drawings and photographs;
- Design Criteria;
- Specifications and Method Statements;
- Demolition Restrictions;
- Details of Equipment;

- Details of Maintenance Facilities;
- Operating & Maintenance Manuals;
- Certificates from suppliers, manufacturers, specialist subcontractors, MSDS Sheets, etc.;
- Details of location and nature of utilities and services encountered and diverted; and
- Details of residual risks in use and maintenance of the works.

PSCS

Wexford County Council will appoint a Project Supervisor for the Construction Stage (PSCS) of the Enniscorthy Flood Defence and the Bridgeworks Schemes when they appoint contractors to carry out the works. The PSCS will be responsible for developing the construction stage Safety and Health Plan, co-ordinating the work of Contractors and providing the PSDP with information required in the Safety File. The project supervisor design process (PSDP) ensures coordination of the work of designers throughout the project. This is to ensure effectiveness in addressing and coordinating safety and health matters from the very early stages of the project.

The requirements of the Safety, Health and Welfare at Work (Construction) Regulations, 2006, as amended will be implemented and complied with in full during the construction phase of the development. However, as with any construction project, there is still potential for adverse impacts associated with the natural environment and nuisance (such as noise and dust emissions). Construction will be undertaken by a competent contractor. The potential for these effects is discussed separately within the respective Chapters.

5.5 Assessment of Impacts

5.5.1 Construction Phase

Population and Housing

The proposed scheme is not expected to have an impact on the population of the study area in terms of changes in population trends or density, or household size. However, the age profile in the 2016 census shows an aging population in the county. It is noted during public consultations, that there is an aging resident population at number of areas in the town, e.g. in Templeshannon and Island Road. Concerns were raised during the public display that the works will result in a short-term adverse impact and will have the potential to limit their mobility around the town. This may include restrictions along footpaths within the town however, where possible, diversions will run close to the existing access or footpaths in order to minimise disruptions.

Health and Wellbeing

The construction phase of the proposed scheme is expected to be 3 years. The construction activities will be sequenced into three primary work streams. The construction of the new road bridge downstream of the Riverside Park Hotel will be carried out independently of the rest of the flood defence scheme. The removal of the Seamus Rafter Bridge will only commence following the completion of the new road bridge and its approach roads. During the construction phase access to existing footpaths alongside the river will be restricted. These restrictions will be temporary where possible, diversions will run close by the existing stretch of paths to minimise lengths of diversions on pedestrians around the town. As noted above the Town is important market town for the wider rural hinterland, the proposed works will be phased to limit impact on the trade within the town. Access to the Town community facilities and will be maintained during the works.

Flood Risk

During the proposed works access to the river will be restricted. The main works contract will utilise temporary dry works areas in the River Slaney. The instream works will be carried out in a manner which will not impair the biological function of the waterbody or amenity of the riverside and not impede more than half the width of the River Slaney. In setting the level of the barrier, cognisance must be given to the flood risk posed to the town by the creation of a dry working area. In order to assess the risk of flooding in the town during the construction works, the sequence of works was represented in a series of hydraulic model runs.

The modelling determined that the greatest risk occurred when the river works on the left bank upstream of Seamus rafter bridge were being undertaken in the dry works area. In order to mitigate this risk, the flows in the river upstream of Enniscorthy will have to be monitored during these works. If the flows in the river are predicted to reach a level that would cause flooding, the impermeable barriers at the upstream and downstream ends of the dry works areas would have to be opened to permit flow on both sides of the channel.

Local Economy

The construction costs of the proposed scheme will be in the region of €43 million. The construction phase of the proposed scheme is expected to be 3 years. Many construction workers and materials will be sourced locally, thereby helping to sustain employment in the construction trade and potentially increase spending and demand for goods and services in the local area. This would result in local retailers and businesses experiencing a short term positive indirect impact on the local economy.

There is also the potential for temporary disruption to economic activity within the town due to the proposed construction activities. This would predominantly be as a result of traffic and access issues which could have the potential to reduce footfall into local businesses, with noise and dust from the works adding to this temporary impact on local businesses. This will have a short term moderate negative indirect impact on the town.

Tourism and Amenity

The proposed works will have a temporary negative impact on the riverside amenity of Enniscorthy and local tourist festivals. Potential increases in noise, dust levels, traffic disruptions and temporary impacts on visual amenity of the riverside are likely to deter and /or disturb visitors during the duration of the proposed works. The proposed works will not directly impact on any tourist attractions or festivals held in the Town. There is a potential short -term moderate negative impact on tourism in the town.

The proposed scheme will be constructed in dry working conditions by the installation of impermeable barrier within the river channel. The proposed in stream works control measures have been designed to prevent environmental pollution and minimise sedimentation on the River Slaney SAC. The measures prescribed will be undertaken as best practice and are proven technologies/methods. This approach will ensure that flow will be maintained within the River Slaney at all times and, therefore, should not impede upstream migration within the River Slaney. In addition to the limited access to the bankside during the works, angling opportunities within the river is expected to be disrupted and is likely to deter angling from this stretch of the river during the construction phase. The proposed works will have a temporary negative high impact on angling within the town.

5.5.2 Operational Phase

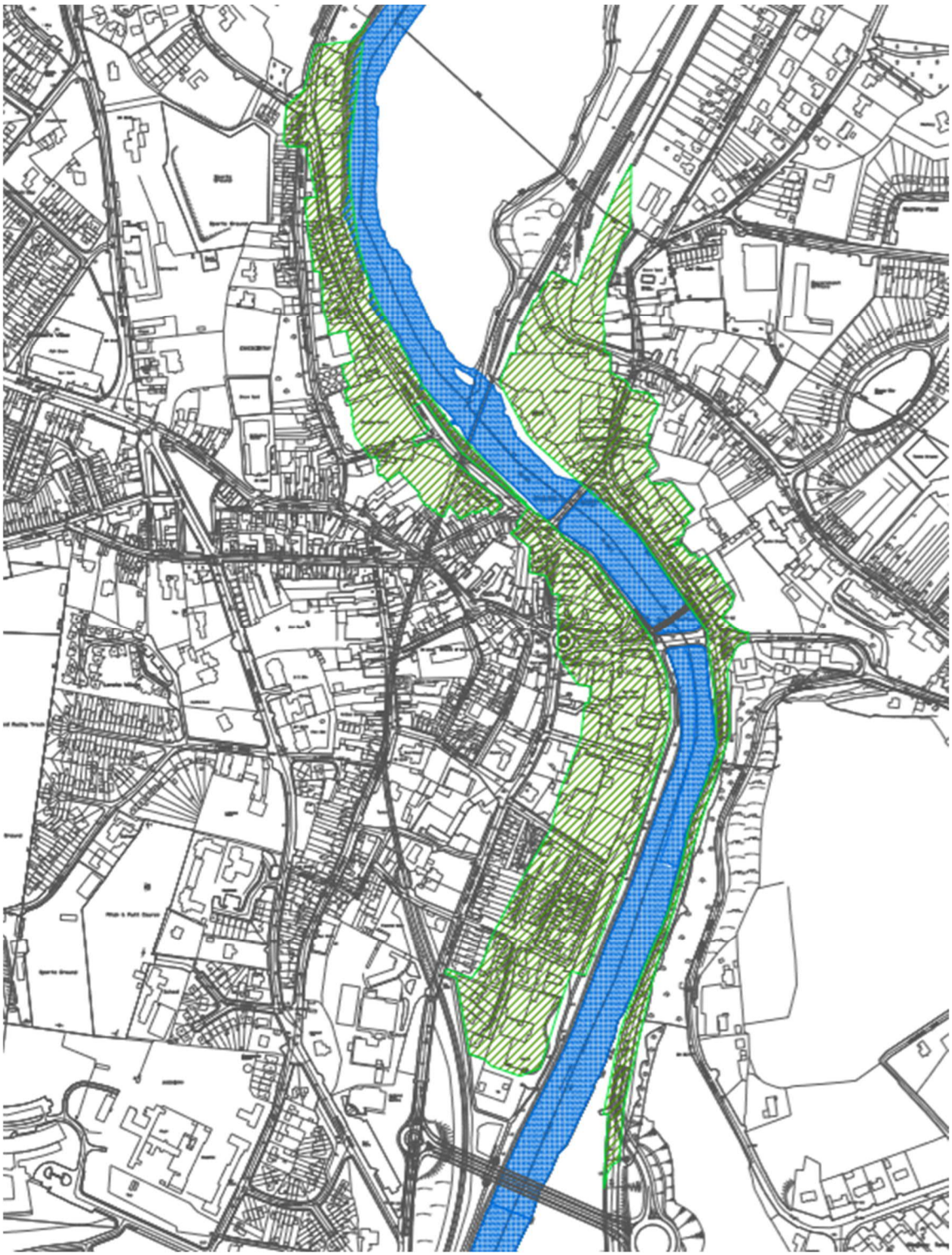
Population and Housing

Centres of population are recognised as vulnerable receptors to flooding and often host services and facilities that, if flooded, will impact a broader catchment of people than that directly impacted by the flood water. The upward trend in population figures in Enniscorthy Town and its hinterland has the potential to result in an increase in the number of receptors vulnerable to flooding. In 2000, over 110 properties in the town were flooded. Some by up to 1.5m in depth.

As well as the potential disruption flooding causes property damage that results in economic losses to both residents or to commercial enterprises. Insurance premiums within Enniscorthy have purportedly increased as a result of increased risk of flooding. These increases are potentially making premiums, if available, prohibitively expensive. This in turn leads to a rise in uninsured losses for properties. While the duration of flooding is relatively short term, economic costs incurred may be more long term, particularly where residential or commercial properties require structural repair or cleaning resulting in residents needing to vacate their properties or close their business for long periods of time. The likelihood of these impacts and subsequent costs occurring are high.

The implementation of the proposed scheme will have a major positive impact on population and human health of Enniscorthy and its wider hinterland, by preventing flooding in the Town. The Scheme will have a major positive impact on residents and business that were directly impacted by flooding in the town. The proposed scheme will offer flood protection to approximately 105 residential properties and approximately 127 commercial properties. Figure 5.2 below illustrated the lands that will benefit from implementation of the proposed scheme.

Figure 5.2: Land Benefit (shaded in green) resulting from the implementation of the proposed scheme



Source: Mott MacDonald 355741-MMD-00-XX-DR-N-0413

Land use

The proposed scheme includes the demolition of the Seamus Rafter Bridge and the construction of a new road bridge plus its approach roads onto the existing national road network. A bank of lands directly adjacent to the proposed scheme in the townland of Killagoley has been identified in the local development plan for the development of a new business and technology park. Whilst the proposed scheme does not facilitate the development of this land, traffic management improvements associated with proposed scheme in combination with the opening of the Bypass will have an overall positive effect on the future development in Killagoley and the town.

Local economy

The economic damage caused by flooding of property was estimated in 2018 using information from the property survey along with the FHRC 2010 Report[4]. The Average Annual Damage, discounted at a rate of 4% per annum, was calculated over a time horizon of 50 year to produce a Net Present Value of the potential flood damage. This has been estimated as €51 Million. Damage calculations were also carried out for the expected 2050 climate change scenario. In that scenario, the damage estimate is €99.45 million. This significant increase is due to both larger flooding and in the frequency of flooding by a factor of two under those circumstances.

There is also the potential for temporary disruption to economic activity within the town due to the proposed construction activities. This would predominantly be as a result of traffic and access issues which could have the potential to reduce footfall into local businesses, with noise and dust from the works adding to this temporary impact on local businesses.

The OPW calculated financial benefit from the scheme is estimated to approximately €51 million The scheme will prevent flooding and the costs associated with it. The estimated Benefit-to-Cost Ratio is estimated as 1.18. Consequently, a positive impact is anticipated in terms of offsetting the local economic costs of flood event. The scheme will ensure that access to the town and its services and business no longer be cut off.

Health and Wellbeing

Air and water are two of the principal requirements to support life and therefore the quality of each has a strong determining influence on human health. Pollutants can be transported so that they come into contact with human beings and pose a serious threat to human health. When surface water and foul drainage infrastructure becomes flooded their material enters residential and commercial properties thereby impacting health by increasing risk of disease. Overland flooding affects public roads and footpaths thereby impacting safety as this could potentially increase the risk of people being swept into the river and possibly lead to loss of life.

Access to the riverside is inhibited during a flood event, floodwater is a safety issue that prevents people from enjoying the amenity of the riverside. Extensive stretches of the riverside in the town are affected, in particular, the popular amenity walkway on the west side of the river. High river levels and flows during a flood event also preclude recreational activities including angling, and navigation activities due to the potential health and safety risks that arise. This disturbance would occur for the duration of high river levels and flows i.e. several days.

Many public objections were raised by the public in 2009 relating to the aesthetics and the loss of views of the River Slaney due to the construction of high walls along the quays. In addition, it was felt that the scheme would remove the connectivity between the quays and would impede access to the river for recreational use. In responding to these concerns, minor design

[4] The Benefits of Flood and Coastal Risk Management: A Handbook of Assessment Techniques- 2010 FHRC-Flood Hazard Research Centre.

amendments have been proposed on this scheme. These include but are not limited to the redesign of the pedestrian and road bridge, the refinement of local designated access points along the quays, incorporated glass walls and look out and seated areas along the Shannan Quay. A full landscape and visual impacts assessment of the proposed scheme is provided in Chapter 9 of this EIAR.

The potential impacts associated with the local traffic congestion within the town are discussed in Chapter 13. The proposed scheme includes the construction of a new pedestrian bridge and improved traffic management within the town. The scheme will have a major positive impact on traffic management and local pedestrian access in the Town.

The effect of flooding on human health and safety that would otherwise occur if the scheme was not implemented would be prevented. Consequently, a major positive impact is anticipated.

Flooding can have significant temporary impacts on some of the more vulnerable members of society including the sick and vulnerable. Enniscorthy Town serves as a market town for the wider hinterland. The majority of the services are not directly at risk from flooding, however during a flood event, access to many services is very restricted or not possible. Historic flood events in Enniscorthy have closed roads and access to the riverside preventing access by emergency services. The key community facilities are all located on the west side of the river. Closure impacts their ability to respond to call outs on the east side of the river and wider hinterland. Closure of key strategic routes and restricted access may increase the risk of loss of life that might otherwise be avoided. For a large flood event, the prevention of access would generally extend for up to a week. The OPW estimate at present, a flood event greater than that in 2000 can be expected, on average, three times every century.

The provision of clean water can be affected when existing services are flooded during a flood event, as power outages may hinder the water treatment plants operation and damaged assets in the plant may impede its operation. Whilst the existing WWTP is not in the flood risk zone, the provision of the Enniscorthy Flood Defence scheme will ensure that strategic infrastructure such as utility assets important to the overall operation of the network are less vulnerable to flooding (i.e. pumping stations, and drainage network) and will prevent service disruptions to the community.

The management of storm water behind the defence line is a key component of the scheme. In the event of a flooding event, where existing storm water outfalls are below the flood level the storm water outfall will be restricted and the network will back up which will result in flooding onto the streets and into community facilities resulting in potential environmental and health risk to the community. The scheme includes for the provision of 14No. surface water pumping stations, varying in size due to the various catchment sizes.

The potential for impacts associated with biophysical factors such as atmospheric, noise and water emissions etc. are considered in the subsequent Chapters of this EIAR.

The potential for impacts associated with traffic in the town are considered separately in Chapter 13 of this EIAR.

Infrastructure

In 2000, the national primary road network and rail infrastructure was impassable during the flood event. These strategic routes were cut off and the town was impassable until flood levels dropped lower. This type of flooding disrupts local traffic as well as through traffic in the town. The N11 is a European designated road as it forms part of the France, Ireland to Scotland route and its closure, represents a significant impact of national importance. Disruption to these major routes results in large commercial vehicles being obstructed or requiring long distance

diversions. Similarly, the railway system is of national importance, disruption to the Wexford to Dublin railway line would affect rail traffic in the south east region.

Tourism and Amenity

The proposed scheme maintains walkways along or adjacent to the river and wall heights ensure connectivity along the riverside and no impact is anticipated.

The reach of the River Slaney at Enniscorthy is the only fishing open to the public on the entire River Slaney. This is a valuable resource for the town and important amenity for the town and wider environs. Details of the proposed access arrangements to the river within Enniscorthy following the completion of works is provided in Section 4.2. Following completion of works no impact is anticipated.

5.5.2.1 Operational Maintenance Programme

The proposed scheme includes the installation of a sediment trap on the North Island and a debris trap at river chainage 6700m. This area will encourage the majority of sediment arriving from upstream to be deposited here. Removal of large items from the debris trap will be carried out following storm events when required and will not involve instream works. The design of the traps eliminates the need for regular maintenance dredging of the entire reach of the river channel, which would be environmentally damaging to the river habitat and, as such, will result in a significant benefitable effect on the River Slaney at this reach.

5.6 Cumulative Impacts

In addition to the proposed scheme, there are a number of additional development projects ongoing and proposed in the vicinity of Enniscorthy that are considered in terms of cumulative impact on the population and human health of the area. These projects include:

- Gorey to Enniscorthy PPP Bypass; and
- Water services upgrade and advance works such as relocation of water services.

Construction of the Gorey to Enniscorthy Scheme is currently ongoing and it is expected to be complete and operational in advance of construction. The PPP Scheme which will divert a significant volume of through traffic from Enniscorthy in advance of the commencement of works. There are no cumulative impacts associated with this scheme.

The Enniscorthy Town and Environs Development Plan emphasises the promotion and facilitation of the Enniscorthy Flood Defence Scheme within the town through its strategies and objectives set out in the Plan. It is worth noting that policy SW11, states all development proposals within Enniscorthy should have regard to the Enniscorthy Flood Defence Scheme also known as ‘River Slaney (Enniscorthy) Drainage Scheme’

The Killagoley Wastewater Treatment Plant is due to be decommissioned as part of the contract for the upgrading of the Enniscorthy Wastewater Treatment Plant at Lucas Park. The Lucas Park WWTP is located south of Enniscorthy Town on the western side of the River Slaney opposite the Bare Meadows floodplain. Access to the WWTP is from a local road next to St. Johns Villas via the N30. The existing pumping station to this WWTP is situated adjacent to the Riverside Park Hotel. The works are expected to be complete by the end of 2019. The network is also being upgraded and the Local Authority with Irish Water. The proposed works will improve the water services for the town and it is expected that there are no cumulative adverse impacts associated with this scheme.

5.7 Mitigation Measures

All works will be carried out having regard to international and national legislation, and best practice guidance, including but not limited to guidance on preventing pollution from construction sites and pollution prevention guidance.

Prior to any demolition, excavation or construction a Construction Environmental Management Plan (CEMP) will be set out by the appointed Contractor. The CEMP will set out the Contractor's overall management and administration of the construction period. The CEMP will be prepared by the Contractor during the pre-construction phase to ensure commitments included in this EIAR in addition to specified conditions that may be prescribed in the confirmation for the project, and any commitments given by WCC in relation to environmental protection associated with the construction phase. The Contractor will be obliged to provide the following information in the CEMP *inter alia* under the following headings:

- Details of working hours and days;
- Details of emergency and Incident Response (IRP) plans in place.
- Details of chemicals /fuel storage areas (including location and bunding to contain runoff of spillages and leakages);
- Details of construction plant storage;
- Construction Traffic Management Plan- Within the tender contract documents the nominated contractor is obliged to keep all areas, access routes and rights of way, leading to, from or crossing the site free from mud, or other hazardous substances that are deposited through construction operations. Where necessary, all carriageways are to be swept by a mechanical sweeper immediately prior to any traffic management scheme being removed.
- Dust Management Plan;
- Landscape Management Plan;
- Incident Response Plan (IRP);
- Ecological Management Plan;
- Construction and Demolition Waste Management Plan; and
- Project Procedures and Method Statements for each phase of the works.

The IRP will describe the procedures, lines of authority and processes that will be followed to ensure that all incident response efforts are prompt, efficient and appropriate to the particular incident. The plan will set out the water monitoring protocols in place upstream of the works areas to ensure the contractor and all employees have all the information and data to respond to an emergency and to handle it effectively. The IRP will set out procedures to be followed in the event of an incident (e.g. high-water levels, or spillages). It will also set out procedures for notifying appropriate emergency services or statutory bodies. The IRP will be prepared in consultation with Wexford County Council and will have regard to the Wexford County Council Flood Plan. A copy of the current WCC Flood Plan is appended in Appendix A of this EIAR. A copy of the Wexford County Council (WCC) Major Emergency Plan will be appended to the IRP and made available to the Contractor during the construction phase. The Major Emergency Plan is prepared in accordance with the Governments Major Emergency Management Framework. A copy of the current WCC Major Emergency Plan in found in Appendix A of this Report;

The Contractor will also be required to develop and implement a Public and Stakeholder Management and Communication Plan and will be required to be agreed with WCC prior to construction phase. Specific measures to mitigate potential significant impacts on human health (i.e. noise, dust, air and traffic are dealt with separately in the appropriate environmental topic in

this EIAR. Local residents and businesses within the surrounding area will be notified in advance of any disruptions to services in the area;

The Environmental Operating Plan (EOP) will be developed and updated by the Contractor during the project construction phase and will be limited to setting out the detailed procedures by which the mitigation measures proposed as part of the EIAR and NIS in addition to specified conditions prescribed in the confirmation. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the proposed scheme and provide a documented account to the implementation of the environmental commitments set out in the EIAR and NIS. The Plan will include the following information;

- Documentation of all commitments set out in the EIAR and NIS and conditions set out for the confirmation;
- List of all applicable environmental legislation requirements and a method of documenting compliance with these requirements; and
- Outline methods by which construction works will be managed to avoid, reduce or remedy potential adverse impacts on the environment.

As noted in Section 4.5 an EnCoW will be appointed by Wexford County Council on behalf of the OPW to ensure that the mitigation measures included in the EIAR, NIS and EOP are executed in the construction of the proposed scheme. The EnCoW will form part of the Employers Site Representative Team.

5.8 Residual Impacts

The successful implementation of the mitigation measures will result in flood protection for Enniscorthy Town and it is expected to have an overall positive impact.

6 Biodiversity

6.1 Introduction

This Chapter of the EIAR has been prepared with respect to ecological features with a specific focus on habitats, mammals, bats, birds and freshwater aquatic ecology occurring within the environs of the proposed scheme. This Chapter of the EIAR considers and assesses the potential direct, indirect and cumulative ecological impacts of the proposed scheme on terrestrial and aquatic ecology.

This Chapter has been prepared by ecological consultants Scott Cawley with the input from several technical specialists including:

- Dr. Joanne Denyer (Denyer Ecology); Botany and Annex I Habitats
- Dr. Evelyn Moorkens; Freshwater Pearl Mussel
- Dr. William O'Connor (Ecofact); Aquatic Ecology; and
- Eleanor Mayes (Ecological Consultant); Birds

The structure of the Chapter is presented below;

- **Section 6.2**- Outline the assessment methodology. The Chapter summarises the desktop and ecological surveys that were carried out within the study area;
- **Section 6.3**- Describes the baseline environment within the study area and provides results of the baseline ecological surveys and describes the nature conservation value of the study area. The section identifies the ecological evaluation of all receptors taking into consideration legal protection, conservation status and local abundance;
- **Section 6.4**- Provides technical information on the principal elements of the proposed scheme and examines the potential impacts on the key ecological receptors arising from the construction and operation phases of the proposed scheme
- **Section 6.5-** Describes the potential for cumulative effects resulting from additional development projects ongoing and proposed in the project area;
- **Section 6.6**- Describes the proposed mitigation measures for many of the proposed elements of the development mitigation measures. Measures that are 'embedded' in the overall design of the scheme are already assessed in the impact assessment section 6.4. Such 'embedded' mitigation is evident in the high level of ecological consideration given to the design of the proposed scheme as well as the proposed construction approach for the Enniscorthy Flood Defence Scheme;
- **Section 6.7**- Summarises the potential for significant residual effects on each of the key ecological receptors; and.
- **Section 6.8** – Summaries the monitoring approach for each of the key ecological receptors.

6.2 Assessment Methodology

6.2.1 Desktop Study

The desk study involved a review of relevant legislation and policy, collation of existing available information on the receiving ecological environment and consultation with relevant statutory bodies.

6.2.1.1 Relevant Legislation, Policy and Guidance

This assessment has regard to the following policy documents and guidelines.

National and International Legislation

- Planning and Development Act 2000, as amended
- Wildlife Act 1976, as amended
- European Communities (EC) (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011 (as amended) hereafter the 'Birds and Habitats Regulations';
- EU Birds Directive 2009/147/EEC;
- EU Habitats Directive 92/43/EEC (as amended);
- EU EIA Directive (2014/52/EU);
- Flora (Protection) Order, 2015;
- Fisheries Act 1959–2010;
- Water Services Act 2007 (Water Framework Directive 2000/60/EC);
- Directive on Environmental Quality Standards (Directive 2008/105/EC);
- Quality of Salmonid Water Regulations 1988 (S.I. No. 293/1988);
- EC Environmental Objectives (Surface Water) Regulations 2009 (S.I. No. 272 of 2009); and
- Conservation of Salmon and Sea Trout Bye-law (No. C.S. 301, 2008).

Relevant Policies and Plans

- National Biodiversity Action Plan 2017 – 2021 (Department of Culture, Heritage and the Gaeltacht, 2011);
- Eastern River Basin District, River Basin Management Plan 2009-2015;
- Wexford County Development Plan 2013 – 2019;
- Enniscorthy Town and Environs Development Plan 2008 – 2014 (as extended); and,
- Wexford County Council's Biodiversity Action Plan 2013 – 2018.

Relevant Guidelines

- Guidelines for Ecological Impact Assessment in the UK and Ireland Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2018);
- Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009);
- Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2002 and Draft Update 2017);
- Advice Notes on Current Practice (in preparation of Environmental Impact Statements) (EPA, 2003 Draft Update 2015);
- Best Practice Guidance for Habitat Survey and Mapping (Heritage Council, 2011);
- A Guide to Habitats in Ireland (Fossitt, 2000);
- Bat Mitigation Guidelines for Ireland (National Parks and Wildlife Service, 2006);
- Bat Surveys: Good Practice Guidelines, Third Edition (Bat Conservation Trust, 2016);
- Bat Surveys: Good Practice Guidelines (Hundt *et al*., 2012);
- Environmental Planning and Construction Guidelines Series (National Roads Authority, 2005 – 2011);
- Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes (NRA, 2006a);

- Design Manual for Roads and Bridges: Nature Conservation Advice in Relation to Bats (Highways Agency, 2001);
- Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (European Union, 2013);
- Central Fisheries Board (CFB) guidance Methods for the Water Framework Directive - Electric fishing in wadable reaches;
- River Habitat Survey in Britain and Ireland Field Survey Guidance Manual: 2003 Version' published by the Environment Agency (EA, 2003);
- 'The Evaluation of habitat for Salmon and Trout' (DANI, 1995);
- 'Ecology of the River, Brook and Sea Lamprey' Maitland (2003);
- IFI Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters; and
- CIRIA C532: Control of Water Pollution From construction sites Guidance for consultants and contractors.

Relevant Data Sources

The following resources and databases were referred to:

- Data on rare/protected/threatened species held by the National Parks and Wildlife Service (NPWS) accessed online http://www.npws.ie/mapsanddata;
- Data on designated sites was obtained from the online National Parks and Wildlife Service (NPWS) database http://www.npws.ie/mapsanddata;
- Data on rare/protected/threatened species and bat landscape suitability mapping held by the online National Biodiversity Data Centre database, available online at http://www.biodiversityireland.ie;
- Data on environmental conditions of the site and environs available from the Environmental Protection Agency (EPA) Geo Portal accessed online http://gis.epa.ie/Envision;
- Data on catchments, sub-catchments, assessments and trends from https://www.catchments.ie;
- Data held by the Botanical Society of Britain and Ireland (BSBI) Vice County Recorder for Wexford;
- Records of bat roost and activity within 10km of the proposed scheme survey area, held by Bat Conservation Ireland (April 2016);
- Records from the All-Ireland Daubenton's Bat Surveys 2006-2011;
- Information from the Irish Bat Monitoring Schemes BATLAS Republic of Ireland Report for 2008 – 2009;
- County Wexford Biodiversity Action Plan 2013 - 2018 (Wexford County Council, 2013);
- M11 Gorey to Enniscorthy Scheme – Environmental Impact Statement. Volumes 1 – 4 (Ryan Hanley WSP, 2009);
- Habitat Survey of the River Slaney Valley around Enniscorthy, County Wexford (Goodwillie, 2003);
- Natura Impact Statement (NIS) Screening Report and Appropriate Assessment (including mitigation) and Baseline Survey of Flora and Fauna for the proposed Extension of the River Slaney Trails at Enniscorthy (Ted Walsh & Associates LTD, 2013);
- An Assessment of the River Slaney for the Presence of Bats, Badgers and Otters in Advance of a Flood Relief Scheme at Enniscorthy, County Wexford and Proposed Mitigation (Keeley, 2005);

- NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Species Assessments Volume 3. Version 1.0. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland;
- King J.J., Hanna G. And Wightman G.D. (2008) Ecological Impact Assessment (EcIA) of The Effects of Statutory Arterial Drainage Maintenance Activities on Three Lamprey species (*Lampetra planeri* Bloch, *Lampetra fluviatilis* L, and *Petromyzon marinus* L). Series of Ecological Assessments on Arterial Drainage Maintenance No 9 Environment Section, Office of Public Works, Headford, County Galway;
- Records of bird species held by the National Biodiversity Data Centre; and
- IWeBS data for the River Slaney, provided by BirdWatch Ireland and by Alyn Walsh, NPWS. The Irish Wetland Bird Survey (I-WeBS) is a joint scheme of BirdWatch Ireland and the National Parks and Wildlife Service (NPWS).

6.2.1.2 Consultations

Consultation was carried out with National Parks and Wildlife Service (NPWS), Inland Fisheries Ireland (IFI) and John Cross (Woodland specialist). Meetings were on-going throughout preparation of this EIAR Chapter, as summarised in Table 6.1 below. Furthermore, in advance of aquatic surveys, consultation with NPWS and Inland Fisheries Ireland (IFI) was also carried out regarding existing information for the area and where licensing was involved to carry out surveys, specifying appropriate methodologies and stipulating conditions for surveys.

Table 6.1: Record of Consultations

Consultee	Date	Details
NPWS	2016-2018	Correspondence with NPWS staff. Communications informed the survey methodology used to collect data for the proposed scheme.
NPWS	17 February 2016	Local NPWS staff met with staff from Scott Cawley. Scope of surveys was discussed and included lamprey, invasive species, otter, bats, birds and Annex I habitats- Alluvial Woodland, Floating River Vegetation. Comments from NPWS were incorporated into the survey design.
NPWS	6 July 2016	Meeting attendance included local NPWS staff; Mott MacDonald, Scott Cawley and Wexford County Council. Overview of ecology baseline survey results and discussion in relation to key issues/constraints identified to inform the design of the scheme.
NPWS	2 October 2017	Meeting attendance included Ciara O'Mahony, Ciara Flynn, Aine O'Connor and David Tierney from NPWS; Mott MacDonald, Scott Cawley, Dr Will O'Connor, Dr Evelyn Moorkens, OPW and Wexford County Council Survey results and key ecological receptors were discussed and the draft mitigation strategy. Feedback from NPWS has been considered and is incorporated in this ecological impact assessment.
IFI	November 2017	Meeting between Mott MacDonald staff and IFI discussed the progress of the scheme and construction approach
John Cross	February and October 2017	Dr John Cross (Woodland Specialist) provided comment on Joanne Denyer's wet woodland surveys and potential impacts relating to [3260] Alluvial woodland.

6.2.2 Field Surveys

A suite of ecological field surveys carried out which have informed the determination of the baseline environment and against which impacts on the biodiversity are assessed are presented in Table 6.2.

Table 6.2: Summary of Field Survey undertaken

Survey Type	Area Surveyed	Reference
Habitat surveys (Fossitt, 2000)	9, 10, 19 May 2016; 9, 10 June 2016, 7 July 2016; 3 August 2016	Appendix C.1
Old oak woodland survey	17 July 2016	Appendix C.2
Wet woodland survey	13 May 2016; 15, 17 July 2016; 25 September 2016; 2 May 2017	Appendix C.3
Macrophyte survey	July 2016	Appendix C.4
Mammal surveys	25, 26 February; 2, 3 March 2016	Appendix C.5
Bat Surveys	20 , 21 April 2016; 4, 5 May 2016; 9, 10 June 2016; 28 September 2016	Appendix C.6
Winter bird surveys	22, 23 March 2016	Appendix C.7
Breeding bird surveys	12, 13, 29 April 2016; 18, 19, 30, 31 May 2016; 16, 17 June 2016; 6, 12, 20 July 2016; 24 August 2016; 16 March 2017; 11 April 2017; 4, 29 May 2017	Appendix C.7
Raptor surveys	3, 10 March; 5 April; 18 May 2016	Appendix C.7
Barn owl survey	16, 17 June 2016; 6 July, 12 July, 29 July 2016	Appendix C.7
Vantage point surveys	February 2016 - January 2017	Appendix C.7
Lamprey and fish surveys	14, 15, 22 April 2016; 4, 5,14, 15, 26 May 2016; 7, 14 June 2016; July 2016	Appendix C.8
Fresh water pearl mussel survey	7 September 2016; 28 October 2016	Appendix C.9 and C.10

6.2.2.1 Zone of Influence

The zone of influence of a proposed scheme is considered from the outset to ensure survey areas adequately account for the zone of influence of the proposed scheme. According to the Chartered Institute for Ecology and Environmental Management (CIEEM) Guidelines (CIEEM, 2018), the zone of influence for a project is *'the area over which ecological features may be subject to significant effects as a result of the proposed project and associated activities. This is likely to extend beyond the project site, for example, where there are ecological or hydrological links beyond the site boundaries.*'

For example, the zone of influence for terrestrial habitats is generally limited to the footprint of the proposed scheme, and immediate environs (to take account of shading or other indirect impacts, such as air quality). Hydrological linkages (*e.g.* rivers or groundwater flows) between impact sources and aquatic habitats and species can often result in impacts occurring at significant distances. The zone of influence was taken into consideration when defining the survey areas described in each section below.

6.2.3 Survey Methodologies

6.2.3.1 Habitat and Flora Surveys

The survey area for terrestrial habitat surveys comprised a corridor of approximately 250-400m wide from approximately S 98043 40828 in the north to S 97490 37409 in the south (see Figure 6.1 in Appendix C.15). This corridor was bordered in the southwest by the Dublin to Rosslare train line, and in the southeast by the N11 road. The area around the proposed location for bridges, roundabouts and approach roads (at approximate NGR: S 97263 39252 in the west and S 97476 39183 in the east) was included in the survey area. All habitats were classified using the *Guide to Habitats in Ireland* (Fossitt, 2000).

Full terrestrial survey methodologies are described in Appendix C.1.

Detailed woodland surveys were undertaken in selected areas of wet woodland and oak-birch-holly woodland where Fossitt (2000) classifications corresponded to Annex 1 habitat types. Full woodland survey details are provided in Appendix C.2 and C.3.

An aquatic macrophyte survey was carried out within representative 100m survey lengths (transects) of the c. 4km main river survey area. The recommended minimum number of transects is one per km (i.e. four sections), although five transects were undertaken to ensure that the full variation of macrophyte vegetation was surveyed. Surveys were also carried out downstream of the proposed scheme and were undertaken for the protected plant species Short-leaved Water-starwort. A “Licence to Take or Interfere with Protected Plant Species” under Section 21 of the Wildlife Act in relation to the aquatic plants: Short-leaved Water-starwort and Opposite-leaved Pondweed within the River Slaney Special Area of Conservation (SAC) was obtained from NPWS before any aquatic macrophyte surveys were undertaken (Licence FL06/2016). Further details of the aquatic habitat survey are provided in Appendix C.4.

6.2.3.2 Mammal Surveys

The survey area for mammal surveys was focussed within a 250m – 400m wide corridor of suitable habitat which encompasses the location of the proposed scheme (see Figure 6.1 in Appendix C). Fauna, such as otters, badgers and other small mammals, were surveyed through the detection of field signs such as tracks, markings, feeding signs, and droppings, as well as by direct observation. Motion-activated wildlife cameras were used to monitor potential mammal resting sites within the survey area. Footage was recorded under a NPWS licence [013/2016]. A full methodology is provided in Technical Appendix C.5.

6.2.3.3 Bat Survey

The survey area for bat surveys was focussed within a 250m – 400m wide corridor of suitable habitat which encompasses the location of the proposed scheme which represented a more focused area compared to the habitat survey area (see Figure 6.1 in Appendix C.15). Bat surveys focussed on suitable roosting and foraging habitat within the zone of influence such as watercourses, treelines, woodlands, hedgerows, grasslands and swamps along the section of the River Slaney which shall be directly impacted by the proposed scheme. Surveys included an assessment of potential roost features (PRFs), post-dusk and pre-dawn bat activity surveys, an extended post-dusk survey and monitoring using static unattended bat detectors. See Technical Appendix C.6 for full survey methodology.

6.2.3.4 Bird Survey

The overall baseline bird survey area included the River Slaney corridor 1.5km upstream of the proposed scheme, and the scheme area including the footprint of the proposed new bridge over the Slaney and the associated roads, and the river floodplains and adjoining lands (see Figure 6.2 in Appendix C.15). Surveys included waterbird surveys, winter walkover surveys, breeding bird surveys, diurnal raptor surveys, barn owl surveys and vantage point surveys. For full survey methodology, see Technical Appendix C.7.

6.2.3.5 Aquatic Survey

Aquatic ecology surveys were carried out at ten different locations along the River Slaney including the scheme extent and upstream and downstream of the scheme (see Figure 6.3 in Appendix C.15). Surveys at these locations included river physical structure surveys (river habitat survey, river hydromorphology assessment, salmonid and lamprey habitat survey), a macroinvertebrate survey, lamprey (adult spawning survey and juvenile survey), and fish surveys. Full survey details are found in Technical Appendix C.8.

6.2.3.6 Mollusc Survey

Surveys for Freshwater Pearl Mussel (FPM) were carried out within the stretch of the river between the upper and lower extent of the proposed scheme by snorkelling, and in some areas using bathyscopes. In addition, a habitat condition survey for FPM was also carried out in the stretch of river where mussels were found. See Technical Appendix C.9 and 6.10 for full methodology.

6.2.4 Study Constraints/Limitations

Surveys undertaken provide a snapshot of the ecological features present at the time of the surveys. Bat surveys were not undertaken in winter and therefore confirming use of certain hibernation roost features by bats in winter was not possible, however, given the lack of suitable structures for such purposes this was not regarded to be a significant limitation.

Aquatic surveys, although carried out in dry and bright weather conditions, were limited by water clarity especially in the southern end of the study area in the tidal reaches of the River Slaney. In addition, parts of the riverbed could not be viewed due to algal growth, instream vegetation and siltation.

Due to difficult terrain in some parts of the survey area e.g. steep rocky outcrops on the eastern side of the N11, and deep river corridor, some areas were inaccessible. However, binoculars (or a grapnel for aquatic vegetation surveys) were used where possible to survey such areas.

Species records data held by record centres and statutory bodies (such as NPWS) are often provided on an *ad-hoc* basis by recorders. These records can only provide an indication of what species might be found in an area; they do not constitute full and complete species lists. Absence of certain species from these sources does not confirm absence of species in the area.

6.2.5 Ecological Evaluation and Assessment of Impacts

6.2.5.1 Ecological Evaluation Criteria

The criteria used to assess the ecological value and significance of ecological features is provided in Table 6.3 below, and follows *Guidelines for assessment of Ecological Impacts of National Road Schemes* (NRA, 2009) and is consistent with the approach recommended in the

Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (CIEEM, 2018).

Table 6.3: Criteria to assess the ecological value & significance of ecological features

Ecological Value	Description
International Importance:	European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA), candidate Special Area of Conservation (cSAC) or proposed Special Protection Area (pSPA). Proposed Special Protection Area (pSPA). Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended). Features essential to maintaining the coherence of the Natura 2000 Network.5 Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive. Resident or regularly occurring populations (assessed to be important at the national level)6 of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and / or Species of animal and plants listed in Annex II and/or IV of the Habitats Directive. Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971). World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972). Biosphere Reserve (UNESCO Man & The Biosphere Programme). Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979). Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979). Biogenetic Reserve under the Council of Europe. European Diploma Site under the Council of Europe. Irish Regulations implementing the Water Framework Directive
National Importance	Site designated or proposed as a Natural Heritage Area (NHA). Statutory Nature Reserve. Refuge for Fauna and Flora protected under the Wildlife Acts. National Park. Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park. Resident or regularly occurring populations (assessed to be important at the national level)7 of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing 'viable areas'8 of the habitat types listed in Annex I of the Habitats Directive

[5] See Articles 3 and 10 of the Habitats Directive.

[6] It is suggested that, in general, 1% of the national population of such species qualifies as an internationally important population. However, a smaller population may qualify as internationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

[7] It is suggested that, in general, 1% of the national population of such species qualifies as a nationally important population. However, a smaller population may qualify as nationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

[8] A 'viable area' is defined as an area of a habitat that, given the particular characteristics of that habitat, was of a sufficient size and shape, such that its integrity (in terms of species composition, and ecological processes and function) would be maintained in the face of stochastic change (for example, as a result of climatic variation).

Ecological Value	Description
County Importance	Area of Special Amenity.9 Area subject to a Tree Preservation Order. Area of High Amenity, or equivalent, designated under the City Development Plan. Resident or regularly occurring populations (assessed to be important at the County level)10 of the following: Species of bird listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance. County important populations of species, or viable areas of semi-natural habitats or natural heritage features identified in the National or Local Biodiversity Action Plan (BAP) if this has been prepared. Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level
Local Importance (higher value)	Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level)11 of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality; Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value
Local Importance (lower value):	Sites containing small areas of semi-natural habitat that are of some local importance for wildlife; Sites or features containing non-native species that are of some importance in maintaining habitat links.

Source: NRA 2009

6.2.5.2 Impact Assessment Criteria

In accordance with NRA guidelines (2009) and CIEEM (2018), impact assessment is only undertaken of Key Ecological Receptors (KERs). These are features within the zone of influence of the proposed scheme which are “both of sufficient value to be material in decision

[9] It should be noted that whilst areas such as Areas of Special Amenity, areas subject to a Tree Preservation Order and Areas of High Amenity are often designated on the basis of their ecological value, they may also be designated for other reasons, such as their amenity or recreational value. Therefore, it should not be automatically assumed that such sites are of County importance from an ecological perspective.

[10] It is suggested that, in general, 1% of the County population of such species qualifies as a County important population. However, a smaller population may qualify as County importance where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

[11] It is suggested that, in general, 1%of the local population of such species qualifies as a locally important population. However, a smaller population may qualify as locally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

making and likely to be affected significantly". According to NRA guidelines (NRA, 2009), KERs are of local importance (higher value) or higher as per NRA value criteria. Features of local importance (lower value) are not considered in the guidance to be KERs and are therefore excluded from impact assessment. The zone of influence for ecological features is defined in Section 6.2.2.1. The criteria used to characterise impacts are outlines in the tables below.

Magnitude of impacts

Table 6.4 below lists impact characteristics combine to form a qualitative description of impact magnitude, referring to impact size, amount, intensity and volume.

Table 6.4: Magnitude of impact parameters

Parameter	Categories
Type of impact	Positive/Negative
Magnitude of impact	Size or amount of impact
Extent	Area over which impact occurs (may be the same as magnitude if whole habitat impacted)
Duration	Time over which impact is expected to last. For example, described as Short-term, Medium-term or Long-term in relation to relevant species/ habitat time-scales.
Reversibility	Temporary/Permanent
Timing and frequency	Timing of impacts in relation to relevant life-stages or seasons
Likelihood of impact occurring	Near-certain: probability >95% Probable: probability 50-95% Unlikely: probability 5-50% Extremely unlikely: probability <5%

Significance of Effects

An impact is considered to be ecologically significant if it impacts the conservation status of a KER within a specified geographical area. If impacts are not found to be significant at the highest geographical level at which the KER has been valued using NRA Valuation Criteria, then the impacts may be significant at a lower level. For instance, there may be a significant impact at a local level on a species which is valued at an international level. The highest levels of impact significance for each KER 'value' rating are shown in the table below.

Table 6.5: Highest level of impact significance for KERs

Sensitive Ecological Receptor 'value' rating	Highest possible significance level
International Importance	Significant Positive/ Negative impact at International level
National Importance	Significant Positive/ Negative impact at National level
County Importance	Significant Positive/ Negative impact at County level
Local Importance (higher value)	Significant Positive/ Negative impact at Local level
Local Importance (lower value)	Significant Positive/ Negative impact at Local level

Biodiversity has been evaluated in relation to the NRA criteria set out in Section 5 which includes for example legal protection they may be afforded (at International or National level), their conservation status and local abundance. For instance, a species that is listed on Annex II or IV of the EC Habitats Directive is considered to be of 'International' importance. As above, this does not mean that an impact will necessarily be significant at an International level.

6.3 Receiving Environment

The River Slaney is approx. 117km long and flows from its source in a southerly direction through Co. Wicklow, Co. Carlow and Co. Wexford before entering the Irish Sea at Wexford Harbour, draining a catchment of 1,631km^2. Downstream of Enniscorthy, the River Slaney enters a 19km long estuary before discharging into Wexford Harbour at Wexford town. The area surrounding the scheme supports a variety of habitats including woodland (scrub, hedgerows and treelines), grasslands and wetlands, as well as more urban habitats and amenity areas associated with Enniscorthy town. Land-uses include agricultural, recreational, forest, commercial and residential use. The tidal reach of the River Slaney extends to the Old Bridge within the scheme area.

6.3.1 Designated Sites

There are six designated areas for nature conservation located within 15km of the proposed scheme (as listed in Table 6-6 below) and of these, only the River Slaney Valley Special Area of Conservation (SAC) and proposed Natural Heritage Area (pNHA) and the Wexford Harbour and Slobs Special Protection Area (SPA) are considered to be within the potential zone of influence of the proposed scheme. The extent of the designated sites within 15km are shown in Figure 6.4 in Appendix C. SAC's are designated under the EC Habitats Directive (92/43/EEC) as amended, which is transposed into Irish law through a variety of legislation including the Birds and Habitats Regulations and the Planning Acts, for the protection of habitats listed on Annex I and/or species listed on Annex II of the Directive. SPAs are designated under the Birds Directive (2009/147/EC) for the protection of protected bird species listed on Annex I of the Directive, regularly occurring populations of migratory species (such as ducks, geese or waders), and areas of international importance for migratory birds.

National Heritage Areas (NHAs) are designations under the Wildlife Acts to protect habitats, species or geology of national importance. Many of the NHAs in Ireland overlap with the boundaries of European sites. Although many NHA designations are not yet fully designated under this legislation (referred to as 'proposed NHAs' or pNHAs), they are offered protection in the interim period under existing planning legislation which requires that planning authorities give due regard to their protection in planning policies and decisions. The location of the pNHA within the study area is shown in Figure 6.5 in Appendix C.

The majority of the proposed scheme is located within the River Slaney Valley SAC and is marginally located within the Wexford Harbour and Slobs SPA. The boundary of this SPA starts within the River Slaney corridor approximately half way along the southern floodplain in the south of the scheme area.

Table 6.6: Designated sites for nature conservation within 15km of the proposed scheme

Site name and code	Distance from Proposed scheme	Reasons for designation (*=indicates a priority habitat under the Habitats Directive)	Source-pathway-receptor link exist?
Special Area of Conservation (SAC) within 15km			
River Slaney Valley SAC [000781]12	The majority of the proposed scheme lies within this SAC.	Qualifying Interest Habitats and Species for the River Slaney Valley SAC [000781]	Yes, as the scheme lies within the SAC and has hydrological linkage to the QIs of the SAC.

[12] NPWS (2011) Conservation Objectives: River Slaney Valley SAC 000781. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

Site name and code	Distance from Proposed scheme	Reasons for designation (*=indicates a priority habitat under the Habitats Directive)	Source-pathway-receptor link exist?
		1029 Freshwater Pearl Mussel *Margaritifera margaritifera*[13] 1095 Sea Lamprey *Petromyzon marinus* 1096 Brook Lamprey *Lampetra planeri* 1099 River Lamprey *Lampetra fluviatilis* 1103 Twaite Shad *Alosa fallax* 1106 Atlantic Salmon *Salmo salar* (only in fresh water) 1130 Estuaries 1140 Mudflats and sandflats not covered by seawater at low tide 1355 Otter *Lutra lutra* 1365 Harbour Seal *Phoca vitulina* 3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation 91A0 Old sessile oak woods with Ilex and Blechnum in the *British Isles* *91E0* Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno - Padion, Alnion incanae, Salicion albae)**	
Blackstairs Mountains [000770] SAC14	This SAC lies c. 14.2km to the north west of the proposed scheme.	Qualifying Interest Habitats and Species for the Blackstairs Mountains SAC [000770] 4010 Northern Atlantic wet heaths with Erica tetralix 4030 European dry heaths	No, due to the absence of hydrological link between the proposed scheme and SAC.
Screen Hills SAC [000708]15	This SAC lies c. 15km to the south east of the proposed scheme.	Qualifying Interest Habitats and Species for the Screen Hills SAC [000708] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) 4030 European dry heaths	No, due to the absence of hydrological link between the proposed scheme and SAC.
Special Protection Area (SPA) within 15km			
Wexford Harbour and Slobs SPA [004076]16	The majority of this site lies outside of the proposed scheme. However, the boundary of this SPA starts	Qualifying interests (Special Conservation Interests (SCI)) for Wexford Harbour and Slobs SPA [004076]A004 Little	Yes, as the scheme lies within the SPA and the SPA area is hydrologically linked to the wetland habitats that

[13] Although Margaritifera is a designated Qualifying Interest, the extent of environmental objectives is restricted to the Derreen River sub-population

[14] Source: NPWS (2016) Conservation objectives for Blackstairs Mountains SAC [000770]. Generic Version 5.0. Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.

[15] NPWS (2016) Conservation objectives for Screen Hills SAC [000708]. Generic Version 5.0. Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.

[16] NPWS (2012) Conservation Objectives: Wexford Harbour and Slobs SPA 004076. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

Site name and code	Distance from Proposed scheme	Reasons for designation (*=indicates a priority habitat under the Habitats Directive)	Source-pathway-receptor link exist?
	within the River Slaney corridor approximately half way alongside of the southern floodplain (Bare Meadow).	Grebe*Tachybaptus ruficollis*wintering A005 Great Crested Grebe *Podiceps cristatus* wintering A017 Cormorant *Phalacrocorax carbo*wintering A028 Grey Heron*Ardea cinereal* wintering A037 Bewick's Swan *Cygnus columbianus* wintering A038 Whooper Swan *Cygnus cygnus* wintering A046 Light-bellied Brent Goose*Branta bernicla hrota* wintering A048 Shelduck*Tadorna tadorna*wintering A050 Wigeon*Anas penelope*wintering A052 TealAnas creccawintering A053 Mallard*Anas platyrhynchos* wintering A054 Pintail*Anas acuta* wintering A062 Scaup *Aythya marila* wintering A067 Goldeneye *Bucephala clangula* wintering A069 Red-breasted Merganser *Mergus serrator* wintering A082 Hen Harrier *Circus cyaneus* post-breeding/roost A125 Coot *Fulica atra* wintering A130 Oystercatcher *Haematopus ostralegus* wintering A140 Golden Plover *Pluvialis apricaria* wintering A141 Grey Plover *Pluvialis squatarola* wintering A142 Lapwing *Vanellus vanellus* wintering A143 Knot *Calidris canutus* wintering A144 Sanderling *Calidris alba* wintering A149 Dunlin *Calidris alpina* wintering A156 Black-tailed Godwit *Limosa limosa* wintering A157 Bar-tailed Godwit *Limosa lapponica* wintering A160 Curlew *Numenius arquata* wintering	are supported by tidal and fluvial flooding on the southern floodplain, including the Bare Meadow. 12 of the Special Conservation Interests (SCI) bird species were recorded within the proposed scheme (FDS) area during the period February 2016 to February 2017.

Site name and code	Distance from Proposed scheme	Reasons for designation (*=indicates a priority habitat under the Habitats Directive)	Source-pathway-receptor link exist?
		A162 Redshank *Tringa totanus* wintering A179 Black-headed Gull *Chroicocephalus ridibund*us wintering A183 Lesser Black-backed Gull *Larus fuscus* wintering A195 Little Tern *Sterna albifrons* breeding A395 Greenland White-fronted goose *Anser albifrons flavirostris* wintering A999 Wetlands This SPA is adjacent to The Raven SPA 004019. These SPAs partially overlap with Raven Point Nature Reserve SAC 000710 and River Slaney Valley SAC 000781. The conservation objectives for this site should be used in conjunction with those for adjacent and overlapping designations as appropriate.	
Proposed Natural Heritage Areas (pNHAs) within 5km			
River Slaney Valley pNHA [000781]17	The proposed scheme lies within the boundary of this site.	This site comprises the freshwater stretches of the Slaney as far as the Wicklow Mountains; a number of tributaries the larger of which include the Bann, Boro, Glasha, Clody, Derry, Derreen, Douglas and Carrigower Rivers, the Estuary at Ferrycarrig and Wexford Harbour. The site supports populations of several species listed on Annex II of the EU Habitats Directive, and habitats listed on Annex I of this directive, as well as important number of wintering wildfowl including some species listed on Annex I of the EU Birds Directive. The presence of wet and broad-leaved woodlands increases the overall habitat diversity and the occurrence of a number of Red Data Book plant and animal species adds further importance to the River Slaney site.	Yes, as the scheme lies within the pNHA and has hydrologically linkage to the designated site.
Ballynabarney Wood pNHA [000746]18	c.2km north east of the proposed scheme.	Woodland occurs in a valley of a tributary of the River Slaney and supports a mosaic of Old	No, as the scheme lies downstream of the pNHA and is not within the tidal reach of the River Slaney

[17] NPWS Site Synopsis for River Slaney Valley – 07.12.2005

[18] County Wexford Biodiversity Action Plan 2013 – 2018 (no NPWS site synopsis available)

Site name and code	Distance from Proposed scheme	Reasons for designation (*=indicates a priority habitat under the Habitats Directive)	Source-pathway-receptor link exist?
		Sessile Oak woodland and Oak-Ash-Hazel woodland.	and therefore has no hydrologically linkage to the designated site.

6.3.1.1 Records of Protected, Rare and other Notable Species

Records of rare or protected flora and fauna within 10km of the proposed scheme were obtained from NPWS, National Biodiversity Data Centre (NBDC), Botanical Society for Britain and Ireland (BSBI) and Bat Conservation Ireland (BCI).

Flora

Records of eight species listed on the Flora (Protection) Order 2015 ("FPO species") within the 10km Grid Squares (S94; S93; T03; and, T04) were returned by NPWS. In addition, rare and threatened species are returned and are listed Appendix C.1, the precise location of these rare plants has been kept confidential.

Rare plants listed by NPWS that would be expected to occur in the environs of Enniscorthy include:

- Blue Fleabane *Erigeron acer* (Vulnerable on the Red List, recorded in 1866);
- Opposite-leaved Pondweed *Groenlandia densa* (Vulnerable, FPO species, recorded at Macmine Junction in 1897);
- Short-leaved Water-starwort *Callitriche truncata* (Vulnerable, FPO species, recorded at Burrmount House, County Wexford in 2010);
- Green-winged Orchid *Orchis morio* (Vulnerable, recorded near Enniscorthy in the 1890's);
- Yellow Archangel *Lamiastrum galeobdolon* (Rare, recorded in Enniscorthy in 1898); and,
- Greater Broomrape *Orobanche rapum-genistae* (Rare, recorded south of Enniscorthy in 2003).

Shepherd's-needle *Scandix pecten-veneris* was recorded in Enniscorthy in 1898, however this plant is now listed as Extinct. Musk Thistle *Carduus nutans* was recorded south of Enniscorthy (outside of the proposed scheme) in 2010 – Brownswood Quarry (NBDC). This plant is listed in the Red List as 'Data Deficient'. It is rare in the country, and was probably introduced, but has been recorded in Wexford since 2000.[19]

Records of county rare and notable flora within 10km of the proposed scheme were obtained from the local BSBI Wexford County Recorder and included recent records of the protected plant Short-leaved Water-starwort *Callitriche truncata.* All of these records lie south of the proposed scheme outside of the anticipated zone of influence.

Mammals

The NBDC database returned records of eight mammal species in relation to the proposed scheme. Records returned occurring within the proposed scheme survey area include otter sightings beside the southern floodplain, red squirrel *Sciurus vulgaris c.*200m east of the centre of the proposed scheme (S975400), hedgehog *Erinaceus europaeus* road kill and harbour seal sighting within the survey area.

[19] http://www.irishwildflowers.ie/pages/493a.html

According to the M11 Gorey to Enniscorthy Scheme (Enniscorthy Bypass) Environmental Impact Statement (EIS) (Royal Haskoning 2009), badger and otter are present within the environs of Enniscorthy (Ryan Hanley WSP 2009). However, none of the otter holts or badger setts identified for the M11 scheme lie within 250m of the proposed scheme.

As part of the EIS for the Enniscorthy Flood Relief Scheme proposed in 2007, mammal surveys were undertaken both in 2004 and 2005 (Keeley, 2005). Three otter holts were identified during this survey.

Flora and fauna surveys were carried out for the proposed extension of the River Slaney Trails at Enniscorthy (Ted Walsh & Associates Ltd, 2013). All activity recorded lies outside of the Survey Area for the proposed scheme, however, the results support the findings that otter and badger are both active in the environs.

Bats

From the NBDC bat landscape suitability mapping, a Bat Landscape Suitability index[20] (Lundy *et. al.* 2011) score of *c.*30 on the index (from 0 – *c.*59) indicates habitats within the survey area are suitable for bats and provide habitat that is of importance to bats.

NBDC record search also returned recent records of the following bat species within the survey area[21]; Daubenton's bat *Myotis daubentonii* (2014); whiskered bat *Myotis mystacinus* (2008); Leisler's bat *Nyctalus leisleri* (2010); common pipistrelle bat *Pipistrellus pipistrellus* (2010); and, brown long-eared bat *Plecotus auritus* (2008).

A search for Bat Conservation Ireland (BCI) records of bat species within 10km of the survey area was conducted on 25th April 2016. Bat roost record results are provided in Appendix C.6 (in order to protect these species, the precise locations have been withheld). Bat roosts recorded within a 10km buffer zone of the proposed scheme included the following species: whiskered bat, brown Long-eared bat, common pipistrelle and soprano pipistrelle bat *Pipistrellus pygmaeus*. In addition, there were roosts recorded for '*Myotis* species' and 'Unidentified bat'.

Bats recorded in County Wexford during BATLAS surveys include; common pipistrelle bat, soprano pipistrelle bat, Leisler's bat and Daubenton's bat. In addition, Nathusius pipistrelle bat *Pipistrellus nathusii*, other *Myotis sp*. (including Natterer's bat *Myotis nattereri* and whiskered bat) and brown long-eared bat were also recorded in Co. Wexford during BATLAS but were not a focus species for that particular study (Carden *et al.,* 2010). It is noted in the BATLAS 2020 Pilot (Abbott *et al*., 2015) that a single Greater Horseshoe bat *Rhinolophus ferrumequinum* was recorded in County Wexford in the winter of 2012-2013, however, no additional specimen of this species has been confirmed since.

The M11 Gorey to Enniscorthy Scheme (Enniscorthy Bypass) EIS (Royal Haskoning 2009) confirmed a number of roosting locations for bats (*Pipistrelle* bat species and Brown Long-eared bat) in 2007-8, however the closest of these was *c.* 1.8km east of the centre of Enniscorthy town centre.[22] The bat roosts identified during these surveys are not considered to be within the zone of influence of the proposed scheme, however, due to their proximity, bats supported by these roosts could make use of suitable habitats within the survey area for foraging or commuting, particularly as most bat species can travel several kilometres from their roosting sites to favourable foraging grounds (Lundy *et al.,* 2011).

[20] http://maps.biodiversityireland.ie/metadata/Landscape_Conservation_for_Irish_Bats_metadata(v.3).pdf

[21] Source: NBDC – Title of Dataset: National Bat Database of Ireland

[22] Source: M11 Gorey to Enniscorthy Scheme (Enniscorthy Bypass) EIS (Royal Haskoning 2009); Volume 4, Figure 9.1.6 Ecology Fauna Map

Bat surveys carried out for the Enniscorthy Flood Relief Scheme (2007) identified four species using the survey area; Daubenton's bat, soprano pipistrelle bat, common pipistrelle bat and Leisler's bat. Separate to the 2005/2006 Flood Relief study, Brown Long-eared bats and Whiskered Bats were recorded along the River Slaney south of Enniscorthy (Keeley, 2005).).

Birds

NBDC returned 53 bird species records for 2km square S94Q, which includes the northern floodplain, and River Slaney north of the Railway Bridge and adjoining lands, and 61 bird species for 2km square S93U which includes the southern floodplain, River Slaney and adjoining lands; these include

- 2 species listed in Annex 1 of the Birds Directive, Kingfisher and Little Egret;
- 6 Red-listed species of Conservation Concern (Colhoun and Cummins, 2013), Wigeon, Lapwing, Redshank, Black-headed Gull, Grey Wagtail and Yellowhammer; and
- 18 Amber-listed species of Conservation Concern (Colhoun and Cummins, 2013), Cormorant, Mute Swan, Teal, Sparrow hawk, Kestrel, Lesser Black-backed Gull, Swift, Skylark, Sand Martin, Barn Swallow, House Martin, Robin, Stonechat, Mistle Thrush, Goldcrest, Spotted Flycatcher, Starling, House Sparrow.

Additional waterbird species recorded in the NBDC database for these 2km squares are Grey Heron, Mallard, and Moorhen.

Goodwillie (2003) noted the gravel bar and riffle in the Slaney in the northern floodplain as providing a feeding area for many Sand Martins, as well as a Grey Heron. A small colony of Sand Martins, of about 12 active nests, was recorded in the left bank of the Slaney in this area, and the suitability of the bank for Kingfisher was noted. Moorhen and Mute Swan were also recorded.

I-WeBS data for the River Slaney sub-site Edermine Bridge to the River Urrin includes the southern part of proposed scheme, this site is counted from a boat. Twelve waterbird species have been recorded during I-WeBS surveys: Little Grebe, Cormorant, Little Egret, Grey Heron, Mute Swan, Teal, Mallard, Lapwing, Snipe, Black-headed Gull, Lesser Black-backed Gull, and Herring Gull.

Aquatic species

Freshwater pearl mussel

The freshwater pearl mussel (*Margaritifera margaritifera*) is a large bivalve mollusc listed on Annex II and Annex V of the EU Habitats Directive, and is protected under the Irish Wildlife Acts (1976 and 2000). The freshwater pearl mussel is considered to be critically endangered in Ireland (Byrne *et al*., 2009) and Europe (Moorkens, 2011). The conservation status of the species was unfavourable-bad, when reported under Article 17 of the Habitats Directive in 2007 and again in 2013 (Moorkens *et al*., 2007, NPWS 2013).

There are numerous records, recent and historical, of this species in the Slaney Catchment from the 19th Century onwards. The wider Slaney Catchment population is important as there is a wide distribution of *Margaritifera* through the main channel and through 3 of its tributaries. The distribution of the mussel in the Slaney main channel has been described as one of the largest in history, and could have supported up to 50 million individuals in the past (Moorkens, unpublished data), but the Derreen River is the last area where successful juvenile recruitment was recorded (Moorkens, 1996), and it is the Derreen River sub-population that is designated for protection within the wider Slaney Valley SAC, as listed in the first schedule of the

Margaritifera regulations (S.I. 296 of 2009; S.I. 355 of 2018), and for which a draft sub-basin management plan has been produced.

Duck mussel

The duck mussel (*Anodonta anatina*) is a large bivalve mollusc listed as vulnerable in Ireland's red list of molluscs (Byrne *et al*., 2009).

This is the most upstream record for live *Anodonta anatina* in the Slaney catchment; the species is known from further downstream in the vicinity of Kings Island, where the flow is quite swift (D. Berridge, pers. comm.), Duck mussels do not occur in upstream areas of acid rivers, so the lower reaches of the Slaney main channel are the most likely area for a population to occur within the overall catchment. Other than the two Slaney locations, only two other 10km records of the species are known from the south east, both from the Barrow River at the Carlow / Kilkenny border (J. Lucey record, NBDC Outputs of Field Surveys.

6.3.2 Habitat Survey

Habitats recorded within the survey area are described in this section and are shown in Figure 6.6 in Appendix C. Habitat codes (Fossitt, 2000) are given in the descriptions below and in the legend of the habitat map.

Table 6.7: Habitat Types within the Study Area

Habitat type (Fossitt 2000)	Area(ha)/ length(km)	Habitat description
Building and artificial surfaces (BL3) and Spoil and bare ground/Recolonising bare ground (ED2/ED3) Mosaic	3.15ha	Artificial and modified habitats that are considered to have a limited ecological value within the survey area are discussed in this section. They include habitats such as buildings and artificial surfaces, amenity grassland and scattered trees and parkland which are associated with Enniscorthy town, areas of open public space, dense residential, industrial or commercial development; and habitats associated with intensive agricultural or forestry practices including improved grassland which dominates fields in the northwest of the survey area managed for cattle grazing. Conifer plantation (WD4) abuts agricultural land in the northwest and spoil and bare ground/recolonising bare ground (ED2/ED3) represents surfaced tracks servicing agricultural lands in the southwest of the survey area.
Improved grassland (GA1)	14.37ha	
Amenity grassland (GA2)	0.56ha	
Scattered trees and parkland (WD5)	1.49ha	
(Mixed) Conifer woodland (WD3), Conifer plantation (WD4) and Recently-felled woodland (WS5)	1.05ha	
Depositing/lowland rivers (FW2)	1.8km	The River Slaney in Enniscorthy is c.40-70m wide within the survey area. There are a number of tributaries including the Moyne River in the northwest, and the Urrin inflow near Munster Hill/ St John's Villas in the south of the survey area. This habitat includes the Annex I habitat [3260] Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho batrachion vegetation.
Tidal rivers (CW2)	2.9km	This habitat type was recorded in the southern part of the survey area where the River Slaney is still influenced by marine influx. The approximate boundary between tidal water and freshwater within the River Slaney is the Old Bridge in Enniscorthy.
Exposed sand, gravel or till (ED1)	0.15ha	Exposed alluvial deposits within the river were recorded at the northern and southern extents of the survey area. On the northern floodplain, a small gravel island was dominated by Dock Rumex sp., while the larger island in the south supported Willow Salix sp scrub.
Reed and large sedge swamps (FS1) and Tall-herb swamps (FS2) (including mosaics)	1.68ha	These habitat types were associated with wet grasslands and were found mainly along the drainage ditch on the northern floodplain, along the drainage ditch in the northwest, within the wet woodland areas in the southeast and south and along the riverside walk in the southwest. The reed and large sedge swamp habitat

Habitat type (Fossitt 2000)	Area(ha)/ length(km)	Habitat description
		was species-poor and dominated by Common Reed whilst the tall-herb swamp habitats were more diverse.
Drainage ditch (FW4)	3.64km	Man-made ditches occur throughout the survey area and function to control and direct the flow of water and/or are local land drains. All of these ditches are directly connected with the River Slaney, and some particularly on the eastern side of the scheme fluctuate in accordance with high and low water levels within the River Slaney. A number of ditches within the survey area were noted to support an interesting floral assemblage, particularly alongside the eastern extents of the scheme within the northern and southern floodplains.
Mesotrophic lake (FL4)	0.29ha	This habitat describes small areas of open standing water that were found alongside the riverside walk in the north-west of the survey area. These are more akin to ponds given their size, the largest being c. 4x4m. These areas were influenced by flood waters but remain present throughout the year through rainwater and drainage inputs in some cases.
Wet grassland (GS4) (including mosaics)	23.47ha	Wet grassland was recorded in both floodplains. A small area within the northern floodplain was recorded as wet grassland graded into a habitat that was dominated by wetland forbs in parts and was considerably waterlogged. In the southern floodplain the grassland habitat was wetter within the east, centre and south east grading into wet grassland in parts. Some areas of this field are better drained than others resulting in a mosaic of neutral and wet grasslands.
Dry meadows and grassy verges (GS2)	1.19ha	East of the “back channel” in the northern floodplain, the grassland sward supported a mosaic habitat of dry meadows and wet grassland where management of this field has been neglected. On the opposite bank to the southern floodplain stretches of dry meadows and grassy verges mosaic occur in the riparian zone.
Dry calcareous and neutral grassland (GS1)	19.58ha	The largest grassland habitat within the survey area can be found in the northern and southern floodplains on the eastern side of the River Slaney. These grasslands are a low-lying, semi-natural, wet grassland, which are seasonally flooded in winter time. The northern floodplain grassland was noted to be a largely uniform area of neutral grassland. It is rarely fertilised and was not heavily grazed during 2016, horses occasionally graze the grassland.
Hedgerow (WL1) and Treelines (WL2)	4.32km	Hedgerows are not the dominant boundary type as fields were often surrounded by ditches, treelines and woodland boundaries. However, where present, particularly in the north of the survey area, these were generally mature, dense and well-connected with the surrounding woodland, scrub and treeline habitats. Mature treelines are present within the north and south of the survey area demarcating field boundaries and bordering watercourse including the back channel in the northern floodplain.
Stone walls and other stonework (BL1) and Earth banks (BL2)	0.9km	Dry stone walls associated with earth banks and treelines were present within mature woodlands within the south western extents of the survey area. The older quay walls alongside the river in the town were noted to support flora typical of such habitats
Oak-birch-holly woodland (WN1)	0.68ha	This woodland was located on acidic soils on the steep west-facing rocky slope, adjacent to the N11 and north of the new road bridge approach roads. It corresponds to the Annex 1 habitat [91A0] Old Sessile Oak Woods with Ilex and Blechnum in the British Isles. It was more mature than the secondary oak-ash-hazel woodland.
Oak-ash-hazel woodland (WN2)	4.32ha	Oak-ash-hazel woodland continues south of the above section of oak-birch-holly woodland. A mature stand of the woodland was also recorded within a walled area in the northwest of the survey area and is present to the southwest of the southern floodplain in drier areas on the embankment, outside of wet woodland areas.
(Mixed) Broadleaved woodland (WD1)	2.19ha	This habitat was recorded across the survey area within larger stands of woodland where it was more recently planted or it could not be classified as semi-natural as it had been modified through

Habitat type (Fossitt 2000)	Area(ha)/ length(km)	Habitat description
		the planting of coniferous trees. This habitat type occurs adjacent to the N11 in the south of the survey area, south of the Riverside Park Hotel and in the vicinity of the northern floodplain.
Riparian woodland (WN5)	9.78ha	Riparian woodland was found along the margins of the river south of the scheme and bordering the east of the southern floodplain. In the southern floodplain riparian woodland is surrounded by wet or damp drainage ditches which connect directly into the River Slaney and were affected by tidal fluctuation as well as surface water. All of the riparian woodland surveyed was considered to be an example of the Annex I priority habitat [91E0] Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) as they were located in typical riparian habitat that was regularly inundated, on alluvial soil, they supported a vegetation community which fits with the Annex I [91E0] communities (Perrin et al. 2008).
Scrub (WS1)	3.53ha	This habitat occurred mainly within the southern extents of the survey area on both the east and west of the proposed scheme, and on the northern floodplain. It was generally associated with slightly higher ground, outside of the immediate area of the floodplains.
Exposed siliceous rock (ER1)		This habitat was recorded along the eastern boundary of the N11 in the southeast of the scheme. This area comprises a large rock outcrop which abuts the road.

6.3.2.1 EC Habitats Directive Annex I Habitats

[3260] Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho batrachion vegetation - occurring within Depositing / Lowland rivers (FW2)

This habitat type was recorded in a number of locations along the river length within the scheme area (Figure 6.7 in Appendix C). There are four main areas that are important for aquatic macrophytes are 1) adjacent to the northern floodplain (chainage 6150-6850; 2) below the Seamus Rafter bridge (chainage 5340-4800); 3) adjacent to the southern floodplain (chainage 4300-4700); and, 4) southern end of the project area (chainage 3220-4000). This habitat was defined using the broad definition in the latest Article 17 report (NPWS, 2013) and other relevant references (see Appendix C.4). Indicator species recorded from the river include Common Water-starwort *Callitriche stagnalis*, Spiked Water-milfoil *Myriophyllum spicatum*, Broad-leaved Pondweed *Potamogeton natans*, Perfoliate Pondweed *P. perfoliatus*, Cooper's Pondweed P. x cooperi and Stream Water-crowfoot *Ranunculus cf penicillatus subsp. penicillatus*. Cooper's Pondweed is a rare hybrid in the Republic of Ireland. This record represents only the third recent hectad record for the Republic of Ireland. It was found in one location, in the river channel about 2m from the western bank, above the junction with the River Urrin. The Annex I Floating River Vegetation (FRV) was assessed to be in good condition (see Appendix C.4 for full details).

[91A0] Old sessile Oak woods with Ilex and Blechnum in the British Isles - occurring within WN1

There is a small area of this habitat type 91A0 on a steep west-facing slope to the east of the N11, just south of Enniscorthy (Figure 6.7 in Appendix C). The woodland is generally dominated by Sessile Oak and its hybrid *Q.* x *rosacea*, although Beech and non-native conifers are locally frequent. A key indicator for the Annex I habitat 91A0 is the presence of Great Wood-rush, which locally dominates with Bramble. Additional species include Rowan *Sorbus aucuparia*, Wood Sage *Teucrium scorodonia*, Polypody, Intermediate Polypody *Polypodium interjectum*,

Wood Melick, Broad Buckler-fern, Male-fern, Bracken, Common Cow-wheat *Melampyrum pratense*, Navelwort *Umbilicus rupestris* (on rock) and the bryophytes Bank Haircap *Polytrichastrum formosum*, Common Tamarisk-moss *Thuidium tamariscinum*, Elegant Silk-moss *Pseudotaxiphyllum elegans* and Swan's-neck Thyme-moss *Mnium hornum.* There are outcrops of rock which become more frequent (and steep) to the north.

This area of woodland is considered to be an example of the Annex I woodland habitat 91A0 as it is dominated by Sessile Oak and its hybrid, the vegetation type has high affinity to 91A0, the relevé contained 12 91A0 positive indicator species, the map is shown on the historic 6" maps (1837-1842) and the notable species Wood Melick was recorded, which indicates long-established woodland (Perrin et al., 2008). The 91A0 vegetation was considered to be in overall good condition, although non-native species such as Beech were locally abundant, and shrub cover locally low. See Appendix C.2 for more details.

[91E0] *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) *Priority Annex 1 - occurring within Riparian Woodland (WN5).

Three areas of wet woodland adjacent to the southern floodplain were considered to be examples of the Annex I priority habitat 91E0 'Alluvial Woodland' (Figure 6.7 in Appendix C). These include a strip of wet woodland adjacent to the southern floodplain and an area of wet woodland to the south of this floodplain. The most northern section of woodland is dominated by White Willow, with the hybrid *S.* x *fragilis*. Additional canopy species include Ash, Alder and Sycamore, with Hawthorn and Elder in the shrub layer. The ground flora is dominated by Hemlock Water-dropwort, Meadowsweet, Nettle, Angelica and Reed Canary-grass. Himalayan Balsam is locally abundant. The bryophyte ground layer is sparse. To the south, Grey Willow becomes more abundant. The ground flora is similar to the northern section but has higher diversity, especially in the most southern area, with species such as Remote Sedge *Carex remota,* Marsh-marigold, Yellow Iris, Tufted Hair-grass, Intermediate Polypody, Opposite-leaved Golden-saxifrage *Chrysosplenium oppositifolium* and Yellow Iris. The bryophyte ground layer is sparse, but epiphytes are relatively diverse with additional species such as Blunt Feather-moss *Homalia trichomanoides,* Frizzled Pincushion *Ulota phyllantha, Lyell's Bristle-moss Orthotrichum lyellii* and Blueish Veilwort *Metzgeria fruticulosa*.

A range of criteria were used to determine whether the wet woodland areas were considered to be examples of the Annex I priority habitat type 91E0 (refer to Appendix C.3 for full details). These include vegetation type and indicator species, history of the woodland, flooding and proximity to a major river and soil type. The 91E0 woodland was in good condition overall, but some areas had locally high invasive and non-native species.

6.3.2.2 Rare Flora

A high level of species richness which was recorded within the back channel on the northern floodplain by Roger Goodwillie in 2003 but was not re-recorded in 2016. This is most likely due to the density of vegetation and the high level of silt within this back channel which is now overgrown in parts.

As part of this survey, the potential for protected aquatic plant species (Short-leaved Water-starwort and Opposite-leaved Pondweed) to occur within the survey area was also noted. The latter species has not been recorded within the survey area and was not recorded in the current survey – however, there are recent records of this species occurring within the River Slaney SAC (e.g.at Edermine Bridge, in 1990 and more recent records (2017) further downstream). With regard to Water-starwort, this rare plant was not recorded at its historic sites during the

2016 survey, however, it may be that it is transient at these sites and may reappear in the future. Records for this protected plant lie south of the proposed scheme.

Other notable flora during baseline surveys also included:

- A Black Poplar *Populus nigra betulifolia* tree grows on the north western bank of the River Slaney upstream of the Old Bridge in Enniscorthy town. This tree has now been undermined by flooding, but cuttings have been taken and grown elsewhere (Pers. comm. Dominic Berridge, NPWS, 2016). A tree from this source grows within the grounds of the National 1798 Rebellion Centre in the town. This species is relatively rare in Britain and Ireland;
- During the specialist botanical surveys, several areas of Annex I rivers with floating vegetation often dominated by water-crowfoot [3260] Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation were recorded. These included one location where a rare aquatic hybrid was found, Cooper's Pondweed *Potamogeton x cooperi*. This was found in the River Slaney above the junction with the River Urrin at grid reference S9719 3886;
- Wood Melick *Melica uniflora*, a rare species typically found in woodland, or species which is indicative of long-established woodland (Perrin et al., 2008) was recorded during the survey of the [91A0] Old sessile oak woodland on the eastern side of the N11;
- Nodding Bur-marigold *Bidens cernua* was recorded within the wetland on the southern floodplain (Pers. comm. E. Mayes, 2016) this species is a new record to the hectad (10km x 10km grid square) and normally only found near the coast in Kettleholes (Pers. comm. P. Green, Wexford Co. BSBI recorder, 2016);
- Tall Mint *Mentha × smithiana* was noted on the embankment of the southern floodplain (at approximate NGR: S 97300 39027) and is the first record for the hectad since 1872 (Pers. comm., P. Green). This plant is probably introduced and naturalised in Ireland (Stace, 2010); and,
- Marsh Yellow-cress *Rorippa palustris* was the first record for the Slaney, Enniscorthy, since 1881 when it was recorded by H.C. Hart (Pers. comm., Paul Green).

No protected plants were recorded within the survey area in 2016. However, Annex I habitats have been identified within the zone of influence of the proposed scheme and a number of rare and notable flora have also been recorded. Several of these were noted on the southern floodplain, particularly within and adjacent to the wetland area within the centre of that site. This habitat is particularly of interest due to its unique hydrology which creates a niche for annual pioneer species which thrive in a nitrogen-rich environment. The bare mud here was exposed, following drying out of flood waters later in summer after winter/spring flooding.

6.3.2.3 Invasive Flora

Himalayan Balsam was noted across the site as seedlings and adult plants, particularly in damper habitats where grazing was less intensive. Japanese Knotweed *Fallopia japonica* was recorded in discrete locations across the site as shown on Figure 6.6 in Appendix C. Giant Hogweed was recorded within the riparian woodland to the southeast of the proposed scheme.

All three species are listed as 'High Risk' invasive species (Kelly *et al.* 2013). They are on the Red List of recorded invasive species in Ireland and it is an offence to plant these species, or to cause them to grow in the wild.[23] Amber listed species that are also known to be invasive included Cherry Laurel *Prunus laurocerasus* which was recorded within woodlands in the

[23] According to the Invasive Species Ireland website. Accessed at http://invasivespeciesireland.com/

northwest and southeast within the Survey Area and within amenity areas - such as the seating area adjacent to the N11.

The non-native invasive aquatic macrophyte species *Elodea canadensis* and *E. nuttallii* are present in the river channel throughout the project area, at low cover (less than 5%). They are part of the floating river vegetation community and are not currently having any negative impact in this section of the river. These species are listed on the Third Schedule to the European Communities (Birds and Natural Habitats) Regulations 2011).

An invasive species survey was carried out in 2016 on behalf of Wexford County Council and treatment of high-risk species such as Japanese Knotweed began during late summer/autumn 2016.

6.3.3 Mammal Survey Results

6.3.3.1 Otter *Lutra lutra*

Otter activity was evident across the survey area with otter prints and spraint recorded in several locations. Four potential otter holts were identified within the survey area. See Figure 6.8 in Appendix C for mammal survey results and Appendix C.5.

All mammal holes that were identified as potential holts that had evidence of otter activity near their entrance(s) during the surveys. The only recorded footage of otter was noted at OH3 and OH4 on the south-eastern and north-eastern sides of the proposed scheme. However, evidence of otter exists throughout the survey area on both sides of the River Slaney, including two otter resting places: one in the northern floodplain and one in the southern floodplain. In addition, there were several recent sightings of otter to the south of the Riverside Hotel during the survey season in 2016.

<u>Otter Holt (OH1)</u>

OH1 is located in the south of the survey area. Otter prints and bedding were noted here. It was not determined whether this potential otter holt was currently active, at the time of surveys. Therefore, a precautionary approach has been taken and OH1 has been treated as an active otter holt.

<u>Otter Holt (OH2)</u>

OH2 is located in the south of the survey area, in the south of the southern floodplain. This holt lies across a tributary ditch of the River Slaney south of the southern floodplain. Old otter spraint was found within a resting site immediately adjacent to this holt. During camera monitoring from March to September 2016, no mammal activity was recorded here but the holt is capable of being occupied by otter and has been treated accordingly due to the presence of otters nearby.

<u>Otter Holt (OH3)</u>

OH3 is located in the south of the survey area, in the south of the southern floodplain. Spraint were recorded at this site. During camera monitoring, up to 4 otters were captured in footage at holt (OH3) during March to September 2016. The otters inspected this entrance to the holt but then left the area without entering or exiting the entrance. They were recorded on numerous occasions in this area and regularly spraint at this location. The burrows were being used by brown rat *Rattus norvegicus* and there was no indication (during camera monitoring from March to September) that this was being actively used by the otters other than for sprainting and as a commuting route.

Otter Holt (OH4)

OH4 is located in the north of the survey area, in the east of the northern floodplain. Otter activity was briefly recorded on the trail camera in this location on one occasion on the 26th February and another brief occasion on 26th April 2016. No recordings of otters entering or exiting this holt throughout March-September 2016 were made. No spraint or prints were recorded here throughout the surveys. Although this holt was briefly visited occasionally by otter in February and April, it was not considered to be currently active, at the time of surveys.

6.3.3.2 Badger *Meles meles*

No badger setts were recorded within the zone of influence for the proposed scheme. A badger latrine was noted within the conifer plantation in the north west of the survey area. A badger print was noted along the upper track within the northern floodplain (this track runs parallel to the railway line fence). Badgers were recorded on the wildlife cameras on two occasions in June and August 2016 within the woodland south of the southern floodplain passing OH3.

Due to the absence of setts recorded within the ecology survey area and lack of badger activity detected within the survey area, badgers were not considered to be key ecological receptors.

6.3.3.3 Harbour Seal *Phoca vitulina*

Ad-hoc harbour seal sightings were recorded within the River Slaney during baseline field surveys carried out for the proposed scheme. On two occasions (17th October 2016 and 28th November 2016) during ornithological surveys, a single seal was observed travelling upstream past the Riverside Park Hotel towards the Seamus Rafter Bridge, and one occasion (24th February 2016) two seals were observed at Edermine Bridge at high tide.

6.3.3.4 Other mammals

An adult red fox *Vulpes vulpes* and its young were recorded investigating OH3 in August 2016. Fox appear to have a den in the centre of the woodland alongside the southern floodplain. Rabbit were noted within the scrub and woodland and along embankments in the north and southern floodplains (and were recorded on the camera at OH4). House mouse *Mus musculus* (a single corpse was recorded on the pavement north of the southern floodplain). Hedgehog (recorded on motion camera adjacent to OH4 in August 2016, and a single corpse was recorded on the eastern side of the survey area. Domestic cats were regularly recorded on the motion-activated cameras, particularly at OH4 on the northern floodplain (this location is immediately adjacent to residential properties around Enniscorthy Railway Station). Brown rat were common throughout the survey area and evidence of their presence were recorded on most surveys, and regularly during the motion sensor camera surveys. Brown rat were occupying OH3 in 2016 (recorded entering and exiting burrow during the trail camera surveys).

6.3.4 Bat Survey Results

Four species of bat were recorded during activity surveys and included common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle *P. pygmaeus*, Leisler's bat *Nyctalus leisleri* and *Myotis* species including Daubenton's bat *M. daubentoni*. The main areas of bat activity were (also see Figure 6.9 in Appendix C):

- Over the River Slaney alongside the northern and southern floodplains (most of the *Myotis sp.* activity was noted directly over the river, particularly Daubenton's bats);
- Along mature treelines with ditches (particularly used by Leisler's bats and pipistrelle bat species);

- Adjacent to, and within woodland habitat (particularly where they included mature trees);
- Above open scrub areas that were sheltered by trees (e.g. pipistrelle species recorded along the N30, St John's Road on the western side of the River Slaney); and,
- Beside the old Enniscorthy Bridge and the Seamus Rafter Bridge. Pipistrelle bat species forage on either side of these bridges. The old Enniscorthy Bridge is illuminated at night-time and public street lighting is found in all urban areas. The Seamus Rafter Bridge also has lighting mounted on the northern side of the structure.

Tree surveys assessed 102 individual trees and six tree groups for potential roost features (PRFs). Of these, 42 were evaluated as having low suitability and 60 were identified as having moderate suitability for bats. Two of the tree groups were assessed as having overall low suitability and four tree groups were assessed as having overall moderate suitability. No trees were considered as having high suitability for roosting bats.

Eight structures were surveyed for evidence of PRFs. Four of the eight structures were considered to have low suitability and included the three main bridges across the Slaney in Enniscorthy town and a railway bridge southwest of the southern floodplain. The remaining four structures were considered as having moderate suitability and included a railway bridge over the River Urrin, sections of the Quay walls south of the southern floodplains on the west side the main channel, and, in the northern floodplain an underground water tank and derelict building. Figure 6.10 in Appendix C presents the location of the PRFs.

6.3.5 Bird Survey Results

6.3.5.1 Waterbirds

The proposed scheme area supports a high diversity of waterbird species, with a total of 25 species recorded including wintering, passage and resident breeding bird species. The key habitat features supporting these populations are the wetland habitats in the southern floodplain at "Bare Meadow", Killagoley that are supported by tidal and fluvial flooding. The relevant key habitats recorded in this area are supporting these waterbird populations in the proposed scheme area are the Reed and Large Sedge Swamps (FS1) and Tall-herb swamps (FS2) (including mosaics), and Wet Grassland GS4 as described in Table 6.7. Duck and waders feed and roost overnight in the swamp habitat mosaic area, where a small area of standing water/ ponds was retained among exposed muddy banks and tall swamp vegetation throughout the baseline survey year, with daytime dispersion through wet grassland within the Bare Meadow on the southern floodplain at Motabeg, and to river channel and river margin habitats throughout the proposed scheme area, including the northern floodplain.

Riverbank standing and dead trees are used as roosts by herons and cormorant throughout the proposed scheme area. Kingfishers use river bank trees and shrubs as perches while hunting and also to kill and eat prey items.

The total number of waterbird species recorded on the southern floodplain and adjoining river channel was 23, (Appendix C.7, Table 12). Sixteen species were recorded on the northern floodplain and adjoining river channel, including 2 species not recorded on the southern floodplain (Goosander and Great Black-backed Gull, Appendix C.7, Table 13). A reduced number of waterbird species was recorded on the River Slaney within the quay walls of Enniscorthy, from the Rail Bridge to Riverside Park Hotel, where 12 species were recorded.

The proposed scheme area is used by a number of wintering waterbird species that are listed as Qualifying Interests (Special Conservation Interests (SCI)) for Wexford Harbour and Slobs SPA. Since this SPA extends into the southern end of the proposed scheme works, and the wetland habitats on the southern floodplain in particular are supported by tidal as well as by

fluvial flooding, and are in hydraulic continuity with the designated SPA area, it is considered appropriate to assess the following waterbird species as forming part of the qualifying SCI populations of Wexford Harbour and Slobs SPA:

- Little Grebe
- Great Crested Grebe
- Cormorant
- Grey Heron
- Whooper Swan
- Wigeon
- Teal
- Mallard
- Lapwing
- Redshank
- Black-headed Gull
- Lesser Black-backed Gull

Table 6.8: Peak counts of waterbirds recorded within the scheme area, and peak counts recorded passing through the proposed new bridge corridor at dawn and dusk, between February 2016 and March 2017

Species	Annex 1/ BoCCI[24]	1% national[25]	Peak count waterbird surveys		Peak count passing proposed new bridge VP			
			Peak count	Peak month	Dawn		Dusk	
					Up	Down	Up	Down
Little Grebe *	Amber	20	1		1			
Great-crested Grebe *	Amber	120	1					
Cormorant *	Amber	120	14	Feb 16	29	9	1	21
Little Egret	Annex 1	20	5	Sep 16	1	1	1	2
Grey Heron *		25	25	Oct 16	6	9	12	3
Mute Swan	Amber	90	15	Nov 16	14	12	2	3
Whooper Swan *	Annex 1	150	1		1			
Wigeon *	Red	630	51	Feb 17				
Teal *	Amber	340	174	Dec 16	8	8		7
Mallard *		290	58	Dec 16	13	7	11	24
Goosander	Amber		5	Jan 17				
Moorhen			9	Nov 16				
Lapwing *	Red	1,100	376	Feb 16	30		80	
Snipe	Amber		26	Mar 16				
Woodcock	Red	1	1					
Redshank *	Red	300	26	Dec 16				
Greenshank		20	1					
Green Sandpiper			1					

[24] Amber and Red listed Birds of Conservation Concern in Ireland (BoCCI) according to **Colhoun, K. & Cummins, S. (2013)** *Birds of Conservation Concern in Ireland 2014 -2019*. Irish Birds 9: 523-544.

[25] Threshold level for national importance (1% of all-Ireland population of each species or sub-species/flyway)

Species	Annex 1/ BoCCI[24]	1% national[25]	Peak count waterbird surveys		Peak count passing proposed new bridge VP			
			Peak count	Peak month	Dawn		Dusk	
					Up	Down	Up	Down
Common Sandpiper	Amber		3					
Kingfisher	Annex 1		3		1		1	1
Black-headed Gull *	Red		267	Feb 16	504	110	28	1,124
Common Gull			1		1			2
Lesser Black-backed Gull *	Amber		4		11	2	1	393
Herring Gull			3		8	3		39
Great Black-backed Gull			1					

Note: Species listed as Special Conservation Interests (SCI) for Wexford Harbour and Slobs SPA are indicated with an asterix. Note: Data refer in most cases to the southern floodplain (Bare Meadow) and adjoining river channel, but counts are combined from the northern and southern floodplain and river channel within the town when these areas were counted within a 1-hour period on the same date

Of waterbirds recorded, a maximum of twelve Grey heron breeding pairs were recorded, up to two Kingfisher territories, five Mallard breeding pairs, two Mute Swan breeding pairs, and three Moorhen breeding pairs were recorded breeding within the extent of the scheme. See Appendix C.7 for full details.

6.3.5.2 Riparian breeding bird species

Riparian breeding birds included two Sand Martin colonies located at different locations along the east bank at the northern floodplain, were recorded in 2016 (see Appendix C.7, Figure 15) with up to 35 active nests in one of the colonies**.** This species is Amber-listed as a Bird of Conservation Concern.

Grey Wagtail were recorded as breeding within the proposed scheme area in 2016, with a confirmed nest in the northern floodplain east bank of the Slaney opposite the gravel island in 2016. In 2017 the nest site was not confirmed, however, a pair may have nested in the deck of the bridge as an adult Grey Wagtail was recorded with three fledglings on the railway bridge. Grey Wagtails are a Red-listed species of Conservation Concern in Ireland.

6.3.5.3 Birds of prey

High levels of Buzzard activity were recorded in the Enniscorthy area, with up to eight individuals recorded simultaneously (see Appendix 4 of Appendix C.7) and over ten territories recorded within the breeding raptor survey area, which extended c. 1km north and 4km south of the proposed scheme. Two Sparrowhawk territories were recorded, one in the Blackstoops area near the northern floodplain, and a second territory to the south of the town in St. John's Wood. Kestrel and Raven pairs were confirmed at the southern Roadstone quarry (Appendix C.7, Figure 16). A Peregrine pair was recorded in 2016 and details provided to the organiser of the 2017 Peregrine survey. As is customary for this Annex 1 listed species, details are withheld from this report. Although nest sites used by raptors were not found in 2016, no nests sites were located in trees and woodland areas potentially impacted by the proposed scheme.

No Barn Owl activity was recorded during the surveys. Long-eared Owl calls were heard at the Larch plantation on the western side of the Slaney c. 1km upstream of the proposed scheme area in April 2016.

6.3.5.4 Additional breeding bird species

Thirty-five additional bird species were recorded as confirmed, possible and probable breeding species in the Enniscorthy area. Within the zone of influence of the scheme, Chaffinch, Robin, and Wren were the species most frequently recorded singing in scattered riverbank shrubs and trees, these also occurred in woodland areas and together with Blackbird were the most commonly recorded resident species. Blackcap was the most commonly recorded warbler, and while more abundant in dry woodland (5 pairs in the west bank woodland adjoining the river at the northern floodplain, c. 20 pairs within the core study area), Blackcaps were also recorded singing in wet woodland, including in the alluvial woodland at the proposed new bridge on the eastern side of the Slaney, in Bramble scrub above the railway line on the western side, and in wet woodland at the eastern side of the northern floodplain. Bird species recorded singing within the footprint of the proposed new bridge and associated roads are listed in Appendix C.7, Table 17.

Two Red listed species of Conservation Concern, Stock Dove and Yellowhammer, were recorded to the north of Enniscorthy outside the proposed scheme area.

Five Amber listed species of Conservation Concern were recorded as nesting within the zone of influence of the scheme, Robin, Mistle Thrush, Goldcrest, Starling, and Greenfinch.

6.3.6 Aquatic Survey Results

Aquatic ecology surveys were carried out at 10 different locations. This included one downstream of the proposed scheme in the tidal reach of the River Slaney, seven within the stretch of river directly affected by the proposed scheme, and two in the freshwater reaches of the River Slaney upstream of the proposed scheme. The aquatic ecology survey locations are provided in Technical Appendix C.5 Figure 3.

6.3.6.1 River Habitat Survey

A River Habitat Survey (RHS) was completed for the study area. This survey forms part of the baseline aquatic ecological surveys. A Habitat Modification Score (HMS), Habitat Modification Classifications (HMC) and Habitat Quality Assessment (HQA) were obtained for three different locations within the study area. HMS scores ranged from 50 to 250, HMC scores ranged from 2 to 3 and HQA scores ranged from 24 to 33 for the three sites. A full overview of these results is contained in Technical Appendix C.8.

6.3.6.2 River Hydromorphology Assessment

The baseline aquatic ecology surveys also involved a hydromorphology assessment to evaluate river physical structure. Again, the three same sites within the study area were assessed using the River Hydro-morphological Assessment Technique (RHAT). A list of existing features and flora and fauna species identified in the three sites are detailed in Technical Appendix C.5. It has been noted that invasive *Himalayan Balsam* and Japanese knotweed are present along the river banks within the study area. Hydromorphological scores obtained for the three surveyed sites indicate WFD ‘Good’ status using the RHAT scheme (score of >0.6 – 0.8 = Good).

6.3.6.3 Salmonid and Lamprey Habitats

The River Slaney downstream of Enniscorthy is tidal. At low tide, numerous suitable spawning areas are present within this reach of the river. The riverbed in this area is largely of uniform character, thus making it difficult to predict the optimal spawning areas. Although there is a large proportion of the riverbed composed of gravel, a substrate used by lampreys and salmon for spawning, there had been no evidence of spawning recorded in the River Slaney downstream of the Seamus Rafter Bridge in Enniscorthy during any of the 2016 surveys nor were Young of the Year (YOY) salmonids recorded within the study area affected by the proposed scheme.

The substrates within the affected stretch of the River Slaney generally increase in size with distance upstream. The bed of the river downstream of Enniscorthy was found to be composed mostly of gravel, sand and silt, while a substratum dominated by cobble/gravel was seen to occur within the town. The low gradient stretch of the river upstream of the town had a mixed substrate comprising rock, cobble, gravel, sand and silt. Only a few areas with fast flowing shallow water over rock/cobble substrate formed optimal habitat for juvenile salmonids within the study area.

Depositing habitat alongside the banks of the river are considered important with respect to the larval lampreys. These fish species depend on soft substrates into which they can burrow. Slower flowing areas of the River Slaney within the study area were considered suitable for the juvenile life stages of lampreys including deposited sand/silt associated with sluggish waters around pillars of the bridges within the town of Enniscorthy.

6.3.6.4 Macroinvertebrates

A sample of macroinvertebrates were taken at five locations and analysed. A full overview of these results is contained in the Appendix C.8. Across the five sites, Mayfly (Ephemeroptera) were well supported with a total of four families recorded. Larvae of *Baetis rhodani* was the most frequently occurring mayfly which ranged from ‘fair numbers’ to ‘common’ across sites 4, 5, 7 and 10. The diversity of *Plecoptera* was limited to one family within the environs of Enniscorthy, where stonefly larvae of less sensitive *Leuctra* sp. were generally ‘scarce’. The Trichopterans (caddisflies) were a well-represented group with five 'less sensitive' taxa (cased) and three 'pollution tolerant' (caseless) taxa recorded. Only a single Odonate was recorded during the sampling: larvae of the damselfly *Agrion* sp. at Site 10. A larva of the Alderfly Sialis sp. (Megaloptera) was recorded at Site 4. Pollution tolerant true fly larvae (Diptera) were well represented in the study area with families Simulidae (*Similium* sp.), Tipulidae, Chironomidae and Ceratopogonidae recorded. The Coleopterans (beetles) recorded were limited to *Limnius* sp. and *Hydraena* sp. Gastropod Molluscs in four families were recorded. Macroinvertebrates in Class Crustacea, Hirudinae and Hemiptera were also recorded.

It has been noted that a specific Freshwater Pearl Mussel (FPM) survey was undertaken. During this study, live FPM and live Duck Mussel *Anodonta anatina* were recorded within the stretch of the river affected by the proposed scheme.

6.3.6.5 Lamprey Surveys

Spawning surveys which examined lamprey activity along a stretch of the River Slaney were conducted between April and June 2016. The lamprey spawning surveys were confined to upstream of the Seamus Rafter Bridge at Enniscorthy. Results of these lamprey spawning surveys are set out in more detail in Appendix C.8.

No lamprey spawning activity was observed or evidence found on the first spawning survey undertaken during mid-April 2016, either within the study site or within the lower 600m reach of the Ballingale Stream.

Towards the end of April, both Brook and River Lamprey were recorded in the proposed area along the River Slaney. Brook Lampreys redds were evident near the banks. Spawning nests believed to be those of Salmon were also detected in the River Slaney. Searches for spawning Lampreys and evidence of spawning (redds) were carried out amongst larger stretches of the River Slaney. One of the Slaney's main tributaries, the Bann, was also surveyed at this time. However, no evidence of spawning was recorded along the surveyed stretch.

In May 2016, River Lamprey spawning was observed in the River Slaney at various locations throughout the area affected by the proposed scheme. Redds of River Lamprey were observed within the site. At three other survey locations outside the proposed project, no spawning nests were recorded despite extensive searches being carried out. Lamprey activity had ceased within the boundaries of the proposed site by the last spawning survey conducted at the end of May.

The entire footprint of the proposed flood scheme was surveyed in June 2016 to assess the presence/absence of adult Sea Lampreys. Only a single dead Sea Lamprey was found at Clohamon. No other evidence of Sea Lamprey activity was recorded during the surveyed dates. In the wider study area of the Flood Defence Scheme, Lamprey activity was noted to be occurring from May to July 2016.

6.3.6.6 Juvenile Lamprey Survey

Specific surveys were carried out for lampreys at seven locations on the River Slaney. A total of 268 juvenile (larval) lampreys were recorded. All were identified as River/Brook Lamprey. Physical characteristics of the juvenile lamprey sites investigated, statistics for lampreys intercepted and Catch Per Unit Effort indices at each of the seven locations and the results of the depletion electrical fishing for lampreys is all contained within the Aquatic Ecology Survey Report provided in the Appendix C.8.

The results of the electrical fishing surveys complete in July 2016 show the absence of lampreys at the lower end of the study area. Near the upper limit of the tidally-influenced reach of the Slaney Estuary, only a single juvenile lamprey was recorded. River/Brook Lampreys had been recorded at a total of four locations. A more detailed description of the findings at each individual site is provided in the Appendix C.8.

6.3.6.7 General Fish Survey

Electrical fishing surveys were also the chosen method to complete the general fish survey in July of 2016. A total of 199 fish were captured during the surveys carried out at the seven sites surveyed (continuous fishing time of 50 minutes). The species which mainly occurred were Minnow *Phoxinus phoxinus* (N=135), European Eel *Anguilla anguilla* (N=24), Three-spined Stickleback (N=20), Stone Loach *Barbatula barbatula* (N=12), Flounder *Platichthys flesus* (N=4), Atlantic Salmon *Salmo salar* (N=2) and Brown Trout *Salmo trutta* (N=2). These identified species were more populated in some sites more than others. The results for each site are discussed in detail in the Appendix C.8.

6.3.7 Mollusc Survey Results

6.3.7.1 Freshwater Pearl Mussel (FPM)

A total of 51 live FPM were recorded in the River Slaney in the surveyed stretch between the upper and lower extent of the surveyed stretch. With the exception of nine individuals, all live FPM were recorded in the uppermost 500m stretch of the river. Within this 500m stretch, the most important area is the short reach between 297531, 140720 (upstream) and 297370, 140633 (downstream) over a distance of 180m. These FPM (n=32) were located between the centre of the channel and the west bank of the river in a substrate of rock/cobble. Of these, approximately the uppermost 10 are considered to be in permanent suitable juvenile FPM habitat, the rest are likely to have washed downstream and provide a role in producing larval glochidia for the next generation only if the fish that carry the glochidia move upstream to release juveniles into suitable habitat.

The current contribution of the majority of mussels is to provide larvae that could attach to host fish travelling in an upstream direction. The small area of juvenile habitat currently has the potential to support both adults and juvenile mussels.

The production of larvae and juvenile mussels contributes to the River Slaney population, the wider Slaney Catchment population, and may contribute to the Derreen population (the population designated as a Natura 2000 population as listed in the 2009 and 2018 *Margaritifera* regulations), through genetic interactions of fish hosts carrying larvae upstream from the River Slaney.

6.3.7.2 Duck Mussel

The duck mussel *Anodonta anatina* was recorded in low numbers (4 live mussels recorded) at the top (close to the side channel inflow) and towards the bottom end of the proposed works area (between Enniscorthy Bridge and Seamus Rafter Bridge). There are records of other individuals downstream of the proposed works in faster flowing habitat near Oilgate (D. Berridge, pers. Comm).

6.3.8 Summary of Ecological Evaluation and Identification of Key Ecological Receptors

The Table below summarises the ecological evaluation of all receptors taking into consideration legal protection, conservation status and local abundance. KERs are identified in grey in the table. Species, habitats and features not qualifying as KERs are not subjected to impact assessment in line with NRA guidelines (NRA, 2009 & CIEEM, 2018). European designated sites are listed in the table below, but these have been assessed separately in the Natura Impact Statement.

Table 6.8: Summary of ecological valuation and identification of KERs (highlighted in grey)

Habitat/Species	Ecological Value (as per NRA guidelines)	Key Ecological Receptor
River Slaney Valley SAC	International	Yes
Blackstairs Mountains SAC	International	No
Screen Hills SAC	International	No
Wexford Harbour and Slobs SPA	International	Yes
River Slaney Valley pNHA	National	Yes
Ballynabarney Wood pNHA	National	No

Habitat/Species	Ecological Value (as per NRA guidelines)	Key Ecological Receptor
Building and Artificial Surfaces (BL3)	Local (Low)	No
Depositing/lowland Rivers (FW2) – includes Annex I habitat [3260]	National (High)	Yes
Tidal Rivers (CW2) – includes Annex I habitat [1130]	National (High)	Yes
Exposed Sand, Gravel or Till (ED1)	Local (Low)	No
Reed and Large Sedge Swamps (FS1)	Local (High)	Yes
Tall-herb swamps (FS2)	Local (High)	Yes
Marsh (GM1)	Local (High)	Yes
Drainage Ditch (FW4)	Local (High)	Yes
Mesotrophic Lake (FL4)	Local (High)	Yes
Improved Grassland (GA1)	Local (Low)	No
Dry Calcareous and Neutral Grassland (GS1)	Local (High)	Yes
Wet Grassland (GS4)	Local (High)	Yes
Dry Meadows and Grassy Verges (GS2)	Local (Low)	No
Amenity Grassland (GA2)	Local (Low)	No
Hedgerow (WL1)	Local (High)	Yes
Treelines (WL2)	Local (High)	Yes
Oak-birch-holly Woodland (WN1) – includes Annex I habitat [91A0]	County[26]	Yes
Oak-ash-hazel Woodland (WN2)	County [Older mature Woodland] and Local (High) [Younger Secondary Woodland]	Yes
(Mixed) Broadleaved Woodland (WD1)	Local (Low)	No
Conifer Woodland (WD3)	Local (Low)	No
Riparian Woodland (WN5) – includes Annex I habitat [91E0]	International	Yes
Scattered Trees and Parkland (WD5)	Local (Low)	No
Scrub (WS1)	Local (Low)	No
Spoil and Bare Ground/Recolonising Bare Ground (ED2/ED3) – Mosaic	Local (Low)	No
Stone walls and other stonework (BL1)/Earth banks (BL2)/Treelines (WL2)/Hedgerows (WL1)	Local (High)	Yes
Exposed siliceous rock (ER1)	Local (High)	Yes
Otter	Local (High)	Yes
Badger	Local (High)	No
Harbour seal	Local (High)	No
Bat species	Local (High)	Yes
Other mammal species (rabbit, house mouse, brown rat, fox and hedgehog)	Local (Lower)	No
Grey Heron	International[27]	Yes

[26] Note: Denyer (2016a) considered the woodland habitat regarded to be Annex I 91A0 recorded east of the N11 to be of County Importance as explained in that report and below. However, it should be noted that other similar Annex I woodland habitat which lies outside of the Survey Area could be considered to be Nationally or Internationally important, depending upon its condition, habitat connectivity etc. and if it lies within the Special Area of Conservation.

[27] Grey Heron is assessed as internationally important, because although the Enniscorthy population is nationally important, this species is listed as a Special Conservation Interest for Wexford Harbour and Slobs SPA, and is assessed as contributing a significant proportion of the Wexford Harbour and Slobs SPA population of Grey Herons when the Enniscorthy breeding colony is taken into account

Habitat/Species	Ecological Value (as per NRA guidelines)	Key Ecological Receptor
Little Grebe	National[28]	Yes
Great Crested Grebe	National	No
Cormorant	National	Yes
Whooper Swan	National	Yes
Wigeon	National	Yes
Teal	National	Yes
Mallard	National	Yes
Lapwing	National	Yes
Redshank	National	No
Black-headed Gull	National	Yes
Lesser Black-backed Gull	National	Yes
Kingfisher	County[29]	Yes
Little Egret	County	Yes
Mute Swan	County[30]	Yes
Goosander	County	Yes
Moorhen	Local (High)	Yes
Snipe	County	Yes
Woodcock	Local (High)	No
Greenshank	Local (High)	No
Green Sandpiper	Local (High)	No
Common Sandpiper	Local (High)	Yes
Common Gull	Local (High)	Yes
Herring Gull	Local (High)	Yes
Great Black-backed Gull	Local (High)	Yes
Wetlands and Waterbirds	International	Yes
Sand Martin	County	Yes
Grey Wagtail	Local (High)	No
Raptors (birds of prey including owls)	Local (High)	Yes[31]
Other breeding birds (red listed species)	Local (High)	No
Other breeding birds (amber listed species)	Local (High)	Yes
Other breeding birds (green listed species)	Local (High)	Yes
Sea lamprey	International	Yes
Brook lamprey	International	Yes
River lamprey	International	Yes
Twaite shad	International	Yes
Atlantic salmon	International	Yes
Freshwater pearl mussel	County[32]	Yes
Duck mussel	County	Yes

[28] Species listed as a Special Conservation Interest for Wexford Harbour and Slobs SPA

[29] Annex 1 listed species

[30] The Mute Swan in Enniscorthy scheme area are part of a nationally important population on the River Slaney downstream of Enniscorthy

[31] No raptor nest sites were recorded within proposed works areas, breeding territories extend into the zone of influence

[32] The freshwater pearl mussel population within the boundary of the scheme is considered to be of county importance (the designated Derreen sub-population is of international importance)

6.3.9 Do-nothing Scenario

6.3.9.1 Existing tends

Considering the do-nothing scenario, it is expected that current practices within the area of the scheme would continue in the same manner as they currently do. Grazing *intensity* on the northern and southern floodplains may change depending on the stock but it is not expected that this would significantly alter the function or condition of habitats recorded on the floodplains. Development within Enniscorthy town is somewhat limited by space, however development on the fringes of Enniscorthy is likely to occur to continue development of the area. Outside of urban areas, agricultural practices are expected to continue at current intensities, however some of these areas on the perimeter of Enniscorthy town may undergo future development.

A number of marked ways including two walking routes (Slí na Sláinte and River Slaney Trail) and a cycle route (Wexford Cycle Hub Loop 1) run along the western side of the River Slaney within the extent of the scheme. Angling activities are also facilitated at Enniscorthy. Along with urban activities from the Enniscorthy environs, these recreational activities contribute to the baseline disturbance levels to birds and mammals using the extent of the scheme. The scheme will retain angling facilities in Enniscorthy however it is not expected that numbers of anglers will increase or significantly change the baseline conditions. No walkways or cycle ways are proposed as part of the scheme design.

6.3.9.2 Likely future trends.

The scheme extent and surrounding environs are under the Enniscorthy Town and Environs Development Plan 2008-2014 (as extended) Wexford County Development Plan 2013-2019 covers the River Slaney outside of the scheme catchment which may have in combination effects on KERs identified in this Chapter. Zoning of lands directly adjacent to the scheme, under the Enniscorthy Town and Environs Development Plan 2008-2014 (as extended), are zoned as ‘natural amenity’, ‘open space and amenity’ or ‘town centre (TC)’. Agricultural lands on the western side of the River Slaney north of the scheme and on the south of the scheme on the east of the N11 are zoned for ‘new residential’ or ‘commercial’ development. The 2008-2014 (as extended) plan includes policy SW11 which states ‘all development proposals within Enniscorthy should have regard to the ‘River Slaney (Enniscorthy) Drainage Scheme, Option Appraisal Report 2006’ by the Office of Public Works’ providing protection to the water quality of the River Slaney.

The Plan also draws on the amenity value of River Slaney and includes policy TR10 which states ‘promote the development of river-side walking routes and foster the enjoyment of the natural amenities of the area including the River Slaney and Vinegar Hill’. In light of this policy it is likely that amenity activities potentially resulting in increased disturbance along the River Slaney will occur in the future. It should be noted however that under the natural heritage section of the plan there is an objective ‘*to require an appropriate ecological assessment of any project that has the potential to significantly impact on the River Slaney Valley SAC’*, which should include any proposed recreational activities.

Overall the likely future trends within the scheme area include water quality pressures from development in the surrounding area and from Enniscorthy town, and disturbance pressures from an increase in recreational activities which may utilise the stretch of River Slaney within Enniscorthy town and the proposed scheme.

6.3.9.3 Characteristics of the proposed scheme

A detailed description of the proposed scheme and sequencing of the construction works is provided in Chapter 4 Description of Proposed Works.

Key sources of potential ecological impact arising from the proposed scheme include direct habitat loss of fluvial and terrestrial habitats as a result of the construction and operation of the scheme, sedimentation and surface water run-off during construction, physical disturbance to habitats during construction, noise and physical disturbance to fauna during construction, spread of invasive species during construction, structure design, proposed road drainage during operation, and proposed lighting during operation. These are detailed in the impact assessment section below.

6.4 Assessment of Impacts

The following section presents the assessment of impacts on biodiversity within the zone of influence of the proposed scheme. As outlined in Section 6.2.5.1, this is focussed on the Key Ecological Receptors identified in Section 6.3. This includes consideration of the do-nothing impact – i.e. the existing trends with the potential to affect biodiversity in the absence of the proposed scheme.

6.4.1 Construction Phase

6.4.1.1 Habitat Loss, Fragmentation and Disturbance

Habitats Loss

The proposed scheme will result in temporary and permanent habitat loss. Temporary habitat loss will arise during the construction phase of the scheme from elements including instream working areas, bank-side working areas, bridge working areas and deposition area in the northern floodplain. Habitats within such areas will be lost for the duration of the works and until such time where reinstatement occurs and vegetation becomes established.

Permanent habitat loss will occur from elements of the scheme including flood walls, dredging and river widening works and footprint of the new bridges. Elements of the scheme may also result in habitat fragmentation and disturbance which have the potential to impact identified KERs.

6.4.1.2 Habitat Degradation

Habitat degradation of habitats occurring during the construction or operational phase within the zone of influence of the scheme could be influenced by:

- Changes in water quality within the River Slaney and/or connecting channels/drainage ditches;
- Changes in the hydro-regime of the River Slaney or connecting channels/drainage ditches;
- A chemical or hydrocarbon spill during works associated with the scheme;
- The spread of non-native invasive species associated with the scheme works;
- Light shading from new proposed road bridge within the scheme; and
- Changes in air quality associated with the scheme from potentially increased numbers of traffic.

These changes in conditions or occurrence of events have the potential to result in habitat degradation directly impacting habitats and potentially indirectly impacting species that utilise these habitats.

6.4.1.3 Loss of Resting/Breeding/Nesting Sites

It is predicted that KERs will experience temporary or permanent loss of their resting site including lamprey spawning beds, an otter holt, grey heron roost site, and/or breeding/nesting site in the absence of any mitigation. There is potential for the scheme to impact these ecological features permanently through removal of the features to facilitate the scheme design or temporarily during the construction phase in such a way that the feature is not suitable for use during this period.

6.4.1.4 Disturbance/Displacement

Disturbance to species may be short-term and temporary over the construction period or long-term over the life-time of the scheme during regular maintenance works at the silt deposition area and debris trap. If the magnitude of disturbance is great enough or occurs persistently, displacement of species may occur. Visual and noise disturbance and presence of human beings throughout the construction phase have the potential to cause disturbance potentially affecting species. Throughout the lifetime of the scheme, maintenance events will be short-term and will occur intermittently when required. Disturbance and displacement impacts have potential to impact KERs listed in Table 6.8.

6.4.1.5 Habitat Severance/Barrier Effect

Instream works and the construction and operation of new approach roads and proposed bridges associated with the scheme have the potential to cause a habitat severance/barrier effect impact on the movement of namely aquatic species, otter and birds.

6.4.1.6 Mortality Risk

A mortality risk arises directly from instream works and translocation of species during construction and maintenance works, from road traffic along the construction haul route, new approach roads and bridge, vegetation clearance may cause accidental nest destruction and bird mortality and the two new bridges within the scheme may present a collision risk for birds and potentially bats. Of the species listed in as KERs, mortality risk has the potential to impact lamprey and fish species, freshwater pearl mussel, otter, and birds.

6.4.2 Designated Sites

A potential source-pathway-receptor has been identified with three designated sites listed in Table 6.6, including two European sites, River Slaney Valley SAC and Wexford Harbour Slobs SPA, and one nationally-designated site, River Slaney Valley pNHA. These sites have also been highlighted as KERs in Table 6.8.

6.4.2.1 River Slaney Valley SAC

The Natura 2000 Standard Data Form (NPWS, 2015b) lists the SAC representing estuaries and intertidal sand and mud flats particularly well with salinity ranging from full freshwater to full seawater. The River Slaney and its tributaries display good examples of floating river vegetation. The site includes an important area of alluvial forest and old oak woodlands. The site is of high importance for the conservation of fish species, salmon *Salmo salar*, river lamprey *Lampetra fluviatilis*, brook lamprey *L. planeri* and sea lamprey *Petromyzon marinus*, and twaite shad *Alosa Fallax fallax*. Otter *Lutra lutra* are distributed along the River Slaney and fresh water

pearl mussel *Margaritifera margaritifera* also occur within the site. The freshwater pearl mussel *Margaritifera margaritifera* is also present within the site, but this is not within the sub-population that is designated for protection within this SAC. Harbour seal *Phoca vitulina* occupy the site which represents regionally significant breeding and moulting sites for the species. The designation is also important for wintering waterfowl and more recently the site supports a nesting colony of little egret *Egretta garzetta*. Threats to the site include agricultural practices such as fertilisation, removal of hedgerows and scrub, forestry management, invasive non-native species, pollution to surface waters from agriculture and forestry activities, household sewage and wastewater treatment works, and surface water abstractions (NPWS, 2015b).

The proposed scheme is within the European site and connectivity between the works and the SAC has been established for the following Qualifying Interests (QIs):

- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]
- Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]
- *Margaritifera margaritifera* (Freshwater Pearl Mussel) [1029]
- *Petromyzon marinus* (Sea Lamprey) [1095]
- *Lampetra planeri* (Brook Lamprey) [1096]
- *Lampetra fluviatilis* (River Lamprey) [1099]
- *Alosa fallax fallax* (Twaite Shad) [1103]
- *Salmo salar* (Salmon) [1106]
- *Lutra lutra* (Otter) [1355]

The potential for adverse effects to arise as a consequence of the proposed scheme alone on this European site has been analysed as part of the preparation of the Natura Impact Statement. In view of the site-specific conservation objectives this assessment determined that there would be no adverse effects on the integrity of the European sites. A summary of the overall impact on the conservation objective for each QI is provided below.

Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]

The proposed scheme will result in a short-term impact on the distribution (occurrence) and area (square kilometres) as some areas of the scheme will have all existing habitat removed. However, this habitat will regenerate in the medium to long-term and due to the river widening works, there will be an increase in the areas suitable for this Annex I habitat leading to a long-term positive impact on distribution.

The main species present within the survey area have a relatively wide ecological tolerance (e.g. *Myriophyllum* spp., *Potamogeton* spp. and *Ranunculus* spp.). There would need to be large changes to habitat attributes (e.g. flow, tidal regime, substrate, nutrient status, water depth, water clarity etc.) before there would be significant changes to overall species composition. The location of the rare *Potamogeton* x *cooperi* will not be dredged. A 100m length of bank 3m wide will be protected at this location.

Callitriche truncata occurs downstream from the study area. Siltation downstream as a result of construction activities could lead to a long-term negative impact on the northernmost historical site for this species. To ensure preservation of this species pre-construction surveys of the sites

closest to the project area (Bormount House and Edermine Bridge) will be undertaken to address more recent recolonisation of new habitats.

Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]

The proposed scheme will not result in a direct change of habitat area or distribution or woodland size. Disturbance as a result of the proposed scheme, mainly the new road bridge and approach road works, has potential to alter the woodland structure and vegetation composition within the herb layer, impact regeneration and cause damage to veteran trees.

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

The proposed scheme will not result in a direct change of habitat area or distribution or woodland size.

To facilitate the new road bridge the canopy height will be topped to 5m in a small area of the woodland. The tree cover will not be affected as the tree species present are adaptive to coppicing and shading. The area impacted is c. 0.018% of the alluvial woodland at the site and 0.003% of the alluvial woodland within the SAC. This tree topping will not impact the site condition assessment. Disturbance resulting from the proposed works could facilitate the spread of the non-native species, however the implementation of the non-native invasive species management plan will minimise this impact.

Margaritifera margaritifera (Freshwater Pearl Mussel) [1029]

The impact of the proposed works without mitigation would be negative as it results in the loss of the species from the extent of the works area, which is the lowest part of their distribution in the Slaney Catchment. Mitigation in the form of translocation is therefore the only option for mussels in these locations. A receptor site has been identified approximately 6km upstream of the proposed scheme. Translocation and establishment of mussels is not always successful, therefore an additional stage in the translocation process is proposed to captive breed a cohort of juvenile mussels from the translocation animals according to the technique of Moorkens (2017). Translocating a higher number of individuals, both juvenile and adult, ensures that the resulting receptor population is significantly higher than the group of donor mussels used.

The status of the freshwater pearl mussel (*Margaritifera margaritifera*) as a qualifying Annex II species for the Slaney River Valley SAC is currently under review, but the legal extent of the SAC designation for the species is the Derreen River sub-population (S.I. 296 of 2009; S.I. 355 of 2018). Therefore, the species is considered both as a legally protected species within the Slaney River, and also as a potential supplier of genetic material to the SAC designated population in the Derreen River.

Petromyzon marinus (Sea Lamprey) [1095], *Lampetra planeri* (Brook Lamprey) [1096], *and Lampetra fluviatilis* (River Lamprey) [1099]

During the construction works of the proposed scheme, the percentage of the river accessible to lampreys will be reduced and works in the river could act as a barrier to migration. However, as the works will take place on one side of the river at a time, with the river flowing normally on the adjacent side, the impact is not considered to be at an extent that would substantially reduce the percentage of river accessible for migration. As noted in Chapter 7 of the EIAR ‘Hydrology’, the installation of the barrier during the construction phase will result in localised changes in velocities on the other side of the river. These changes are likely to be temporary as the works will be undertaken during the summer months when flows are low, and if flood conditions arise they are likely to be short-term and therefore would not significantly affect migration. These

works will be relatively short-term, and following completion of construction, the percentage of river accessible will return to its original status.

Proposed dredging works will remove spawning habitat from within the extent of the works area and therefore impact juvenile lamprey production and extent and distribution of spawning habitat during the construction works phase.

Alosa fallax fallax (Twaite Shad) [1103]

During the construction works, the percentage of the river accessible to Twaite Shad will be reduced and works in the river could act as a barrier to migration. However, as the works will take place on one side of the river at a time, with the river flowing normally on the adjacent side, the impact is not considered to be at an extent that would substantially reduce the percentage of river accessible for migration. As noted in Chapter 7 of the EIAR 'Hydrology', the installation of the barrier during the construction phase will result in localised changes in velocities on the other side of the river. These changes are likely to be temporary as the works will be undertaken during the summer months when flows are low, and if flood conditions arise they are likely to be short-term and therefore would not significantly affect migration. These works will be relatively short-term, and following completion of construction, the percentage of river accessible will return to its original status.

Twaite Shad are considered unlikely to be affected by the removal of spawning habitat from within the extent of the proposed works, as even if they occur in low numbers in the Slaney, they would have free access up as far as Clohamon Weir so could spawn anywhere along this stretch.

Salmo salar (Salmon) [1106]

During the construction works, the percentage of the river accessible to Atlantic Salmon will be reduced and works in the river could act as a barrier to migration. However, as the works will take place on one side of the river at a time, with the river flowing normally on the adjacent side, the impact is not considered to be at an extent that would substantially reduce the percentage of river accessible for migration. As noted in Chapter 7 of the EIAR 'Hydrology', the installation of the barrier during the construction phase will result in localised changes in velocities on the other side of the river. These changes are likely to be temporary as the works will be undertaken during the summer months when flows are low, and if flood conditions arise they are likely to be short-term and therefore would not significantly affect migration. These works will be relatively short-term, and following completion of construction, the percentage of river accessible will return to its original status.

Proposed dredging works will remove spawning habitat from within the extent of the works area and therefore impact salmon production, salmon fry abundance and number and distribution of redds.

Lutra lutra (Otter) [1355]

The proposed scheme has potential to affect otter distribution, the extent of terrestrial river bank habitat and freshwater habitat used by otter, number of couching sites or holts, fish biomass within the River Slaney and may cause a barrier to connectivity.

6.4.2.2 Wexford Harbour Slobs SPA

The Natura 2000 Standard Data Form (NPWS, 2015c) states that the SPA is one of the top three sites in the country for numbers and diversity of wintering birds and, of particular importance, it is one of the two most important sites in the world for Greenland white-fronted

geese *Anser albifrons flavirostris*. The site also supports internationally important populations of Brent geese *Branta bernicla hrota*, Bewick swans *Cygnus columbarius bewickii* and bar-tailed godwit *Limosa lapponica*. As mentioned above for River Slaney Valley cSAC, a nesting colony of little egret has become established within the site. Threats to the site include forestry management and practices, disturbance from nautical sports and recreational activities including walking, horse-riding and non-motorised vehicles. The site is not currently under any management plan (NPWS, 2015c).

The proposed scheme is within the European site and connectivity between the works and the SPA has been established for the following SCIs:

- Little Grebe (*Tachybaptus ruficollis*) [A004]
- Cormorant (*Phalacrocorax carbo*) [A017]
- Grey Heron (*Ardea cinerea*) [A028]
- Wigeon (*Anas penelope*) [A050]
- Teal (*Anas crecca*) [A052]
- Mallard (*Anas platyrhynchos*) [A053]
- Lapwing (*Vanellus vanellus*) [A142]
- Black-headed Gull (*Chroicocephalus ridibundus*) [A179]
- Lesser Black-backed Gull (*Larus fuscus*) [A183]

The potential for adverse effects to arise as a consequence of the proposed scheme alone on this European site has been analysed as part of the preparation of the Natura Impact Statement. In view of the site-specific conservation objectives this assessment determined that there would be no adverse effects on SCIs listed. A summary of the overall impact on the conservation objectives is provided below.

Grey Heron (*Ardea cinerea*) [A028] and other SCI waterbird species

In the absence of mitigation, the proposed scheme has the potential to affect population trend and distribution of SCI species arising from; habitat degradation resulting from the removal of the natural riparian edge in the southern floodplain and instream dredging and compound channel works; disturbance and displacement of birds from the core wetland area in the southern floodplain resulting from instream works and construction of the new road bridge, potential changes in land use and habitat change, removal of existing visual screening; and, collision risk with the new road bridge

6.4.2.3 River Slaney Valley pNHA

This site comprises the freshwater stretches of the Slaney as far as the Wicklow Mountains and supports populations of several species listed on Annex II of the EU Habitats Directive, and habitats listed on Annex I of this directive, as well as important number of wintering wildfowl including some species listed on Annex I of the EU Birds Directive. Connectivity between the proposed scheme and the national designation has been identified and the scheme has potential to result in adverse impacts on the designated site mainly arising during the construction phase. The River Slaney Valley pNHA and the two European sites identified above as having connectivity to the scheme, overlap boundaries with the pNHA and ecological features of interest. This national designation will not be adversely impacted by the development due to reasons listed above for the European sites.

6.4.3 Habitats

6.4.3.1 Construction Phase Impacts

Habitat Loss

The proposed scheme will result in habitat loss along the length of the works resulting from river widening and dredging works, the construction of the flood defence walls, pumping substations, bridges (road and pedestrian) and approach roads. In addition, there will be temporary habitat loss within the construction working areas, deposition area in the northern floodplain, compound channels and enhancement of the back channel. Table 6.10 below summarises the areas of habitats that will be permanently or temporarily lost as a result of the scheme.

There will be no direct permanent or temporary loss of the following KER habitats of reed and large sedge swamps, Tall-herb swamps, wet grassland, mesotrophic lake, oak-birch-holly woodland, riparian woodland or exposed siliceous rock as a result of the proposed scheme. For habitats, not including the aforementioned, resulting in a combined direct permanent or temporary habitat loss less than 0.5ha, the impacts are predicted to be insignificant and are not discussed further.

Table 6-10: Summary of permanent and temporary habitat loss for habitats (Fossitt, 2000) identified as KERs with the proposed scheme extents

Habitat Type	Area/length Permanent Loss	Area/length Temporary Loss
Depositing/lowland Rivers (FW2) – includes Annex I habitat [3260]	-	3.55 ha
Tidal Rivers (CW2)	-	4.73 ha
Reed and Large Sedge Swamps (FS1) / Tall-herb swamps (FS2)	0.10 ha	-
Drainage Ditch (FW4)	-	859 m
Dry Calcareous and Neutral Grassland (GS1)	3.12 ha	10.16 ha
Dry Meadows and Grassy Verges (GS2) / Wet Grassland (GS4)	0.33 ha	-
Hedgerow (WL1) / Treelines (WL2)	1,301 m	-
Oak-ash-hazel Woodland (WN2)	0.09 ha	0.05 ha

<u>Depositing/lowland Rivers (FW2) and Tidal Rivers (CW2)</u>

Instream works area will be installed in sections of the eastern and western half of the river channel upstream of the Seamus Rafter Bridge between July and October in year 1 of construction and downstream of the Seamus Rafter Bridge for the same period in year 2. During these works, the main flow of the river channel will be diverted away from the dry works area by an impermeable barrier. As a result, there will be a temporary restriction of both non-tidal and tidal reaches of the River Slaney to exclude the dry works areas. Annex 1 floating river vegetation habitat was recorded within the extent of the dry works areas and is discussed in detail in Section 6.4.7 below.

Although the dry works areas will be installed during summer months when flow conditions are generally lower than high flow winter conditions, there is a risk of bankside and riverbed erosion and deposition of materials downstream. Regular bathymetric surveys to monitor erosion will occur, especially after any significant fluvial flood event, during the instream dry works to identify early warning signs and prompt implementation of mitigation procedures to combat these adverse effects on the river habitat.

Where dry works areas are being used as a haul route to transport materials, a risk of river bed compaction is possible. Prior to the removal of pile sheets from the dry works area, scarifying of the riverbed materials to aerate and de-compact the area will be carried out. Sheeting piling of the dry works areas will be removed in such a way to minimise the suspension of siltation during re-flooding. Downstream monitoring occurring at appropriate frequencies and intervals during the re-flooding process will identify at an early stage the risk of siltation reaching ecological sensitive features downstream. An alarm will be raised if the threshold limit has been reached and mitigation procedures will be prompted.

Post-dry works, riverbed conditions are not expected to represent pre-works baseline characteristics given the nature of the proposed scheme dredging works and sediment deposition area in the north of the northern floodplain which will alter deposition of material throughout the scheme extent. However, favourable riverbed conditions are expected to restore naturally from the dynamic flow and process of the main channel over a period of 3-5years. Deflector locations positioned along the main channel will create a variation in flow conditions and encourage the regeneration of favourable riverbed characteristics.

It is important to remember that the River Slaney is a dynamic system and that natural processes such as flooding or high-flow conditions often result in erosion and deposition of materials, and changes in the riverbed characteristics due to the ephemeral nature of sediments within the river system. Considering this, overall it is expected that potential direct and indirect impacts resulting from the temporary restriction of river flow to half the width of the main channel during instream works has the potential to result in short-term adverse significant impacts at a local geographical scale.

Dry Calcareous and Neutral Grassland (GS1)

The northern and southern floodplains within the extent of the scheme mostly comprise dry calcareous and neutral grassland with some areas of wet grassland mainly in the southern floodplain. The grassland habitat represents a low-lying, semi-natural grassland which is seasonally flooded during winter months and is intermittently grazed by horses.

As a result of river widening works in both the floodplains, there will be a permanent loss of approximately 3.12ha of dry calcareous and neutral grassland. Following river widening works the compound channel created will be reseeded in a similar grassland mix, however due to the change in hydrology of these areas they may be submerged in water more frequently and therefore it cannot be guaranteed that dry calcareous and neutral grassland will regenerate along the compound channel.

The deposition zone in the northern floodplain will result in the temporary loss of 10.16ha during the works period and until vegetation has become suitably re-established. Vegetation on the northern floodplain will be stripped and the topsoil layer stored, material will be deposited and compacted on the northern floodplain to a height of 1.5m. The original topsoil, excluding material that may be contaminated with non-native invasive species, will be reinstated and a similar dry calcareous and neutral grassland mix used to reseed the area. It is expected that this grassland habitat will regenerate and that the northern floodplain will continue to function as a floodplain.

The area of permanent dry calcareous and neutral grassland loss resulting from the scheme works represents *c.* 16% of this habitat type recorded within the survey area. The area of temporary habitat loss expected to regenerate following reinstatement works within 2-3years of the completion of works represents *c.* 52% of this habitat within the survey area. Overall the permanent and temporary loss of this grassland habitat, which will continue to function as

floodplains post works, is considered to result in an adverse significant impact at a local geographical scale.

Drainage Ditches (FW4)

The existing drainage ditch in the northern floodplain, also referred to as the back channel, is 859m in length and represents *c.* 23.5% of drainage ditches recorded within the survey area. Sections of the existing back channel will be temporarily lost during the re-profiling and ecological enhancement works in this area. Post-works, the enhanced back channel will represent a channel 945m in length due to the addition of meanders in the channel. No other drainage ditches will be lost or affected by the scheme works.

The current back channel is inundated with non-native invasive species, including Himalayan Balsam and Japanese knotweed, and there is minimal flow in the channel which is largely choked by vegetation. On completion of the back-channel enhancement works, the channel will represent an open watercourse with a continual flow that is suitable for use by a variety of mammals, birds and aquatic fish species. See Appendix C.12 for further details on the design and enhancement measures of the back channel. Considering this, adverse impacts are considered to be temporary during the works period but significant at a local geographical scale, however long-term positive impacts resulting from the enhancement works are predicted to be significant at a local to regional geographical scale.

Hedgerows (WL1) / Treelines (WL2)

Linear treelines and hedgerows will be lost to accommodate the design of the enhanced back channel in the northern floodplain, and the new road bridge and approach road design and construction working areas. At worst-case scenario *c.* 30% of treelines/hedgerows will be removed to accommodate these areas, although where possible trees will be retained.

Native tree and riparian planting along the enhanced back channel will compensate for tree loss in this area, although until this vegetation has suitably matured it will not provide the same ecological value or connectivity as existing treelines in the northern floodplain. Trees removed as a result of the construction of the new road bridge and approach roads will be permanently lost on the eastern side of the river channel, with landscape planting compensating a proportion of treeline loss on the western side of the main channel. Overall the removal of treelines within the scheme extent is considered to result in a temporary adverse negative impact, significant at a local geographical scale.

Habitat degradation

Water quality

During construction, contaminated surface water runoff and/or an accidental spillage or pollution event into any instream or surface water feature has the potential to have a significant negative impact on water quality and consequently affect aquatic and wetland habitats both within the scheme extent and downstream of the works. Instream, riparian and wetland habitats fed by the River Slaney have the potential to be impacted by a depreciation in water quality as a result of the scheme works. Of the KER habitats identified, instream and riparian habitats directly fed by the main channel or fed by associated drainage ditches are at risk to habitat degradation from a reduction in water quality.

Although the main reason for the dry works areas is to minimise siltation during dredging and river widening, it is likely that the main siltation threat will arise from the re-flooding of the dry works areas. The dry works areas will also contain any pollution event which can then be dealt

with accordingly before reaching any aquatic environment. In a worst-case scenario, it is considered that the siltation plume associated with re-flooding of the instream dry works areas has the potential to reach downstream estuarine and coastal habitats. However, sediment analysis deposition carried out by the scheme hydrologists have predicted that sedimentation will be localised and expected to settle at a maximum 0.5-2km from the works area, fine (silt-sand) sediments are consistently transported by the river and a natural flood or high flow event could carry deposited silts further downstream. In order to minimise the risk of such impacts, detailed monitoring and mitigation measures to protect the downstream hydrology environment have been included in the mitigation section of this Chapter, and the Hydrology and Geomorphology Chapters.

Deposition of fine silts, within instream and riparian habitats has the potential to impact plant growth and habitat condition. With frequent monitoring in place during instream works and re-flooding of dry work areas, early detection of an exceedance of siltation will trigger mitigation measures set out in this Chapter. Habitat degradation as a result of a decline in water quality during construction works has the potential to affect downstream habitats hydrologically connected to the main channel and could theoretically result in an adverse effect, significant at a regional geographic scale.

Hydrology (e.g. flow and flooding regime)

Instream dry working areas, designed to minimise siltation during instream dredging and river widening works, will constrict the main river flow to half the width of the current main channel in sections. The longest dry works area within the extent of the scheme is the western half of the main channel upstream of the Seamus Rafter Bridge and will extend for 1.2km of the scheme extent. A single dry works area will be in place at any one time and will be installed for a two-month period between either July and August or September and October, which are generally considered to be low flow times. During these periods, flow in the main channel will be diverted away from the dry works areas and will be constricted to half the width of the main channel. Flow conditions such as velocity will change during this period due to the constricted area and there is potential for the change of flow conditions to cause erosion to instream and riparian habitats. Frequent visual monitoring by bathymetric surveys of river bank erosion will be carried out to monitor and detect early signs of erosion and prompt mitigation when required. These measures are outlined in the mitigation section of this Chapter and the Hydrology and Geomorphology Chapters.

Instream works will not interfere with the tidal flooding regime of the River Slaney. Wetland habitats and mesotrophic lakes in the southern floodplain are fed by the tidal flow drainage ditches that spur off the main channel. Neither the dry works area nor the river widening works south of the southern floodplain will interfere with the flow in these drainage ditches and therefore will not impact wetland habitats within the southern floodplain.

Habitat degradation as a result of construction of the main channel flow adjacent to the dry works areas has the potential to negatively impact adjacent river banks and riparian habitats and result in a likely temporary significant effect at a local geographical scale.

Non-native invasive species

Given the presence of non-native invasive plant species along the River Slaney and within the working area of the proposed scheme, there is potential for these species to spread during the scheme works. A provisional Invasive Plant Species Management Plan has been prepared and a treatment plan for the non-native invasive plant species identified within the works areas is underway. A copy of the Plan is accompanying this report. A construction non-native invasive

species management plan will be implemented by the contractor during the works phase to control the spread of species and suitable dispose of contaminated material. However there remains a risk of spread via construction contamination spread by construction works and construction traffic. Wexford County Council have made a commitment to implement a non-native invasive species management plan within the extent of the scheme and wider area to control the long-term spread of invasive species. Several treatments of the management plan were undertaken prior to the submission of this Chapter.

The introduction and spread of non-native invasive plant species to sensitive and ecologically important areas within the scheme and surrounding area has the potential to result in a long-term likely significant negative effect at a local to regional geographical scale.

6.4.3.2 Overall Construction Impacts

Overall construction phase impacts are negative and largely temporary where habitat loss is offset by reinstatement or creation of new habitat associated with the re-profiling of the back channel and have been assessed as significant at a local geographical scale. The exception to this is of the spread of non-native invasive species which has the potential to result in long-term significant impacts at a regional scale, and habitat degradation which although is a temporary impact may extend to downstream environs up to 2km of the proposed scheme works.

6.4.3.3 Operational impacts

Habitat Loss

The operational phase of the proposed scheme will not result in any additional habitat loss other than that discussed in the above Section 6.4.4.1. Maintenance works of the sediment trap in the northern floodplain will be carried out as and when required which is expected to be approximately every 7-10 years. These works will remove excess sediment and potentially exposed sand, gravel or till (ED1) in the designated area. The loss of exposed sand, gravel or till will represent a very small area of this habitat which will fringe the existing gravel island at the northern floodplain, and which is expected to regenerate over time. These maintenance works will be carried out in a dry works area to minimise siltation further downstream of the works.

Habitat degradation

<u>Water quality</u>

The operation of the proposed scheme will have minimal impacts on water quality of the River Slaney. Any impacts will arise from instream works associated with maintenance of the silt deposition area in the northern floodplain and will involve a dry works area and sediment removal which is expected to be required every 7-10 years. Removal of large items from the debris trap will be carried out from bankside following storm events when required and will not involve instream works.

Habitat degradation downstream of the instream maintenance works will be temporary and arise during re-flooding of the dry works area. Potential instream siltation during installation and removal of the dry works area is considered to result in a temporary adverse impact, significant at a local geographical scale.

<u>Shading</u>

With the exception of Annex 1 habitats, discussed in Section 6.4.4 below, it is not considered that either the proposed road bridge or pedestrian bridge will cause shading impacts that could negatively affect the condition of KER habitats identified within the proposed scheme extent.

Non-native invasive species

Wexford County Council have committed to implementing a non-native invasive species management plan for the scheme extent. Providing this plan is implemented correctly it has the potential to result in long-term positive impacts on the habitats within the extent of the scheme.

Air quality

With the exception of Annex 1 habitats, discussed in sections 6.4.4 and 6.4.6 below, it is not considered that KER habitats identified within the scheme extent are sensitive to air quality impacts resulting from the scheme that could negatively affect their overall condition.

6.4.3.4 Overall Operational Impacts

Operational impacts have potential to arise from instream maintenance works of the silt deposition area which will be carried out in a dry works area, as requested by IFI. These works are expected to result in temporary adverse impacts, at a local geographical scale.

6.4.4 Annex I habitat: Old Sessile Oak Woodland [91A0]

The area of Old Sessile Oak Woodland is located on a steep rocky slope, west facing onto the N11 on the eastern side of the proposed bridge location. It transitions into an area of younger Oak-Ash-Hazel woodland to the south (non-Annex).

6.4.4.1 Construction Phase Impacts

Habitat Loss and Fragmentation

There will be no direct habitat loss as a result of construction works. The new road bridge will be located immediately south of the Oak woodland. There will be no loss of Oak woodland habitat for sightline construction. As the embankment transitions from a cut into a very minor level of fill close to the Oak woodland, there will be no requirement to access or for infringement to, the Oak woodland area during the works.

Habitat degradation

Water quality and hydrology

The woodland is located above the construction works (new bridge and associated road layout). It is a dry woodland type and there are no water dependent features within the woodland.

Hydrology (e.g. flow and flooding regime)

There is no proposed drainage into the woodland as it is situated above the construction works (new bridge and associated road layout).

Non-native invasive species

There will be disturbance close to the woodland during construction of the new road bridge and access roads. Non-native species such as the herbs *Fallopia japonica* and/ or *Impatiens glandulifera* could become established or spread from nearby sites (e.g. on machinery) during construction. This could lead to a reduction in the species diversity of the ground flora within the woodland. Therefore, the establishment and spread of non-native invasive species would result in a likely significant negative effect, at a local geographic scale.

Air quality

There will be no residual impacts of significance on air quality or climate from the construction of the proposed scheme.

6.4.4.2 Overall Construction Impacts

In the absence of mitigation, construction impacts would result in a likely significant negative effect on Oak woodland, at a local geographic scale.

6.4.4.3 Operational Phase Impacts

Habitat Loss

There will be no loss of Oak woodland during operation.

Habitat disturbance

Access to the Oak woodland from the N11 due to steep slopes and dense undergrowth, particularly of thorny species. During construction, an area of the Oak-ash-hazel woodland to the south of the Oak woodland will be removed. This may increase access to the Oak woodland from the road resulting in negative impacts such as trampling, increased nutrients from dogs, litter deposition, burning and wood removal. This would result in a negative effect, significant at a local geographic scale. It would be unlikely to affect a large area of woodland due to the steep slope and dense undergrowth, which make access very difficult in the northern area of the woodland.

Habitat degradation

Water quality

The woodland is located above the new bridge and associated road layout. It is a dry woodland type and there are no water dependent features within the woodland.

Shading

The removal of the Oak-ash-hazel woodland to the south of the Oak woodland will increase light levels at the southern woodland edge. This may locally increase the cover of the shrub layer. The shrub layer criteria within the Oak woodland failed the condition assessment due to the low cover of native shrubs. Therefore, an increase in shrub cover as a result of increased light levels would lead to a likely significant positive effect, at a local geographic scale.

Non-native invasive species

The disturbance immediately south of the woodland and increased light levels in this area could facilitate the growth and regeneration of non-native tree species such as *Acer pseudoplatanus* and/ or *Fagus sylvatica*, which are currently present within the local woodland area. The establishment and spread of non-native species, particularly flora species that are not currently present within the woodland, would result in a likely significant negative effect, at a local geographic scale.

Air quality

There will be no residual impacts of significance on air quality or climate from the operation of the proposed scheme.

6.4.4.4 Overall Operational Impacts

In the absence of mitigation, operational impacts would result in a likely significant negative effect on Oak woodland, at a local geographic scale.

6.4.5 Annex I priority habitat: Alluvial Woodland [91E0]

The area of Alluvial Woodland is located to the east and south of the southern floodplain. It comprises a narrow strip of woodland to the east of a ditch on the southern floodplain and a wider area to the south of the southern floodplain.

6.4.5.1 Construction Phase Impacts

The new bridge deck will span the northern section of alluvial woodland. There will be no direct loss of habitat, as the bridge supporting structures will be located to the east and west of the alluvial woodland. There will be construction works in close proximity to the alluvial woodland and there is the potential for accidental direct habitat loss during construction. However, the woodland is very wet and separated from the floodplain by a ditch that has standing water for most, if not all, of the year. It is therefore highly unlikely that machinery would accidentally damage the woodland. The woodland in this area is very narrow (c. 30m wide) and any impact would be very localised.

Pruning of the crown of the trees to 5m under the bridge deck will be required. The alluvial woodland strip is c. 30m wide in the location of the new bridge and c. 0.06ha of alluvial woodland will require topping. The total area of alluvial woodland on southern floodplain (to the east and south) is c.3.02ha. Therefore, the pruning will impact c.0.02% of the area of alluvial woodland. The main tree species in this area of woodland are *Alnus glutinosa* and *Salix fragilis*, which are both trees that have a history of management by coppicing and pollarding. Therefore, pruning at the correct time of year (e.g. November to March) by an experienced arboriculturist should not lead to direct tree mortality. However, there is the potential for disturbance to ground flora during the works. Given the small area of alluvial woodland in this location, this would at most result in an adverse effect, significant at a local geographic scale. There will therefore be no direct loss of Annex I wet woodland habitat as a result of pruning works.

Habitat degradation

<u>Water quality</u>

The alluvial woodland has a high-water table for much of the year and is regularly flooded in winter. During construction, contaminated surface water runoff and/or an accidental spillage or pollution event adjacent to the alluvial woodland (or into a surface feature hydrologically connected to it) has the potential to have a significant negative impact on water quality within the alluvial woodland. This could lead to a temporary loss of plant life (e.g. from toxic substances) or a change in ground flora (due to increased nutrients). Frequent and/or prolonged pollution events in the river system have the potential for significant long-term effects in the alluvial woodland. It is considered unlikely that a pollution event of such a magnitude would occur during construction or be any more than temporary in nature. Nevertheless, a precautionary approach is being taken in assuming a level of risk of water quality impacts and detailed mitigation measures are required to further minimise the risk of any perceptible impact on water quality during construction. Habitat degradation as a result of the negative impacts to surface water quality during construction has the potential to affect the habitats' conservation status and result in an adverse effect, significant at an international geographic scale.

Hydrology (e.g. flow and flooding regime)

During construction a compound channel will be created along the River Slaney adjacent to the southern floodplain, to the west of the alluvial woodland. This has the potential to impact upon the hydrology of the alluvial woodland. The alluvial woodland receives tidal water and surface water runoff from the slope above to the east. Geotechnical investigations were carried out for the proposed scheme. These investigations noted that soils in the southern floodplain (Bare Meadows) consist of clay and silt materials lying on sands and gravels. The groundwater level was found to be at the top of the gravel / sand layers in trial pits. This is at a depth of between 1.6 and 3m below existing ground level and the groundwater is generally below the river level. It can be concluded that the groundwater does not rise through the impermeable clay layer and the surface water in the field does not seep down through this impermeable clay at a significant rate. Therefore, the works in the river will not influence the surface water level in the field.

Non-native invasive species

Two non-native invasive species are present within the alluvial woodland on the southern floodplain area. There is a small area of *Fallopia japonica* to the east of the northern section and *Impatiens glandulifera* is established and locally frequent throughout the alluvial woodland in this area. During construction (and tree-topping) there is the potential to facilitate the spread of *Fallopia japonica*, which is currently very localised and does not occur in the wet woodland area. *Impatiens glandulifera* is already established but disturbance to ground flora during topping could potentially increase the local abundance of this species. Currently the site condition assessment for alluvial woodland (Appendix C.3) passes the criteria for cover of negative indicator species. An increase in the cover of non-native invasive species could cause this criterion to fail, which (in the absence of mitigation) would affect the habitats' conservation status and result in an adverse effect, significant at an international geographic scale.

Air quality

There will be no residual impacts of significance on air quality or climate from the construction of the proposed scheme.

6.4.5.2 Overall Construction Impacts

In the absence of mitigation, construction impacts would result in an adverse effect, significant at a local geographic scale.

6.4.5.3 Operational Phase Impacts

There will be no direct loss of habitat area during operation. However, regular tree-pruning will be required to ensure that branches do not interfere with the bridge structure. This would cause the canopy height criterion of the condition assessment to fail, as canopy height will be below 7m (Appendix C.3). However, as 8/10 of the condition assessment criteria at the 1-plot level would pass (with negative species regeneration and canopy height criteria failing), the overall 1-plot assessment in this area would still pass. In addition, the site would pass at the 4-plot level and therefore the alluvial woodland would still be given a 'Green' result for Structure and Function assessment (Appendix C.3).

Currently there is very low cover of dead wood (fallen and standing dead wood) habitat in the alluvial woodland and this criterion fails the condition assessment (Appendix C.3). This could be increased by the topping activity in the area of the bridge if dead wood is left in situ.

Habitat degradation

Water Quality

There will be no surface water discharge from the bridge or roads into the alluvial woodland. Surface water from the new road bridge will flow to the east (the deck will fall to the east) and be collected and combined with back of wall drainage and discharged through a petrol interceptor to the river to the north. The roundabout cut slope will be intercepted at the top of the slope and discharge to the north through the new outfall and to the south through the existing outfall or to the new northern outfall. These will also be utilised for pavement and cut slope drainage.

Hydrology (e.g. flow and flooding regime)

The alluvial woodland receives tidal water inundation surface water runoff from the slope above to the east. There will be no change to runoff from the slope to the east. The tidal water reaches the woodland via a drain, which flows north (upstream) with the rising tide. The river has a tidal range of c. 1.5m in this location. During neap tides, this will be c. 0.5m lower than at present but the drain that feeds the alluvial woodland will continue to be inundated every tidal cycle. In extreme floods, the depth of flooding will be reduced on the southern floodplain by between 50 and 240mm. It is the frequency and duration of flooding that is important in alluvial woodland, rather than the actual depth of water. Regular flooding is important to prevent species from drier woodland becoming dominant. However, alluvial woodlands are typically not submerged during at least the summer months. Prolonged flooding can lead to dieback of some species and nutrient enrichment. The ditch adjacent to the alluvial woodland currently supports standing water for all of the year. The woodland regularly floods in winter and standing water continues to be present in at least May (Appendix C.3). Therefore, a slight decrease in the water levels from an extreme flooding event would not impact the woodland flora.

Shading

There will be no direct habitat loss during operation. However, the new road bridge will shade a small area of the northern section of alluvial woodland. A shading study (Integrated Environmental Solutions Limited, 2016) shows that only a small area of woodland will be affected by shading and that all areas will still receive over 2 hours of sunlight per day during the growing season (spring and summer). This could lead to a slight local change in species composition. However, alluvial woodland will still be present, even if there is a change in woodland vegetation type. Alluvial woodland is dynamic and changeable and small changes in species composition would not cause the species composition condition assessment criteria to fail. For instance, even if half of the positive indicator species were lost, there would still be sufficient indicator species present to pass (Appendix C.3). The tree canopy would still be dominated by target species (*Alnus glutinosa, Fraxinus excelsior, Salix cinerea* or other *Salix* sp.), as the prolonged winter flooding does not favour other tree species. It may be that there would be a shift to dominance by the native willow *Salix cinerea*, as in the majority of the alluvial woodland at this site.

The field layer is dominated by tall herb species. These can grow in closed or open woodland and many can also persist outside of woodland e.g. in tall-herb swamp. Therefore, the cover and height of the field layer is unlikely to change in response to the tree topping and slight bridge shading. Currently the cover of the field layer is 100% in this area, with a height of c.1m, but to pass this condition assessment it is only required to be ≥20% of plot and ≥20cm. A very large change in the field layer would be required for this target to fail and there is no reason why this would occur.

The shrub cover is currently very low in this area of the woodland (and fails the standard condition assessment criterion). Despite slight shading by the bridge, the topping of canopy trees will increase the light reaching the shrub layer. In addition, some of the coppiced/pollarded trees will also form part of the shrub layer, increasing cover. Therefore, the lower, site-specific, target for alluvial woodland at this site should continue to be met and may actually be increased (Appendix C.3).

Non-native invasive species

There will be regular management to ensure that tree branches do not interfere with the bridge structure (regular topping height of 5m). Direct disturbance to ground flora during topping (if severe) could lead to an increase in the invasive field layer species *Impatiens glandulifera* and lead to invasion by *Fallopia japonica.* However increased shading could have a negative impact on these species. This could affect the overall alluvial woodland condition assessment and result in an adverse effect, significant at an international geographic scale.

Air quality

There will be no impacts of significance on air quality or climate from the operation of the proposed scheme.

6.4.5.4 Overall Operational Impacts

In the absence of mitigation, operational impacts would result in a likely significant negative effect on alluvial woodland, at a local geographic scale.

6.4.6 Annex I habitat: Floating River Vegetation [3260]

Aquatic macrophyte populations fluctuate annually and can be absent from suitable habitat in any one year. It is considered that in 2003 the Floating River Vegetation was at a minimum (very little growth and/ or species diversity recorded in most of the river). In 2016, however, aquatic plant growth was recorded throughout much of the channel and four main areas were identified as being important for aquatic macrophytes within the project area:

1) adjacent to the northern floodplain (chainage 6150-6850);

2) below the Seamus Rafter bridge (chainage 5340-4800);

3) adjacent to the southern floodplain (chainage 4300-4700); and,

4) southern end of the project area (chainage 3220-4000).

Floating river vegetation was most abundant close to the riverbanks where water depth is c. 1.5m. Macrophytes can grow in much deeper water (e.g. up to 3.5-4m) where water clarity is very good. However, it may be that water clarity is not high enough for macrophyte growth in deeper water in this area of the River Slaney, or that siltation in the centre of the channel is too deep. As aquatic plant growth was in good condition in 2016, it is considered that all significant areas of potential Floating River Vegetation were detected.

6.4.6.1 Construction Phase Impacts

Habitat Loss and Fragmentation

The construction works that have the potential to disturb the floating river vegetation within the channel are in-stream works (dredging and widening), associated movement of equipment and vehicles within the channel and construction of hard flood defences (e.g. walls). All works within

the channel will be carried out within a dry works area. An impermeable barrier will be constructed along the centreline of the river along the extent of the works area. Works will be undertaken over a 36-month period. The expected programme of relevant works is:

- Year 1: Instream works will be undertaken upstream of the Seamus Rafter Bridge on the east side from July to August and on the west side from September to October.
- Year 2: Instream works will be undertaken downstream of the Seamus Rafter Bridge on the west side from July to August and on the east side from September to October.
- Year 3: No dry works but river widening downstream of the River Urrin, July to August.

A summary of the main works likely to disturb macrophytes in each of the four main macrophyte areas is summarised below:

1) Northern floodplain (chainage 6150-6850):
    a. river widening by up to 30m on the eastern bank;
    b. creation of a wall on the western bank (outside of the main floating river vegetation distribution);
    c. dredging in one c. 100m length as existing river bed mostly below the desired bed level.
2) Below Seamus Rafter Bridge (chainage 5340-4800):
    a. dry works area and river widening on the western bank (no dry works on the eastern half of the channel);
    b. flood defence wall on both banks;
    c. little or no dredging as the existing river bed is mostly below the desired river bed level.
3) Southern floodplain (chainage 4300-4700):
    a. dry works area and river widening on eastern bank and shallow dredging in channel (10-20cm). NB Area where *P.* x *cooperi* was found is just above end of dredging zone. There is no planned widening on the western bank. This would also leave vegetation *in situ* for recolonisation of the channel opposite and downstream.
4) Southern end of survey area (chainage 3220-4000):
    a. widening in the north of the area on both banks. No dredging required but dry works on both sides of channel.

Dredging and river widening will lead to direct removal of aquatic macrophyte vegetation from the river channel. However, removal of vegetation does not necessarily mean the complete loss of floating river vegetation habitat. The amount of macrophyte growth in any one year is variable, due to factors such as water temperature, winter flooding, plant life-cycles and water clarity. This is a dynamic habitat that is adapted to natural disturbances such as high flows, flooding and scouring. Aquatic macrophytes have features that facilitate quick regeneration (such as the ability to regenerate from vegetative fragments, seeds and other propagules). Vegetation can recover from severe disturbances within a couple of years, but the speed at which recovery occurs will depend on habitat suitability, source of propagules for regeneration and vegetative spread from nearby stands of macrophytes. Most propagules involved in the short-term regeneration of aquatic macrophytes are located within the top 10cm of sediment, (Dugdale et al., 2001, cited in Combroux and Bornette, 2004; Ozimek, 2006). However, seeds within the long-term seed bank may be buried up to 15cm deep and still have the ability to germinate if exposed to the right conditions (de Winton et al., 2000). In addition, many aquatic macrophyte species in rivers can grow from fragments washed down from upstream (Haslam, 2006). A species rich assemblage can regenerate within two to five years, with species such as *Elodea* spp., *Chara* spp., *C. demersum*, *E. canadensis*, *P. pusillus*, *M. spicatum*, *P. crispus* and

P. pectinatus as early colonisers (Beltman et al., 1996; Boedeltje et al., 2001; Capers, 2003; Chow-Fraser, 2005; Haslam, 2006; Moss et al., 1996a and 1996b).

Sediment stability is also a major factor determining the growth, recolonisation success and stability of recovering macrophyte populations (Schutten et al., 1997). Where deep silt has accumulated in a watercourse (e.g. 1m), some macrophyte species remain rooted at a consistent level, whilst silt accumulates above. Plants can become easily dislodged and damaged where sediment is loose (Schutten et al., 2005) and dredging can improve plant growth (Haslam, 2006). In alluvial plains, the subsoil is soft and after dredging a soft substrate remains (Haslam, 2006). In this case, or where the hard bed is untouched, or broken, but the watercourse is silting, aquatic macrophytes will quickly regenerate (Haslam, 2006). Temporary drawdown can also be used to stabilise sediments (Cooke et al., 2005).

After the in-stream works have been completed within a section of the river, the section will be re-flooded. Aquatic macrophytes that were previously present within the section (if works occur during the growing season), will have been removed from dry works areas. In addition, sediment will have been removed by dredging in some sections. The total area to be dredged is c. 85,000m2, which is about 50% of the channel within the survey area. As most sections will require a dry works area and vehicle and equipment movement within the dry works area, most areas that are not dredged will still be disturbed. However, the propagule bank will remain in situ in undredged areas and those that are dredged, to a depth of less than 10cm (c. 30,200m^2, 35% of the dredged area). In total, approximately 70% of the channel within the survey area will either be not dredged, or dredged to a depth of less than 10cm, thus leaving the propagule bank in situ.

Propagules in the sediment will survive and regenerate when re-flooded (for instance this reproductive strategy allows macrophytes to quickly regenerate in drawdown zones or reservoirs). There will therefore be a small source of in situ propagules in each macrophyte section, as well as the recolonisation from aquatic macrophytes to the north (upstream) of the project area. After work on the eastern side of the river has been completed, the floating river vegetation in the western side of the river will be intact. However, the sheet-piling in the centre line of the river channel will prevent vegetative spread of aquatic macrophytes from the west to the newly dredged east side of the channel.

The drawdown and sediment removal will stabilise the substrate and, where soft substrate is still present (i.e. not dredged down to bedrock or gravels), conditions will be suitable or enhanced for macrophyte growth. Conditions may not be immediately optimal if compaction of the sediment occurs during vehicle use within the dry works area. However, the gravels within the channel are not highly likely to compact and silt will re-accumulate within the channel (e.g. at times of high flows). Therefore, whilst these areas may recolonise more slowly they are still likely to support potential floating river vegetation habitat in the long-term. Regeneration will also occur from propagules within the sediment (where no dredging or shallow dredging only has taken place), from areas of replaced sediment (see below) and from fragment of plants washed down the river from north of the works area.

Regeneration of aquatic plants after construction works can be facilitated by methods such as replacement of the top 15cm of sediment (propagule bank) or vegetative fragments into the channel. These would be removed prior to the works, stored (wet/ dry) and then replaced before re-flooding. The main native aquatic macrophyte species that was found within the survey area was *Potamogeton perfoliatus*. This lacks specialised vegetative propagules and does not colonise well from vegetative fragments (Capers 2003; Preston and Crofts, 1997). It does however germinate from seed (e.g. Boedeltje et al., 2002) and by vegetative spread from adjacent plants (Capers 2003). Seed would be expected to be present in up to 15cm depth of

sediment and would withstand drying during storage. Conversely the non-native invasive *Elodea* species only reproduce vegetatively and regenerate well from plant fragments (Barrat-Segretain & Bornette, 2000; Cronk and Fennessy, 2001; Preston and Crofts, 1997; Strand, 1999). The use of sediment replacement as a mitigation method would enhance the establishment of aquatic macrophytes post-dredging. There is the potential that some of the replaced sediment could become suspended during re-flooding of the dry works area and be carried downstream. This could potentially facilitate the regeneration and spread of *Elodea* species within the channel and downstream. However, *Elodea* species were present at very low cover within the channel and these species are well established in the river within the project area and downstream. In addition, dry storage of sediment will favour the native *Potamogeton perfoliatus*, which can regenerate from seed, whilst reducing the potential of regeneration of *Elodea* species (as plant fragments have a lower tolerance to drying than seeds and specialised propagules). It will be important to ensure however that sediment from areas with high cover of *Elodea* species prior to works (if present) is not replaced post-construction.

The loss of aquatic macrophytes from the channel will lead to a likely significant short-term negative effect, at a local geographic scale. However, as suitable (and potentially enhanced) floating river vegetation habitat will be present after construction, there will be no significant long-term negative impacts on this habitat condition or distribution.

The widening (and in some areas the dredging) will lead to the creation of additional habitat for floating river vegetation within the river channel. The Type 1 and Type 3 riverbank widening should have the same or greater area of shallow water as the present riverbank profile. Type 2 widening has sheet piling and may result in localised loss of habitat in deeper water areas. Aquatic macrophytes were found in water that was below 1.5m in depth within the survey area. The area that is currently below 1.5m depth in the channel is 13,670m^2. Post-dredging, the area of channel below this depth will be 70,900m^2. This is <u>an increase of greater than five times the amount of potential floating river vegetation habitat</u>. In addition, the modification of the back channel on the northern floodplain (which is currently heavily shaded with little flow) will enhance its potential to support aquatic macrophytes. This will increase the abundance and distribution of aquatic macrophytes within the project area. Therefore, there will be a likely long-term positive effect, significant at a local geographic scale.

Habitat degradation

<u>Water quality</u>

The in-stream works will be undertaken in a dry works area. Water will be allowed to leave the dry works area naturally (by leaving the downstream end open). Any residual water that remains will be pumped out with an appropriate filter on the pipe to prevent sediment being released downstream. Therefore, there will be no impact on water quality during this stage. When the dry works areas are re-flooded there is the potential for silt to become suspended in the water column and be washed downstream. However, most of the silt is likely to be deposited shortly after the works areas. This may be re-suspended and carried further downstream during a flood event, a natural process. If the silt settles within the dredged/disturbed areas, then this will facilitate aquatic macrophyte regeneration on the dredged river surface. If silt is suspended in the water column then it will be rapidly dispersed travel downstream and so be highly unlikely to impact on light levels within the river channel in this area (e.g. as it would in an extreme flooding event). Any accidental spills during construction would be contained within the dry works area and would be remediated before the area was re-flooded. Therefore, there are no likely significant impacts of water quality changes on aquatic macrophytes during construction.

Hydrology (e.g. flow and flooding regime)

During the dry works, in some areas the river will be reduced to half its width. The velocity within the adjacent river channel is therefore expected to increase during the dry works. This will only be for a few months during one year for each of the sections. As most above-ground macrophyte growth will be lost from the channel due to the construction of dry works areas and dredging activities, this is not expected to have any additional impact. However, below the Seamus Rafter bridge, there is one section (eastern half of the channel), which will not have a dry works area. The macrophyte vegetation in this area will be undisturbed and can act as a propagule source for regeneration of macrophytes downstream after works have completed. The species present within this area have a relatively wide ecological tolerance (e.g. *Myriophyllum* spp., *Potamogeton* spp. and *Ranunculus* spp.) and it is not expected that there will be a significant change in species composition or cover due to a short period of higher flows.

Non-native invasive species

The non-native invasive aquatic macrophyte species *Elodea canadensis* and *E. nuttallii* are present in the river channel throughout the project area, at low cover (less than 5%). They are part of the floating river vegetation community and are not currently having any negative impact in this section of the river. Both species freely regenerate from vegetative fragments (they are only found as female plants in the British Isles and therefore must reproduce vegetatively (Preston et al., 2002)). They are highly likely to recolonise the dredged areas. However, as they are currently at relatively low cover in the channel, it is not expected that they would become dominant after construction works. The river bed has had low cover of aquatic macrophytes in previous years (e.g. 2003) and yet *Elodea* species did not dominate during subsequent recolonisation (as shown by the low cover of the species in relation to other aquatic macrophytes in 2016). *Elodea* species spread from vegetative fragments so will have less regeneration capacity after dry works than species that spread by seed (which will tolerate higher disturbance and drying). *Potamogeton perfoliatus* is the main aquatic macrophyte in the channel and regenerates mainly by seed and spread from adjacent plants. Vegetation removed during the creation of the dry works area will not be stored adjacent to a watercourse, to reduce the potential for spread of *Elodea* species (although they both occur downstream of the project area and are well established in the river).

6.4.6.2 Overall Construction Impacts

In the absence of mitigation, construction impacts would result in a likely short-term negative impact on floating river vegetation, significant at a local geographic scale.

6.4.6.3 Operational Phase Impacts

Habitat Loss

During operation, maintenance dredging will be limited to the sediment trap on the north island on the east bank. The design of this trap eliminates the need to undertake extensive maintenance dredging along the main channel. The maintenance on the trap is expected to take place approximately once every 5 years but this may be less. The new road bridge will shade the channel under the bridge in this location. However, the Seamus Rafter Bridge to the north will have been removed, and the new bridge is a higher height and therefore there will be increase in shading of aquatic macrophytes within the channel. Therefore, there are is no predicted habitat loss during operation of the scheme. There is the potential for silt to enter the river channel during these instream works leading to a short-term impact on water quality.

Habitat degradation

Water quality

The removal of sediment by dredging during construction will remove nutrients that have built up locally in the sediment. This should improve local water quality and conditions for aquatic macrophytes. There is no reason why water quality should decrease during operation of the scheme.

Hydrology (e.g. flow and flooding regime)

The species present within the survey area have a relatively wide ecological tolerance (e.g. *Myriophyllum* spp., *Potamogeton* spp. and *Ranunculus* spp.). There would need to be large changes to habitat attributes (e.g. flow, tidal regime, substrate, nutrient status, water depth, water clarity etc. before there would be significant changes to overall species composition.

Non-native invasive species

Aquatic macrophyte growth varies from year to year and *Elodea* species may be more abundant in any one year for a range of factors (e.g. water temperature, winter flooding, plant life-cycles and water clarity). However, there is no specific reason why *Elodea* species would become dominant in the channel during operation, as there would be no increase in local nutrients or disturbance regime (e.g. weed cutting or regular dredging) which could favour long-term dominance growth of these species.

6.4.6.4 Overall Operational Impacts

In the absence of mitigation, operation impacts would result in a likely short-term significant negative effect on floating river vegetation, at a local geographic scale.

6.4.7 Rare aquatic flora: *Callitriche truncate*

The nearest known historical site for *Callitriche truncata* is c. 1.9km downstream, from mud on the west bank of the river below Bormount House (recorded by Roger Goodwillie, 2003). This was not re-found during surveys in 2016. The nearest most recently recorded site is c. 6.3km downstream near Jamestown Nature Reserve (Paul Green, *pers. comm*.). The furthest south known site is c. 9.3 km south of the project area and washed up plants have been recorded from the river over 12km south of the project area. The project area does not contain suitable habitat for this species and it was not recorded during the 2016 surveys (either from the detailed transects, or from the riverbank walk-over survey). It was also not recorded during the detailed boat survey in this area in 2003.

6.4.7.1 Construction Phase Impacts

Habitat Loss & Fragmentation

Callitriche truncata does not occur within the project area and there will therefore be no direct habitat loss during construction. As noted above, the nearest known historical site for *Callitriche truncata* is c.1.9km downstream, (recorded by Roger Goodwillie, 2003). This was not re-found during surveys in 2016. The nearest most recently recorded site is c. 6.3km downstream near Jamestown Nature Reserve (Paul Green, *pers. comm*.). The furthest south known site is c. 9.3 km south of the project area and washed up plants have been recorded from the river over 12km south of the project area.

Habitat degradation

Water quality

Siltation downstream could occur as a result of increased flow in the reduced width channel, leading to mobilisation of fine sediment and when the dry works areas are re-flooded. *Callitriche truncata* tends to occur as an early colonist on mud and silt banks in shallow water at the edge of the river in its tidal reach. Annual surveys of *Callitriche truncata* (2004 to 2013) at a reservoir in Essex, England show that this species is tolerant of moderate siltation but can be negatively impacted by deep siltation (e.g. 30cm) and subsequent reduced water clarity (Denyer, 2006-2013). As the nearest *Callitriche truncata* site is c. 1.9km downstream from the construction area, siltation downstream would need to be significant before there is any potential to impact this species at its furthest north sites. Any impact at its southern most known site (c. 6.3km south) would be highly unlikely. However, this is the only river stretch from which this species has been recorded in Ireland, and it is a component of the Annex I floating river vegetation community within the river. Therefore, a precautionary approach is being taken in assuming a level of risk of water quality impacts and detailed mitigation measures are required to minimise the risk of any perceptible effect on water quality downstream during construction. Any habitat degradation at the *Callitriche truncata* northern sites, as a result of negative impacts to surface water quality during construction, has the potential to affect the species' distribution within the river and result in a likely significant negative effect, at a local geographic scale. Impacts to the southern populations (where *Callitriche truncata* is most frequent and has been recorded recently), however, are highly unlikely.

Non-native invasive species

As previously mentioned, a mitigation measure that can be used to facilitate the regeneration of aquatic plants in newly dredged/ disturbed areas is to return the top layer of sediment (which has been stored wet) to the newly dredged channel. There is the potential that some of this sediment could become suspended during re-flooding of the dry works area and be carried downstream in the absence of mitigation. Similarly, the return of vegetative fragments of plants (which have been stored wet) to the newly dredged channel can be used to restore aquatic vegetation after dredging/ disturbance. However, there is the possibility that this would lead to vegetative fragments travelling downstream. *Elodea canadensis* and *E. nuttallii* are both present within the scheme construction area. Both of these species regenerate very successfully (and rapidly) from vegetative fragments. *Elodea nuttallii* was recorded from the three northernmost *Callitriche truncata* sites and it is highly likely that *E. canadensis* is also established in this area. However, even if these species are established in this area, it is important not to facilitate their spread. For this reason, only sediment from areas with low cover of *Elodea* species pre-construction will be replaced post-construction. The sediment will be stored dry, which favours species that regenerate from seed (such as the native *Potamogeton perfoliatus*), rather than *Elodea* species). Vegetation removed during the creation of the dry works area will not be stored adjacent to a watercourse, to reduce the potential for spread of *Elodea* species.

6.4.7.2 Overall Construction Impacts

In the absence of mitigation, construction impacts would result in a likely long-term significant negative effect on *Callitriche truncata*, at a local geographic scale.

6.4.7.3 Operational Phase Impacts

Callitriche truncata tends to occur as an early colonist on mud and silt banks in shallow water at the edge of the river in its tidal reach. The nearest (historical) population is 1.9km downstream so there will be no direct habitat loss during the operational phase.

Habitat degradation

Water quality

The results and analysis of the Geomorphology Study (EIAR Chapter 7) conclude that the proposed works will have relatively limited impacts on sediment processes in the River Slaney. This is '*primarily because the river is a low energy river with very limited geomorphic activity occurring under current conditions, and the proposed works will not substantially change this characteristic*'. There is a potential for localised changes to existing erosion and deposition processes. However, the potential changes to erosional processes are negligible under normal flow conditions, and only minor changes are likely to occur during significant flood events (1 in 100-year events).

Hydrology (e.g. flow and flooding regime)

There are no predicted changes to the hydrological regime downstream of the study area.

Maintenance work on silt trap

During operation, there will be instream works associated with maintenance of the silt trap in the northern floodplain which will involve sediment removal and are expected to be required approximately every 5 years. Removal of large items from the debris trap will be carried out following storm events when required and will not involve instream works. The instream works will be undertaken in a dry works area to reduce the potential for sedimentation downstream.

Non-native invasive species

Elodea nuttallii is already established downstream in *Callitriche truncata* sites, but currently some bare sediment remains as suitable habitat for *Callitriche truncata.* There is no change expected in the distribution and abundance of *Elodea* species as a result of the operation of the scheme.

6.4.7.4 Overall Operational Impacts

There are no predicted significant impacts to *Callitriche truncata* during the operational phase

6.4.8 Otter

Otters were recorded regularly commuting and foraging along the River Slaney during surveys carried out in 2016. Four otter holts and two resting sites were identified along the banks of the main channel, back channel in the northern floodplain and along the banks of drainage ditches associated with the southern floodplain. Activity recorded at the holts was intermittent and a number of identified holts were deemed not active in 2016, however more frequent use in the future could not be ruled out.

6.4.8.1 Construction Phase Impacts

Loss of breeding/resting sites

In the northern floodplain, OH4 located along the existing back channel towards the southern end of this channel, will be excluded and removed to accommodate the proposed new back channel design. Additionally, the resting site identified along the main channel in the northern floodplain will be removed to facilitate the silt deposition area and river widening at this location. No additional holts or resting places will be removed as part of the scheme.

Activity recorded at OH4 was intermittent with only two confirmed otter recordings at this holt during monitoring. Furthermore, evidence of otter, e.g. spraint or prints, was not recorded in the vicinity and therefore the holt was not considered to be active at the time of surveys. Otters maintain a number of holts and resting places within their territory and evidence has shown that they can use these on a transient basis, however they are more likely to show faithful year-to-year use of breeding holts (Liles, 2003). OH4 is not considered to be a breeding holt due to the lack of otter activity recorded and absence of signs that would indicate a breeding site.

At the time of surveys, recent otter prints and signs of digging were noted at the resting site recorded at the northern floodplain. Although a trail camera was not placed at this location, fresh evidence of otter activity at the resting site suggests it was actively used in 2016. The resting site will not be replaced as these are temporary structures created by otter that are generally used on a short-term, transient basis and otter generally relay on a network of holts and resting sites across their territory, which have been shown to extend for up to 20km in length (Liles, 2003).

The permanent loss of one otter holt and one resting site within the extent of the scheme is expected to have an adverse impact on otter significant at a local geographical scale.

Mitigation measures to provide an artificial holt along the proposed back channel have been incorporated into the scheme and will provide an alternative holt location for potentially displaced otter. The use of artificial holts has been proven successful by a study in Wales, where otter occupancy was confirmed using hair samples (Cowell et al., 2001). The flexibility of otters using resting sites has been previously demonstrated, and it is expected that otters using the resting site will in time establish an alternative resting site along the banks of the main channel or re-profiled back channel. Otter, and their breeding and resting places, are protected under the Wildlife Acts and are listed on Annex II and Annex IV of the EU Habitats Directive. Under this legislation, a derogation licence will be to be requested from NPWS to remove OH4 if proven to be active prior to the commencement of works.

Habitat Loss

Riparian habitat considered to comprise part of otter habitat is defined in NPWS (2009) *Threat Response Plan Otter Lutra lutra 2009-2011* as a 10m riparian buffer of a river bank. Given the type of scheme, there will be permanent riparian habitat loss of *c.* 1.8km which will include habitat on both banks of the main channel where the scheme's flood defence walls will be constructed. Temporary riparian and instream habitat loss during the construction period will be attributable to the instream dry works area and re-profiling of the back channel.

The longest stretch of the dry works area runs for *c.* 1.2km and will contain half of the main channel. In addition to the temporary loss of half of the width of the main channel, access to riparian habitat along the length of the dry works area will be restricted and has the potential to reduce foraging and commuting efficiency for otter. Otters using the back channel will experience temporary habitat loss during the construction and re-profiling of the proposed back channel. Some stretches of the existing back channel will be permanently lost; however, the new proposed back channel will provide enhanced long-term habitat suitable for otters.

Otter will not be excluded from feeding or foraging within the main channel outside the dry works period, however temporary loss of one side of the channel and loss accessibility on one side of the channel will reduce otter foraging efficiency in such areas. Full width of the main channel will be restored following removal of the dry works area and riparian habitats will be reinstated following construction works.

Considering the above information and nature of the habitat loss associated with the construction phase, it is likely that otter using the scheme extent will experience a temporary negative impact, significant at a local geographical scale.

Disturbance/displacement

Otter are known to tolerate human disturbance, under certain circumstances (Bailey & Rochford, 2006). Disturbance during the construction works as a result of increased noise and visual disturbance, presence of construction machinery and humans is likely to occur at otter holts and resting places located close to the works area. As established OH4 and the resting place in the northern floodplain will be removed to facilitate the scheme. OH2 and OH3 are located along banks of the tributary drainage ditch to the south of the southern floodplain and are within the locality of river widening in the most southerly section of scheme, OH2 is located *c.* 10m from the nearest works and OH3 *c.* 80m from the same widening works. Activity was not recorded at OH2 during 2016 surveys, and between one and four otters were recorded at OH3 although none were recorded entering or exiting the entrance. As such OH2 and OH3 are treated as potential holts that may be used in the future but were not necessarily active in 2016 during surveys. In addition, one resting site was identified on the opposite bank of the drainage ditch to OH2 and is *c.* 15m from the widening works.

National Roads Authority guidance states that no wheeled or tracked vehicle (of any kind) should be used within 20m of an active non-breeding holt and light work such as digging by hand or scrub clearance should also not take place within 15m of such holts, except under licence (NRA, 2008). If otters are confirmed to use OH2 prior to the commencement of adjacent river widening works, disturbance will be likely and a derogation licence will be applied for with NPWS.

It is likely that if otters are present and using the above otter holts, disturbance as a result of works in the area could negatively impact these individuals. Otter can occur in areas that often have high levels of disturbance, e.g. in towns, ports and harbours, and close to busy bridges (Sleeman and Moore, 2005), however they have been shown to be less tolerant to disturbance at active holt sites (Liles, 2003). Disturbance in the vicinity of OH2 and OH3 has the potential to displace otters during periods of nearby works, or could discourage otter from using these holts during the same period. As mentioned in the above section, otter use of holts and resting places that are not associated with breeding, is highly adaptable and the use of a number of different sites within their territory has often been observed.

In addition, foraging and commuting otters using the area within the scheme will be exposed to disturbance from construction activities. Disturbance will mostly be localised around active construction works, e.g. new road bridge construction, flood wall construction, and within the dry works area. The dry works area will potentially screen some of the visual disturbance and limit the spread of noise disturbance created along the haul route from the construction traffic. As otter are crepuscular mammals and will feed at dawn and dusk and commute during the hours of darkness, they will avoid a large proportion of disturbance occurring during daylight hours.

Construction lighting operated at night and associated with the scheme works has the potential to disturb commuting and foraging otter and alter their behaviour in highly lit areas. Otter currently occurring within the surrounds of Enniscorthy town will have habituated to current levels of light spill, however temporary construction lighting used in currently unlit areas, the northern and southern floodplains, may cause disturbance and localised displacement of otter. Displaced otters are expected to readily occupy habitats up and downstream of the scheme until construction is complete.

It is predicted that disturbance from construction of the scheme will have a temporary negative impact on otter which is likely to be significant at a local level.

Water quality

The principal function of the dry works area is to prevent siltation and to protect water quality in the main channel during the period of works. It does not however rule out the incidence of a serious pollution event during the construction phase, although it may aid in containing the pollution if occurring within the dry works area.

Siltation during the re-flooding of the dry works area is likely to occur as sediments present within the dry works area become re-suspended and travel up to 2km downstream. Water quality could indirectly affect otter as increased siltation may reduce prey abundance and prey detectability, and directly by toxic materials, such as chemical or hydrocarbons, which could directly cause harm to otter either causing mortality or reducing individual fitness. It is not expected that the scheme will cause any pollution or siltation event at such a magnitude that would directly or indirectly affect the well-being of otter, therefore there is no likelihood that the scheme would cause significant impacts to otter through water quality issues.

Habitat Severance/Barrier Effect

In the main River Slaney channel there will be no habitat severance or barrier effect created by the dry works area. The dry works area will only enclose one side of the main channel within the scheme works area at a time.

Mortality Risk

There is a mortality risk to otter from construction traffic along identified haul routes, mostly contained within the dry works area in the main channel and southern floodplain. Construction traffic will be operational during construction working times (Monday-Friday 07.00 – 19.00 and Saturday 07.00-1300) and will be restricted to the marked haul route detailed in the CEMP, Appendix A. During summer months it is likely that construction traffic will not be operational at dawn and dusk times when otters are active, however during winter months and transitional seasons it is possible that otter may encounter construction traffic and therefore a risk of mortality is possible.

As mentioned above under water quality, there is a direct risk to otter if a toxic pollution event were to occur, however it is unlikely that a spill of toxic material of such a magnitude that would cause mortality to otter would occur as a result of the construction phase of the scheme. It is therefore considered unlikely that construction of the scheme would result in any significant mortality risk at any geographical scale.

6.4.8.2 Overall Construction Impact

It is considered that the overall negative impact on otter using the scheme extent during the construction phase will be temporary and is likely to be significant at a local geographical scale.

6.4.8.3 Operational Phase Impacts

Loss of breeding/resting sites

The loss of one otter holt (OH4) and one resting site along the main channel in the northern floodplain has been assessed, in above section, as likely to result in an adverse impact on otter significant at a local geographical scale.

Habitat Loss

Habitat loss during the operational phase is likely to be significantly less than during the construction phase. Following construction habitats will be reinstated and the full width of the main channel restored. Riparian habitats, defined as a 10m riparian buffer of a river bank, is considered to comprise part of otter habitat (NPWS, 2009). The scheme will result in permanent loss of established riparian habitat, reinstatement of riparian habitats along stretches of river widening will occur, however maybe of lower value where trees and scrub species are not replanted. Nonetheless, the proposed back channel will provide additional riparian habitat, which in time will provide enhanced habitat for otter.

Along the base of vertical flood defence walls, an environmental berm will be constructed to provide alternative riparian habitat. The environmental berm will consist of hard-core stone which could serve as an otter commuting corridor when above water level.

Long-term habitat loss of habitats important to otter, mainly the main channel and riparian habitats, will be minimal. Riparian planting of native tree and scrub species along the back channel will provide valuable riparian habitat for otter, improving local-scale habitat diversity which will reduce the impacts of development (Lundy and Montgomery, 2010). Overall long-term riparian habitat loss as a result of the scheme is expected to have minimal effects on the local otter population, which are known to occur in urban river systems, and impacts are not predicted to be significant.

Disturbance/Displacement

There will be maintenance works to ensure the design of the scheme operates at full efficiency. Maintenance of the silt trap in the northern floodplain using an instream dry works area will occur as required which has been estimated to be approximately once every 5 years. Maintenance of the debris trap will be carried out from bankside and will occur when required, likely to follow a high flow or storm event. It is possible that these works may cause temporary disturbance to otter in the area, however given the works short-term nature it is considered that there will be no significant impact on otter.

Habitat degradation - water quality

There may be short-term, temporary siltation during the re-flooding of the dry works, however not of magnitude that would significantly impact otter using the main channel within the zone of influence of these works.

Habitat Severance/Barrier Effect

The instream dry works area set up to carry out maintenance works of the sediment deposition area will be set up from the northern floodplain and will isolate half the main channel on the eastern bank. There will be no habitat severance or barrier effect during the works and the full channel width will be restored following the removal of the dry works area, therefore there is no risk of any likely significant impacts.

Mortality Risk

The new road bridge and approach roads have potential to cause a mortality risk to otter with moving vehicles. The number of cars using the road network in Enniscorthy is not expected to increase as a result of the scheme and the presence of the existing road network does not appear to currently pose a mortality risk to otters. It is therefore considered that the new road bridge and approach roads will not result in any likely significant impacts.

6.4.8.4 Overall Operational Impact

There are no predicted significant impacts to otter during the operational phase of the scheme.

6.4.9 Bats

6.4.9.1 Construction Phase Impacts

Roost Loss

No confirmed roosts were recorded during 2016 surveys, however in total 116 features were considered to have bat roost potential and included trees, tree groups, built structures and bridges (Figure 6.10 in Appendix C). It is estimated that 17 trees assessed as having moderate roost potential[33] and 19 with low roost potential[34] will be removed. The Seamus Rafter Bridge will be removed but was assessed as not being suitable for roosting bats. Four tree groups will be impacted upon, with tree removal or works occurring with these areas, three of which were assessed as having moderate suitability (T93, T94, T102, T103).

The removal of 36 structures determined to have some suitability for roosting bats has the potential to cause a significant impact to roosting bats on a local geographical scale. At the time of the surveys, it was not considered that trees with potential roost features had the capacity to accommodate a large number of roosting bats, but more likely are used on a temporary basis as night roosts.

The roost features potentially at risk of impacts from the scheme were not confirmed to be used as roosts during baseline surveys. Tree roost features close to the main channel are considered to be important for bats foraging over the main channel and adjacent riparian habitats. In the event that potential roost features are confirmed to be used by roosting bats during pre-removal surveys, appropriate mitigation will be provisioned in line with an application for a derogation licence from NPWS.

Overall, it is considered that in the absence of mitigation, there will be a significant impact at a local level as a result of the removal of bat roost features within the scheme.

Habitat Loss

Semi-natural habitats which support insects provide an important food source for bats. The proposed scheme will result in the loss of areas of treelines, grassland, and riparian habitat used by bats for foraging/commuting. Bat activity was highest in the northern floodplain, along the main channel and existing back channel rather than over floodplain grassland, in the mid-section of the scheme activity focused around the existing three bridge structures and in the southern floodplain focused around the main channel and wooded habitats east and south of the floodplain (Figure 6.9 in Appendix C).

Instream dry works area during the construction phase will temporarily reduce the area of the main channel and consequently may affect localised number of insects. Vegetative riparian habitat will be affected or lost during the construction works, however will largely be reinstated following works although it will take time before these are established and will regain the value of removed riparian habitats. The Seamus Rafter Bridge which provides a habitat feature used by bats during baseline surveys will be removed.

[33] (T23, T26, T27, T40, T41, T48, T53, T54, T58, T60, T61, T62, T63, T64, T91, T92, T101)

[34] (T28, T29, T30, T34, T35, T36, T37, T38, T39, T51, T57, T59, T65, T66, T69, T69A, T71, T72, T72A)

In the southern floodplain the main channel and woodland habitat to the east provided important foraging/commuting habitat for bats. The new road bridge will overlap with the northern tip of woodland in the east, however continuity of this habitat will be retained as tree pruning is the only the works directly impacting this woodland.

The dry works area will reduce the area of surface water bats can forage over by up to a half of the existing channel width. Although a temporary impact it does have the potential to significantly affect the foraging area and potentially prey availability during the bat active season in the first and second year of construction.

Established linear habitats present along the existing back channel will be fragmented and some removed during the construction of the new proposed back channel. Similarly, this habitat loss will be temporary until such time that native planting proposed becomes suitably established. Although habitats will be temporarily lost or interfered with during the construction stage, it is not predicted that foraging bats will be excluded from these areas. It is expected that foraging will continue in the current areas marked as having the highest activity (Figure 6.9 in Appendix C), however foraging efficiency may be reduced. As such the impacts of habitat loss on local bat populations has been assessed as temporary and likely significant at a local geographical scale.

Lighting

As the scheme is located within Enniscorthy town, bats using the area are exposed to existing light levels in the main surrounds of the town. The northern and southern floodplain, outside the town centre and main source of light, represent relatively dark areas within the survey area. Artificial lighting can alter a bat's behaviour, it can affect their roost emergence and re-entry times, consequently altering their feeding behaviour. Daubenton's bat feed along watercourses, often dark zones even in urban environments, and show particular sensitivity to light levels, actively avoiding illuminated areas (NRA, 2005). Soprano and common pipistrelle and Leisler's bat show less sensitivity to illumination and will continue to feed in lit areas.

Construction lighting associated with the works will illuminate some areas previously unlit. In the northern floodplain, areas closer to the town centre are exposed to light spill, while light spill in northern areas of this floodplain is limited. Similarly, the southern floodplain experiences low levels of light, with any light spill coming from the N11 where directional lighting and adjacent treelines contain the majority of light within the road corridor.

It is the intention of construction lighting to provide directional illumination to focus on areas of work, and not to illuminate large areas outside the confines of the works. Even with this directional lighting adhering to best practice guidance (BCI, 2010) there will be impacts at a local scale on the bat population using areas within scheme. Construction lighting during the summer months will be minimal due to the prolonged day length, and it is more likely to be used in concentrated areas during the winter months. The temporary impact from construction lighting will be reduced to periods when lighting times will conflict with summer bat activity. If lighting is required during the summer months for any element of the scheme, it is likely to negatively affect foraging/commuting individuals, and potentially roosting bats however roosts were not identified during baseline surveys.

6.4.9.2 Overall Construction Impacts

Overall construction impacts on the local bat population are considered to result in a temporary likely significant impact at a local geographical scale.

6.4.9.3 Operational Phase Impacts

Habitat Loss

Habitat loss within the scheme is largely resulting from construction works. Post-construction, riparian and grassland habitats will be reinstated and treelines will be replanted along the re-profiled back channel and where possible throughout the scheme. The river widening works will increase the overall surface area of the main channel and may potentially increase insect availability however it is not considered that this would result in an overall significant positive impact, and rather that no significant negative impact during the operational phase is predicted.

Mortality Risk

Mortality through direct collision with moving vehicles using the new road bridge is a risk. A literature review carried out by Fensome and Mathews (2016) on vehicle collisions and barrier effects found that, unsurprisingly, low-flying species (e.g. *Myotis* spp.) are more prone to collisions that high-flying species (e.g. *Pipistrellus* spp. and *Nyctalus leisleri*), and that juveniles are more vulnerable to collisions that adults. They also found a bias towards male casualties and that the presence of woodland was linked to reduced barrier effects but a heightened risk of collision.

The new proposed road bridge will pass over perpendicular woodland habitat. No area of woodland will be removed to facilitate the bridge and maintaining habitat connectivity and usage by foraging and commuting bats. Given the lowest point of the bridge deck is approx. 6.5m, low flying Daubenton's bat are not expected to be at risk from collision with moving vehicles as they will be flying close to the water level in the main channel, well below the height of the bridge. High flying species, *Pipistrellus* spp. and Leisler's bat that are more likely to forage over the woodland east of the southern floodplain and may cross under or over the bridge deck. The bridge lighting design, discussed below, will maintain a dark corridor along the east of the bridge which passes over the woodland habitat. The approach roads to the proposed road bridge are not expected to pose a higher collision risk to bats, as the existing road network largely occupies the area of the proposed approach roads and traffic moves relatively slowly within the network.

The new pedestrian bridge further upstream of the proposed road bridge is not expected to pose a collision risk. Static structures have not been shown to cause detectable levels of bat mortality.

Overall, mortality during the operational phase is not expected to cause a significant mortality risk to the local bat population at any geographical scale.

Habitat Severance/Barrier Effect

As discussed above the new road bridge will span over woodland habitat in the north of the southern floodplain and will cross the river at *c.* 6.5m in height. The bridge will not fragment habitat below the bridge deck and approach roads link to the existing road network, minimising habitat severance. Bats using habitats in the vicinity of the proposed road bridge are expected to pass under the bridge deck e.g. Daubenton's bat, or over the bridge e.g. *Pipistrellus* spp. and Leisler's bat, and continue to use habitat as normally. A dark corridor in the east of the bridge deck will be maintained to protect a dark foraging and commuting corridor through the area. Considering existing use of bridges in the town centre, the addition of the proposed pedestrian bridge is not expected to create a barrier effect or habitat severance.

Overall, the potential long-term impact of habitat severance/barrier effect created by the schemes two proposed bridges are not expected to have a significant impact on the bat population at any geographical scale.

Lighting

As previously highlighted artificial lighting can significantly impact bat behaviour having long-term effects on their success. As part of the scheme, new artificial lighting is proposed along the pedestrian bridge, new road bridge and approach roads. No artificial lighting has been proposed in the northern floodplain. Bats recorded during the 2016 activity surveys are exposed to light spill from Enniscorthy town, however rivers and watercourses often provide dark corridors even within highly lit urban areas.

Lighting proposed at the new road bridge has been designed to minimise impacts on bats. A dark corridor will be maintained in the eastern section of the bridge, where the bridge spans over alluvial woodland habitat, maintaining continuity for foraging, commuting and potentially roosting bats. While also maintaining low light levels in the wider southern floodplain.

Lighting elements of the proposed scheme outside Enniscorthy town have the potential to impact commuting, foraging and potentially roosting bats. However, considering the design of the lighting plan, these potential impacts are considered to be reduced, and are likely to significantly impact bats at a local geographical scale.

6.4.9.4 Overall Operational Impacts

Overall operational impacts on the local bat population are considered to result in likely significant impacts at a local geographical scale.

6.4.10 Birds

Overview of Potential Impacts on Waterbirds

The proposed scheme area supports a high diversity of waterbird species, with a total of 25 species recorded including wintering, passage and resident breeding species. The key habitat features supporting these populations are the wetland habitats in the southern floodplain at Bare Meadow Killagoley that are supported by tidal and fluvial flooding. Duck and waders feed and roost overnight in the swamp habitat mosaic area, where a small area of standing water/ mesotrophic ponds was retained among exposed muddy banks and tall swamp vegetation throughout the baseline survey year, with daytime dispersion through wet grassland within the Bare Meadow, on the southern floodplain at Motabeg, and to river channel and river margin habitats throughout the proposed scheme area, including the northern floodplain. Grey Herons occur in Enniscorthy as a resident wintering and breeding species, and make feeding, roosting and breeding use of the proposed scheme area (see Figure 11, Technical Appendix C.7). Grey Heron is listed as a Special Conservation Interest (SCI) for Wexford Harbour and Slobs SPA. Grey Herons were recorded in nationally-important numbers within the proposed scheme area.

The proposed scheme involves a series of works in all parts of the scheme area, giving rise to potential impacts arising from different work elements in different areas at different times during the construction phase. Potential impacts arise principally from channel widening and dredging works, and from the construction and operation of the proposed new road bridge. These impacts will potentially affect wintering, passage and resident breeding species, some of which move within and use the entire development area, so that the same birds and populations will be subject to multiple potential impacts. For this reason, potential impacts of the individual pressures arising are cumulative on waterbird populations in the proposed scheme area, so

after examining each issue under the headings listed below, a combined impact assessment of the proposed scheme on waterbirds is provided.

Habitat Loss

Channel dredging: loss of shallow water and waterbird feeding areas

Shallow water and exposed substrate feeding areas in the River Slaney channel that are used by resident and wintering waterbirds at low tide in particular, will be removed during channel dredging works. This will impact negatively on Grey Heron, Little Egret, Mallard and Teal. Three such areas will be permanently removed by the proposed scheme, their approximate extent, since extent of exposure varies with tide level as well as river level, are as follows:

- CH 4580-4650: tidally exposed gravel and silt near east bank of river at the northern end of the Bare Meadow, c. 100m downstream of the proposed new bridge, used by up to 5 Grey Herons, and 2 Little Egrets.
- CH 5400-5500: tidally exposed cobble and gravel banks between Seamus Rafter Bridge and Old Bridge within the east side of the river channel (area subject to fisheries measures, layout not yet provided), used by 1 or 2 Grey Herons
- CH 5640-5750: tidally exposed silt at and upstream of the Railway Bridge, used by 1 or 2 Grey Herons.

These three areas are also used by gulls, principally by Black-headed Gulls that gather at low water to rest, preen and bathe, though they have also been observed to feed at the Railway Bridge area silts.

The gravel bar within the Slaney channel at the northern floodplain, located at CH 6600-6700, is unaffected by tidal fluctuation, and is proposed to be retained. This area is used by used by 1 or 2 Grey Herons.

Kingfisher

Two Kingfisher territories were identified in the scheme area in 2016 and again in 2017; both territories will be potentially impacted by loss of river bank trees and shrubs that are used as perches, and to kill and eat fish, by Kingfishers. Potential nest sites along the east bank in the northern floodplain will be removed during the compound channel works. This potential impact is assessed as a likely significant negative and will reduce the range of two kingfisher breeding territories in the absence of mitigation.

Sand Martins

Within Enniscorthy scheme area, near-vertical and vertical high river banks over deep water suitable for the establishment of Sand Martin breeding colonies are restricted to the east bank on the northern floodplain. Three colony areas were recorded during 2003, 2016 and 2017 surveys. The colony recorded in 2003 was inactive in 2016 and 2017, although remnants of nest holes were visible. Two colonies were recorded in 2016, of which one was used during 2017, both colonies showed evidence of nesting use in previous years although, following the high flood during the winter of 2015/16, most nests were newly excavated in 2016. Sand Martin colony no. 1 extended some 60m in length in 2016, with a peak count of 35 active nests. Peak counts of active nests at Colony 2 were 5 in 2016, and 8 in 2017. The total active nest count in 2016 was 42 in 2016, and 16 in 2017, including second broods.

River banks along the Slaney downstream of the scheme area are too low and are increasingly estuarine, and are not suitable for nesting Sand Martins. Upstream of the scheme area, there are no suitable nest banks within the 1.5km reach surveyed.

The creation of a compound channel will remove all potential for future establishment of Sand Martin colonies throughout the length of the east bank in the northern floodplain. In the absence of mitigation, the potential impact on this Amber listed bird species of conservation concern is assessed as negative, permanent, and significant at county level.

Other potential breeding bird habitat loss

Loss of riparian trees and shrubs, including the back channel at the northern floodplain, and loss of trees and scrub within the footprint of the proposed new road bridge, has the potential to result in the loss of active nests, and mortality of eggs and nestlings, if felling and clearance works are carried out between 1 March and 31 August, in the absence of mitigation.

Dredging and compound channel works

Waterbirds

Waterbirds will be excluded from river banks and river channel margins during the construction phase. These impacts arise in different areas of the scheme area in sequence, throughout the development area along the east bank of the river, from CH 5550 to CH 6790 in the northern end of Enniscorthy town and along the full extent of the river at the northern floodplain (100% of CH 5550 to CH 6790), and from CH 3750 to CH 3920 and CH 4100 to 5000 at the southern floodplain (86% of CH 3750 to 5000). The river channel margins and banks within the town will be impacted by the construction of flood protection walls.

The west bank in the southern floodplain will be impacted by channel widening from CH 3830 to CH4200 (30% of CH 3830 to CH 6790). At the northern floodplain, the west bank will be filled from CH 5750 to CH 6125 (30% of CH 5550 to CH 6790). The river channel margins and west bank within the town will be impacted by the construction of flood protection walls, and by a short, widened section upstream of the railway bridge.

Because there are existing footpaths and less formal walking routes along the west bank in both the northern and southern floodplain, there are existing disturbance impacts that affect the distribution of waterbirds using the proposed scheme area, and waterbird feeding use of the river corridor is concentrated along the eastern, east side of the river channel, where more extensive impacts on habitats will arise during construction. The principal waterbird species potentially impacted are Grey Heron, Little Egret, Moorhen, Mallard, Teal, and Kingfisher; these species feed in shallow water close to and along the base of the east bank. All of these species, with the exception of Teal, are resident species present throughout the year. Grey Heron, Moorhen, and Mallard breed within the proposed scheme area; two Kingfisher breeding territories extend into the proposed scheme area.

The installation of dry working areas from mid channel to the channel margin to facilitate dredging, compound channel excavation, and channel realignment fill areas, is proposed to occur over a period of three years.

The following assessment assumes that all sheet-piling used to provide dry working areas will be installed immediately prior to works, and removed immediately on completion of works and re-watering in individual areas.

It is anticipated that most waterbirds will be displaced from each of the three individual channel widening works and dredging working areas during construction, to be scheduled in Chapter 4. As river flows will be confined to 50% of the existing channel width within the individual working areas, water depth and velocity will increase, reducing the suitability of the river for feeding birds; more energy expenditure will be required for birds to maintain a feeding location and this will potentially reduce foraging efficiency. Disturbance impacts also arise. The principal

waterbird species potentially impacted are Grey Heron, Little Egret, Cormorant, Moorhen, Mute Swan, Mallard, Teal, and Kingfisher.

The proposed programme of works is set out in Chapter 4 of the this EIAR. As noted it is expected that works upstream of the Seamus Rafter Bridge will be carried out in the first year. Works commencing on the eastern side of the river followed by the works commencing on the western site. While works are carried out within the western side of the channel, water depth and velocity will reduce the suitability of the river for feeding birds; more energy expenditure will be required for birds to maintain a feeding location and this will reduce foraging efficiency. Disturbance impacts also arise. In addition, feeding opportunities for waterbirds will be limited initially and will depend on the successful establishment of suitable vegetation within the newly created compound channel, including the berm which will be subject to tidal flooding, and on recolonisation of the channel and river bank habitats by invertebrate and fish fauna (estimated as taking 2 years for Sticklebacks and Minnow, the main prey species taken by Kingfisher).

In the southern floodplain, dredging and compound channel works between Seamus Rafter Bridge and the River Urrin inflow to the River Slaney are proposed to take place within dry works areas, along the west side of the Slaney during June and July 2020, and along the east side along the Bare Meadow in August and September 2020. As noted above the river flows will be confined to 50% of the existing channel width within the Seamus Rafter Bridge to the River Urrin inflow, water depth and velocity will increase, reducing the suitability of the river for feeding birds; water depth and velocity will reduce the suitability of the river for feeding birds; more energy expenditure will be required for birds to maintain a feeding location and this will reduce foraging efficiency. Disturbance impacts also arise. Works along the east side of the Slaney potentially impact on the core wetland area on the Bare Meadow, which is used by waterbirds throughout the year; there is also a potential for wetland habitat damage. In addition, feeding opportunities for waterbirds will be limited initially and will depend on the successful establishment of suitable vegetation within the newly created compound channel, including the berm which will be subject to tidal flooding, and on recolonisation of the channel and river bank habitats by invertebrate and fish fauna (estimated as taking 2 years for Sticklebacks and Minnow, the main prey species taken by Kingfisher).

Compound channel works within the River Slaney downstream of the River Urrin inflow to the River Slaney in Areas 9 and 10 are proposed to take place between 1 June and 28 August 2021. No dredging of the River Slaney channel is proposed downstream of the Urrin inflow. The full extent of the river channel, excluding the proposed works areas, will remain open to fluvial and tidal flow during these works; significant changes in water depth and velocity potentially affecting the distribution of feeding waterbirds are not expected to arise in this area. Disturbance issues will arise. Works along the east side of the Slaney will potentially impact on the core wetland area on the Bare Meadow, which is used by waterbirds throughout the year; there is also a potential for wetland habitat damage. Feeding opportunities for waterbirds will be limited initially and will depend on the successful establishment of suitable vegetation within the newly created compound channel, including the berm which will be subject to tidal flooding, and on recolonisation of the channel and river bank habitats by invertebrate and fish fauna (estimated as taking 2 years for Sticklebacks and Minnow, the main prey species taken by Kingfisher).

In summary, channel widening and dredging works in the River Slaney are proposed to be carried out during June, July, August and September. This proposed schedule is expected to result in partial displacement of waterbirds within the scheme area during channel widening and dredging works, while works are in progress in the three individual works areas. The full length of the River Slaney channel within the scheme area will be available to waterbirds from October to May in each year of the construction phase.

The impacts of partial displacement during channel widening and dredging works are assessed as negative and locally significant for the Grey Heron resident population, which has been assessed as nationally important and is listed as a SCI for Wexford Harbour and Slobs SPA. With regard to aquatic habitat recovery post-construction, assuming a 2-year recovery timescale, it is likely that aquatic habitat as a food resource for Grey Herons in the River Slaney within the northern floodplain will have recovered by the time channel widening works commence at the southern floodplain downstream of the River Urrin. There is some potential for reduced productivity in the Grey Heron breeding colony, since, if the birds remain and breed in the area at the existing nest sites during construction, they may have to travel further to feeding areas outside the scheme area, resulting in increased energy expenditure by foraging birds and potentially reduced frequency of provisioning of chicks. Less frequent attendance of adults at nests potentially increases predation risks to chicks. This impact is assessed as negative, temporary, and of moderate significance at County level, because the Grey Heron resident population has been assessed as nationally important and is listed as a SCI for Wexford Harbour and Slobs SPA.

Waterbird Habitat gain

The proposed compound channels in the northern and southern floodplains will result in the creation of low berms that will submerge tidally as shown in the accompanying design drawings. In the southern floodplain adjoining the Bare Meadow, this shallow water berm is expected to flood on all high tides, to a depth of 0.65m during neap high tides, and to a depth of 1.38m during spring high tides. The low tide level at Enniscorthy varies between -0.75m- and -0.2m OD, thus during low tide the compound channel berm adjoining the Bare Meadow on the southern floodplain (berm level -0.63m OD, will remain submerged during neap tide low water, and will be exposed during spring tide low water.

In the northern floodplain, tidal range will be somewhat reduced because the proposed berm levels are somewhat higher upstream, though the berm will submerge during both neap and spring high tides and expose only on spring low tides.

Tidal flooding of the berms provides an opportunity for the development of wetland habitat for waterbirds, replacing the existing grassland and relatively steep existing river banks with a wider wetland habitat that, subject to substrate and colonising and planted vegetation, will be available during the operational phase to some waterbird species during low and mid tide. Waterbird species potentially benefitting from habitat gain are Grey Heron, Little Egret, Mallard, Teal and Moorhen. Potential impacts are assessed as positive, permanent, and locally significant for Grey Heron and Little Egret, commencing during the latter part of the construction phase, because the compound channel will increase the area of access to the river channel for feeding birds, subject to the constraint of tidal fluctuation in water levels similar to the existing situation at existing shallow water feeding areas.

With regard to Mallard, Teal and Moorhen, potential impacts of wetland habitat development on compound channel berms are assessed as positive, permanent and locally significant, subject to planting/transplanting/seeding proposals, proposed species, and likely establishment and recovery timescales for compound channels.

Restoration of the North Island Back Channel

The proposed restoration of the back channel at the northern floodplain largely, but not entirely, overlaps with the existing back channel. Waterbirds will be displaced from this area during proposed construction during 2019 arising from wetland and woodland habitat removal and associated disturbance during works. Impacts to breeding birds (Mallard, Moorhen, and passerine bird species) and wintering waterbirds (Mallard, Moorhen, Teal) will arise, with

potential loss of active nests, eggs and nestlings during vegetation removal, in the absence of mitigation. Existing reedswamp vegetation provides cover for breeding waterbirds (Mallard, Moorhen), as well as feeding habitat through the autumn and winter season for Mallard, Moorhen, and Teal. Woodland and scrub along and to the east of the existing back channel provide breeding habitat for passerine birds.

Kingfisher make feeding use of the southern end of the existing back channel, which was assessed as forming part of the Kingfisher breeding territory identified as extending through the River Slaney in northern floodplain and upstream of the scheme area (see Appendix C.7). Kingfisher nesting along the existing back channel is possible but is considered unlikely.

Re-vegetation of aquatic and marginal habitats, and of woodland, is proposed along the back channel, and will take time to establish. Some displacement of birds, including waterbirds, is likely to occur during a 3 to 5-year period. This potential impact is assessed as being of locally high significance in the absence of mitigation.

Loss of visual screening

This potential impact arises at the Bare Meadow and along the river channel in the southern floodplain, where waterbirds are largely screened from view of pedestrians and dogs using the promenade along the west bank. Existing visual screening includes trees and shrubs on the west bank, between the promenade and the river. It is proposed to undertake pruning and general cutting back and where necessary remove existing tree cover along the west bank of the River Slaney between the proposed new road bridge and the River Urrin inflow; this may include removal of semi mature Alder trees where they are currently slumping and or fallen into the channel.

The natural raised riverine edge of the southern floodplain parallel to the east bank will be removed during the construction of the compound channel. The existing riverine edge provides visual screening to waterbirds on the Bare Meadow from human activity on the promenade, including construction activity in the river channel, and also from recreational activity such as boating and canoeing on the river, particularly in the hours around high tide when water levels are high.

In the absence of mitigation, there is a potential for likely significant negative impacts on waterbird use of the Bare Meadow arising from disturbance displacement during construction.

Habitat degradation - water quality

Turbidity

There is a potential for turbidity to increase in the water column in the event of sediment release from works areas and from excavated material deposition areas, or arising from scour of riverbanks when the river flow is constricted by the presence of dry works areas, and also arising from turbulent flow, scour and erosion if the impermeable barrier is retained in mid channel over a protracted period of time. This could potentially result in direct impacts on waterbirds by reducing foraging efficiency, as food plants and invertebrate and fish prey would be less visible to foraging birds. This could result in reduced condition of waterbirds remaining in the area, or displacement of waterbirds from the proposed scheme area to avail of more favourable feeding conditions.

Indirect impacts potentially arise through displacement of invertebrate and fish prey adversely affected by siltation, and could be followed by similar displacement of bird species. Injury or mortality to invertebrate and fish prey could potentially increase their availability to foraging birds.

Spillages of hydrocarbons and cement products

Spillages of hydrocarbons into waterbodies and wetlands have the potential to impact directly on waterbirds, by oiling of plumage and by ingestion by preening birds attempting to remove adherent hydrocarbons. Mortality to waterbirds has a potential to arise. Indirect impacts of spillages of hydrocarbons and cement products on waterbirds have a potential to arise through ingestion of affected invertebrate and fish prey.

Habitat degradation - hydrology (e.g. flow and flooding regime)

Southern floodplain

The existing ground level in the Bare Meadows ranges from 0.3-3.2mOD. The lowest point in the floodplain is in the centre, where there is generally water standing year-round, arising principally from tidal flooding via the existing channel along the eastern margin of the Bare Meadows. The ground level rises to the east and west from the centre of the floodplain. At the existing River Slaney bank the levels varies between 1.8m and 2.5mOD. The predicted flood level at the Bare Meadows for the existing scenario for the 1 in 1 flood year event at this floodplain is approximately 2.2mOD. When the water level in the River Slaney rises during a flood event, water flows back up the drainage channel into the Bare Meadows and floods out into the Bare Meadows outwards from the low point in the centre of the floodplain. An impermeable clay layer deposited in the Bare Meadow, that overlies alluvial sands and gravels, may arise from both tidal and fluvial flooding.

Following the completion of works the predicted water levels in the Bare Meadows during an annual flood event will reduce by 40mm. This would equate in terms of the reduction in the width of the cross section that will be flooded in the Bare Meadows to approximately 1.5m out of the total wetted cross section length of approximately 200m. This is expected to be approximately 0.75% of the flood plain width.

Following the completion of the development, the predicted 1 in 100-year flood event the flood levels are predicted to reach approximately 4.2m. That is, post-works, the flood levels will be approximately 200mm lower in the Bare Meadows. At the lowest point of the Bare Meadows this would lower the depth of flooding from approximately 4.2m in the current scenario to 4.0m post works.

The removal of the natural riverine edge arising from channel widening works will change the characteristics of river bank overtopping as the extreme fluvial flood levels rise and fall, by reducing the flood impoundment provided by the existing profile, and will have a potential to reduce the duration of extreme event flooding in the Bare Meadow, with potential negative consequences for the existing waterbird diversity and peak numbers on the Bare Meadow, in the absence of mitigation. Similarly, extensive excavation into the impermeable clay underlying the wetland habitats in the Bare Meadow has a potential to facilitate drainage, with negative long-term impacts of national significance on existing waterbird diversity and peak numbers on the Bare Meadow, in the absence of mitigation.

Disturbance/displacement, including Machinery movement and operation, and scheme design (fish pools and deflectors)

The key habitat features supporting waterbird populations in the proposed scheme area are the wetland habitats in the southern floodplain at Bare Meadow Killagoley that are supported by tidal and fluvial flooding. Disturbance arising from the proposed works on and adjoining the southern floodplain has the potential to displace all waterbirds from the proposed scheme area,

including the following regularly occurring waterbird species listed as qualifying SCI populations of Wexford Harbour and Slobs SPA:

- Cormorant
- Grey Heron
- Wigeon
- Teal
- Mallard
- Lapwing
- Redshank

The responses of waterbirds to various sources of anthropogenic disturbance have been studied in a number of different habitat contexts. Data have been recorded in relation *of Alert Distance*, at which waterbirds exhibit altered behaviour in response to an approaching perceived threat (ceasing to feed, alert 'head up' posture, vocalisation, etc.) and *Escape Distance* or *Flight Initiation Distance*, at which waterbirds either move away within the site or leave the site area. Responses to disturbance tend to be site-specific, and to vary with the species mix present, the body mass of individual species (smaller species tend to leave at a greater escape distance), and exposure of waterbirds to hunting. Manipulative experiments carried out by pedestrian observers who provided the source of the disturbance and measured escape distances showed species-specific responses in escape distances, including effects of body mass, flock size, flock composition, visibility of the stimulus to the birds and season (Bregnballe et al., 2009). Mean escape distances increased with the mean body mass recorded for each species, although Wigeon flushed at greater distances than expected for their size. Birds in mixed flocks of Mallard and Teal reacted at longer distances than those in single species flocks for either species. Grey Heron escape distances increased through the autumn.

In the proposed scheme area, escape distances were recorded where possible, during walk-over surveys. No site-specific escape distance data relating to operating machinery were recorded. While machinery can in some circumstances be less disturbing to birds than personnel on the ground, since both will be present during construction, it is considered appropriate to refer to waterbird escape distance to pedestrians recorded in the scheme area when assessing impacts and providing mitigation.

Grey Heron were the most frequently recorded, and observations were recorded throughout the year. Escape distances were observed to vary according to location within the proposed scheme area. In the northern floodplain, Grey Herons feeding at the gravel bank located in the river between CH 6600 and 6700 left the area at escape distances of 120 to 150m. In the southern floodplain at the Bare Meadows, Grey Herons left roost sites at the core wetland area at escape distances of 50 to 90m, sometimes they moved within the Bare Meadow initially, and then left the area if the observer continued to approach directly. There was a single observation of 2 adult Grey Herons arriving to two separate nests in Scot's Pine trees to the east of the Bare Meadow with well grown chicks while 2 observers were present on the Bare Meadow at distances of approximately 50m and 150m from the nests; the adults attended the nests briefly and then left the area.

Escape distances for mixed flocks of duck and waders Wigeon, Teal, Mallard, Lapwing, Snipe and Redshank disturbed on the Bare Meadow during walk over surveys were approximately 150m (observers approaching out of tall vegetation to the south in March and April 2016); all duck and waders left the area. Escape distances recorded for Mallard later in the spring and summer varied with context; escape distances of approximately 100m were observed on two

occasions, while female Mallard performed distraction displays and remained in the core wetland area with their (usually concealed) brood.

Escape distances of duck (Wigeon, Teal and Mallard) on the southern floodplain at Motabeg appeared to be greater than at the Bare Meadow but were not recorded accurately.

Since channel widening and dredging works are proposed to be carried out during June, July, August and September, resident waterbird species Grey Heron, Little Egret, Mallard and Moorhen will be present in the Bare Meadow and adjoining wetland habitats including the Slaney River Channel during works. Migratory Teal start to arrive on the Bare Meadow in August and can be expected to be present in this area and in adjoining wetland habitats including the Slaney River Channel during works. In the absence of mitigation, temporary significant negative displacement impacts of up to national level will arise to Grey Heron, Little Egret, Mallard, Moorhen, and Teal, particularly where works take place within 150m of the core wetland area on the Bare Meadow (Figure 6.11 Appendix C). Cormorant, Wigeon, Lapwing and Redshank are not likely to be displaced, since significant numbers are not expected to be present during the scheduled channel widening and dredging works.

Fish Pools and deflectors

A series of 5 No. fish pools and deflectors are proposed for inclusion in the River Slaney channel, as shown on proposed scheme drawings to create diversity within the scheme extent post works. Indicative locations include immediately downstream of the Railway Bridge, the next is downstream of Enniscorthy Bridge, two are located between the existing Seamus Rafter Bridge and the proposed new road bridge, and the southernmost fish pool is proposed to be located immediately upstream of the River Urrin inflow. Deflectors will facilitate regeneration of fish habitats within the scheme extent to enable quicker recovery of fish populations, which may benefit Grey Heron and Cormorant. The primary purpose of the fish pools and deflectors is to provide fish habitat, but is also likely to facilitate angling, and this element of the design gives rise to a conflict with the requirement to avoid disturbance to bird species listed as Special Conservation Interests for Wexford Harbour and Slobs SPA. Since the southernmost proposed fish pool is located within the Bare Meadow core wetland 150m buffer, this feature was removed from the proposed scheme design, and no part of any fish pool and deflector will be located downstream of CH 4750.

Noise

The sources of construction phase disturbance will include noise associated with pile driving. Augured pile driving will be used in the construction of the proposed new road bridge pier foundation works. This method is not expected to cause significant disturbance to waterbirds in the vicinity of these works.

The creation of dry works areas will require the insertion of sheet piles into the river bed. The design team have confirmed that a low noise and vibration piling method will be used. The proposed method is not expected to cause significant disturbance to waterbirds in the vicinity of these works.

Potential changes in land use during construction

The Bare Meadow is currently grazed seasonally by horses. Seasonal grazing by horses at the current stocking densities is considered beneficial to waterbirds because is maintains a sward of varying height, tends to reduce Rush (*Juncus* spp.) cover, and provides significant, though not total, control of the invasive plant species Himalayan Balsam *Impatiens glandulifera*. Exclusion of horse grazing during construction would allow a dense, tall vegetation to develop that would tend to exclude waterbirds, with negative significant impacts for waterbird species diversity and

numbers. The proposed works will not change the land use practices in the Bare- Meadows during the works and continued grazing will be facilitated with the landowner.

Construction phase impacts at the proposed new road bridge

The construction of the proposed new road bridge and the associated approach roads is scheduled to take approximately 18 months. Temporary construction areas will be required on both sides of the River Slaney. The construction area on the east bank of the river at the northern end of the Bare Meadow is c. 100m away from the 150m disturbance displacement buffer zone around the core wetland area used by feeding and roosting waterbirds. Waterbirds do make some feeding use of wet grassland habitats near the temporary bridge construction area, and it is expected that there will be local displacement of Mallard and Grey Heron, assessed as being a negative, temporary, and locally significant impact within the range of a nationally important Grey Heron population, during construction. One or two Grey Herons occasionally roost in trees in the Alluvial woodland impacted by the bridge, and occasionally feed in the drainage channel that flows through and supports this woodland hydrologically, thus there will be displacement from the works area.

A number of waterbird species commute along the Slaney River corridor, through the bridge area, as birds move between feeding and roosting areas, giving rise to the risk of collision with the bridge structure. Detailed data are included in Section 4 of Appendix C.7, summary flight height data are included in Table 6.11 of this EIAR. This table includes calculation of the percentage of all flights through the bridge corridor that were below, and within 5m above the deck level of the proposed bridge for each species, since the 4m bridge structure lies within these height bands and the principal collision risk with the proposed bridge structure arises within these combined flight height bands.

With regard to Grey Herons, 75% of all flights recorded were within 5m of the bridge deck level, with 84 recorded flights below deck level and 43 recorded flights between deck level and 5m above deck level (0-5m height category). Many of the Grey Heron flights recorded at the proposed bridge location were short movement flights between feeding sites on the river bank and channel or in the drainage channel to the east of the southern floodplain. These flight heights were usually low, below the base of the proposed bridge deck and within 2m of river bank level, for example, at mid tide as feeding areas in the vicinity of the proposed bridge became available, and peak heron movement rates were recorded at mid tide. Grey Heron flights close to bridge structure level at the bridge corridor (both above and below deck level) included movement flights at dawn and dusk to and from tree roosts in and near the alluvial woodland at the proposed bridge location, tree roosts in the woodland to the east of the N11, and flights between feeding areas and the wetland roost at the Bare Meadow in the southern floodplain, where most of the daytime Grey Heron roosting occurred (see Appendix C.7, Section 3.2.1, Figure 11, and Tables 20 and 21). At the proposed bridge corridor, 25% of Grey Heron flights were more than 5m above deck level. These included movement flights to and from tree roosts, and also longer distance flights within and outside the scheme area. Only three Grey Heron flights of more than 30m above deck level were recorded; two of these were birds gaining height to fly east and north east above the woodland east of the N11.

Little Egrets mostly flew below the bridge level, within 2m of the Slaney water surface (Table 6.11).

Cormorant flight activity included commuting flights to and from overnight roosts, as well as local movements of feeding birds; 47% of all flights were within the principal collision risk height band, and 53% of flights were above the principal collision risk height band.

Most Mute Swan movement through the proposed bridge corridor was by swimming birds (61 movements recorded of which 49 were swimming, 80% of total movements, Table 6.11). Flight height ranged up to 30m above deck height, with 33% of recorded flights below deck height and up to 5m above deck height. One observation was of a Mute Swan changing flight height from below and close to water at bridge deck location, rising as it flew upstream past the hotel towards Seamus Rafter Bridge. Another observation was of a group of 4 Mute Swans flying downstream 10-20m above deck level, and then flying west away from the Slaney floodplain.

Most Mallard flew along the Slaney river corridor, 84% of records were of flying duck and 16% of swimming birds. Flying Mallard were mostly close to deck height, with 77% of recorded flights below deck height and up to 5m above deck height, many of which were close to deck height. All recorded Teal flights were below bridge deck level (Table 6.11).

All recorded Kingfisher flights were well below bridge structure height. Typically, this species moves within the river corridor between the river banks and below bank height, and using perches within this cross-sectional area; the highest recorded observation was a Kingfisher briefly perching on a fence post c. 1m high on the east bank at the southern floodplain.

With regard to waders, there was one record of a flock of 60 Lapwing milling above and below deck level at the bridge location, and three records of flocks flying to and from the ponds on the southern floodplain crossing the bridge corridor at heights of at least 10m above deck height (Table 6.11). A single record of a Redshank, and of a Common Sandpiper observed during walk-over survey, recorded flight below deck level at the bridge location.

Gull flight heights ranged from below deck level to more than 30m above deck level at the bridge location. Black-headed Gulls are the dominant gull species using the scheme area and commuting daily from estuarine / coastal overnight roosts. Recorded flight height peaked below deck height and at more than 30m above deck height, with 35% of all recorded flights below deck height and up to 5m above deck height (Table 6.11).

Lesser Black-backed Gulls recorded flying downstream during dusk watches in September and October 2016 were recorded at heights of more than 20m and mostly more than 30m above proposed bridge deck height, moving along the oak woodland and ridge along the eastern side of the river corridor towards the south east. This species typically commutes along topographic ridges, though it does occur in small numbers through the scheme area throughout the year and this is reflected in 7% of recorded flights being below deck height and up to 5m above deck height (Table 6.11).

Herring Gulls flew mainly at 10 – 20m above deck height when commuting, 19% of recorded flights were below deck height and up to 5m above deck height (Table 6.11), reflecting birds feeding within the proposed scheme area.

Table 6.11: Total number of recorded movements of each waterbird species recorded moving through the proposed new bridge corridor at Enniscorthy, and flight height relative to proposed bridge deck level

Species	Total movements	On water swimming	Height of flight relative to proposed bridge deck level							% below to 5m above deck height (principal collision risk height band)
			Below bridge deck	Above 0-5m	Above 5-10m	Above 10-20m	Above 20-30m	Above 30m	Above/ below	
Cormorant	224	9	74	24	29	37	32	10	3	47%
Little Egret	21	0	16	1	1	1	1	0	1	81%
Grey Heron	172	0	84	43	17	11	5	3	6	75%
Domestic geese	20	20	0	0	0	0	0	0	0	
Mute Swan	110	49	2	2	3	4	0	1	0	33%

Species	Total movements	On water swimming	Height of flight relative to proposed bridge deck level							% below to 5m above deck height (principal collision risk height band)
			Below bridge deck	Above 0-5m	Above 5-10m	Above 10-20m	Above 20-30m	Above 30m	Above/ below	
Whooper Swan	2	2								
Teal	35	23	12	0	0	0	0	0	0	100%
Mallard	263	37	70	81	23	6	6	2	9	77%
Moorhen	2	1	1	0	0	0	0	0	0	
Lapwing	240	0	0	0	0	80	0	100	60	25%
Redshank			1							
Kingfisher	6	0	6							100%
Black-headed Gull	5,997	2	1,228	835	571	557	623	1,541	528	35%
Common Gull	5	0	1	0	0	0	1	3	0	20%
Lesser Black-backed Gull	789	0	7	48	40	59	103	529	6	7%
Herring Gull	101	0	5	14	19	49	9	1	4	19%
Great Black-backed Gull	1			1						
Total waterbirds	7,989	144	1,507	909	703	804	780	2,190	617	

Note: Records include swimming waterbirds feeding within the bridge corridor in a few instances, e.g. Cormorant, Teal. Above/below refers to records during which the height of flight changed as a bird moved through the bridge corridor

Non-waterbird movements through the bridge area were dominated by Wood Pigeon, Rook and Jackdaw. Wood Pigeon feed on floodplain grasslands and also in intensively farmed land, and nest throughout the scheme study area in woodland and mature treelines. Rooks and Jackdaws feed widely within the scheme area and, outside the breeding season, were using an overnight roost site in the Aughnagalley / Drumgold area, c. 2km to the east of the River Slaney corridor, so some the flight activity recorded related to dawn and dusk movements across the river between feeding and roosting areas. Records of Hirundines included movement of Swallows and House Martins upstream on 29 April 2016, and these appeared to be late migrants. Swallows, House Martins and Sand Martins also made feeding use of the river corridor, feeding over the Slaney and also making quick visits to drink.

The dimensions and detailed design of the proposed new road bridge over the River Slaney are provided in the accompanying design drawings. The vertical distance between soffit (base of the deck of the bridge) and the top of the pedestrian guardrail of is approximately 4m. The distance from the top of the deck to the top of the pedestrian guardrail is 1.4m. The soffit level is 6.5m above the Bare Meadows. Clearance between the base of the bridge and the River Slaney will vary with tidal and fluvial flows, and apart from high fluvial floods will be in excess of 6.5m. The proposed pedestrian guardrail is 1.4m high. The detailed drawings show 4 No. guardrail types to be used at different sections along the bridge. These include options for the use of stainless steel or painted steel. Parapet type 3 is proposed for use above the River Slaney; this type comprises horizontal tensioned steel 9mm cables at 10cm centres inserted through steel plate uprights, and includes a 50mm diameter rail incorporating lighting at the top of the guardrail.

The spiral stairway access from the bridge to the west bank of the Slaney will each be lit by a 25m high stainless steel lighting mast. The eastern end of the bridge, over the eastern river bank and existing N11, will be lit by 7 No. 8m high standard light columns; no light column is provided over the alluvial woodland on the southern side of the bridge.

During construction, 2m high security fencing will be provided around the temporary construction compounds required during bridge construction. Tall machinery expected to be required during construction will include piling rigs, cranes, and mobile elevated work platforms.

In the absence of mitigation, during the construction phase there will be a potential for waterbirds flying in poor light conditions and during the hours of darkness to collide with temporary security fencing, tall machinery, and structures under construction. Grey Herons are the main risk species, since they feed and move between feeding sites at all times during the day and night, and 75% of all recorded flight heights fall within the risk area of below bridge deck height to 5m above deck height. While resident waterbirds tend to habituate to obstacles in their environment, during construction high machinery will move within construction areas, and risks arise with regard to juvenile Grey Herons as well as adults. In the absence of mitigation, potential impacts during construction are assessed as significant negative, since there is a potential for mortality to arise from collisions.

Other species at risk from collision are Mute Swan, Cormorant, Mallard, Teal, and Black-headed Gull. Mute Swan and Mallard breed within the scheme area. Collision risks for Mute Swan and Mallard are assessed as moderate, because as a breeding species, juveniles will be present seasonally and are at higher risk of collision than resident adults. Cormorant and Black-headed Gull commute to overnight roosts in Wexford Harbour and are generally absent during the hours of darkness and thus collision risk is assessed as moderate. Collision risk is assessed as relatively low for Teal, most movements recorded through the bridge corridor were of swimming birds, and the few records of Teal in flight were of birds close to water level.

6.4.10.1 Operational phase impacts on birds

Habitat change

During the operational phase, aquatic and marginal vegetation and habitat is expected to become established in compound channels throughout the proposed scheme area, potentially including native species, non-native and invasive plant species. Vegetation and habitat recovery is expected to take place within a 3 to 5-year timeframe. Invertebrate and fish fauna will re-establish populations within the bed of the river, subject to the success of habitat restoration measures undertaken as mitigation for aquatic flora, fauna and habitats as discussed elsewhere in this EIAR. Aquatic and marginal habitats along the River Slaney are expected to be more accessible to Grey Herons and Little Egrets during the operational phase, arising from the compound channel included in the design. There is an element of uncertainty regarding the types of vegetation, habitats, and associated fauna that will develop in the scheme area, because of hydro-morphological change, altered flow and sedimentation patterns, following the works, as discussed elsewhere in this EIAR.

Habitat degradation - hydrology (e.g. flow and flooding regime)

Following the completion of works the predicted water levels in the Bare Meadows during a 1 in 1-year flood event will reduce by 40mm. This would equate in terms of the reduction in the width of the cross section that will be flooded in the Bare Meadows to approximately 1.5m out of the total wetted cross section length of approximately 200m. This is expected to be approximately 0.75% of the flood plain width.

Following the completion of the proposed scheme, the predicted 1 in 100-year flood event flood levels are predicted to reach approximately 4.2m. That is post works, the flood levels will be approximately 200mm lower in the Bare Meadows. In the absence of mitigation, at the lowest point of the Bare Meadows this would lower the depth of flooding from approximately 4.2m in the current scenario to 4.0m post works with potential negative consequences for the existing

waterbird diversity and peak numbers on the Bare Meadow. Similarly, in the absence of mitigation extensive excavation into the impermeable clay underlying the wetland habitats in the Bare Meadow has a potential to facilitate drainage, with negative long term impacts of national significance on existing waterbird diversity and peak numbers on the Bare Meadow,. All potential habitat degradation relating to hydrology impacts have been addressed by mitigation measures.

Disturbance and Loss of visual screening

In the absence of mitigation implemented during the construction phase, the loss of visual screening arising from the removal of trees along the west bank of the Slaney between the new road ridge and the River Urrin inflow, together with the removal of the profile of the existing riparian edge on the southern floodplain at the Bare Meadow, will expose waterbirds within the river channel including the compound channel, and waterbirds on the Bare Meadow to disturbance from human and dog activity along the promenade. Disturbance impacts also have a potential to arise from recreational use of the River Slaney. Slipway and canoe launch facilities are proposed to be located on the west bank immediately upstream of the proposed new road bridge, where a fish pool is also proposed.

Potential changes in land use during the operational phase

The Bare Meadow is currently grazed seasonally by horses, and the proposed scheme will not inhibit or change the current land use practices or management on the Bare Meadows. Current land use management is considered beneficial to waterbirds because is maintains a sward of varying height, tends to reduce Rush (*Juncus* spp.) cover, and provides significant, though not total, control of the invasive plant species Himalayan Balsam *Impatiens glandulifera*.

Operational phase impacts at the proposed new road bridge

Grey Herons are the main risk species during the operational phase, since they feed and move between feeding sites throughout the day and night, and 75% of all recorded flight heights fall within the risk area of below bridge deck height to 5m above deck height. While resident waterbirds tend to habituate to obstacles in their environment, risks including potential mortality arise with regard to juvenile Grey Herons as well as adults.

Other species at risk from collision are Mute Swan, Cormorant, Mallard, Teal, and Black-headed Gull. Mute Swan and Mallard breed within the scheme area. Collision risks for Mute Swan and Mallard are assessed as moderate, because as a breeding species, juveniles will be present seasonally and are at higher risk of collision than resident adults. Cormorant and Black-headed Gull commute to overnight roosts in Wexford Harbour and are generally absent during the hours of darkness and thus collision risk is assessed as moderate. Collision risk is assessed as relatively low for Teal, most movements recorded through the bridge corridor were of swimming birds, and the few records of Teal in flight were of birds close to water level

6.4.11 Aquatic Environment

6.4.11.1 Construction Phase Impacts

As dredging involves direct removal of the river bed, physical removal of habitat is unavoidable. This will result in direct loss of habitat for aquatic species within the footprint of the scheme. It is noted however that the extent of habitat loss is relatively minor in relation to the size of the River Slaney catchment. The affected area is also at the tidal head in the lower reaches of a large (in an Irish context) river and habitats in this area are somewhat dynamic due to tidal and river processes. The areas affected are already significantly modified.

The physical removal of aquatic habitat directly from the river bed can result in destabilising the river bed, the loss of suitable spawning gravels, disturbance to fish feeding sources and loss of aquatic vegetation, all of which can lead to other indirect impacts. There is however significant scope for mitigation and rehabilitation of the dredged channel.

The physical removal of riparian habitat is also likely to have an impact on aquatic organisms in the study area. The removal of vegetation from within channels and along channel banks during dredging processes can increase water temperatures by reducing shade: temperatures result in lower oxygen concentrations, making fish and invertebrates in dredged channels more vulnerable to stress during hot weather (CIWEM, 2014). However, extensive removal of bankside trees is not a component of the current scheme, and there is significant scope for riparian restoration. The removal / control of non-native invasive species which are extensive on the river banks in the affected area will be a positive impact.

Disturbance of Spawning Sites

It is known that active spawning areas for lampreys and salmonids are present with the footprint of the development. Young-of-the-year juvenile salmon and trout were not recorded in the study area during the 2016 survey; however salmonid spawning could occur here again in the future. The proposed dredging works will result in the destruction of these spawning areas. If the dredging works were to occur during the lamprey spawning times, then adult lampreys would be disturbed and potentially removed during the works. Similarly, salmonids would be affected in this way if dredging works were undertaken during the winter months.

Dredging works are likely to affect the spawning areas of lampreys and salmonids both through direct loss of habitat, and the mobilisation and deposition of river silts that may clog up spawning gravels further downstream. There is however considerable scope for rehabilitation of the affected stretch following the dredging works.

Physical Removal of Species

Lamprey ammocoetes living within the sediment of the river bed will potentially be directly removed during the dredging process. Aquatic invertebrates will also be removed, and this results in a reduction in the diversity and density of invertebrate species present within the channel, which is likely to have knock-on impacts on fish, and subsequently on top predators such as otters and fish-eating birds like kingfishers (CIWEM, 2014).

The physical removal of fish species due to the proposed dredging, re-grading and intermittent widening of the river could potentially result in aquatic fauna being directly impacted by the works. However, the works would take place one section at a time, thereby resulting in only a localised area of disturbance. Also, if the works were to take place outside sensitive seasons, this would minimise the direct impacts on spawning fish. Most of the fish and lamprey ammocoetes can also be translocated in advance of the dredging works – or salvaged from the dredged spoil.

It is noted that if the dry works area floods then fish (and lamprey ammocetes) will enter the dry works areas and can potentially get trapped. This will require a new fish translocation / salvage operation after any flood event which overtops the piling.

Upstream migrating River Lampreys could also potentially get trapped in the dry works are as the impermeable barrier is being installed. River lampreys are vulnerable to this impact due to their extended migration period and also due to the fact that they migrate at night and seek out refuge areas during the day. However, if the impermeable barrier is installed outside of the times when lampreys are migrating then this impact will be avoided.

Water Quality

Dredging will have an impact on water quality, involving the re-suspension of sediment. There is also the potential for other pollution, for example fuel / oil spillages from machinery. Aquatic species are likely to be affected by sedimentation and re-suspension, increases in turbidity and contamination. Impacts on water quality are discussed individually below.

Sedimentation and Suspended Sediments

Operations associated with the proposed scheme including river widening and dredging, and works to raise floodwalls adjacent to the river. These activities will all give rise to the re-suspension of silt and soil into the river. Increases in suspended sediment in a river can cause stress and affect the gills of fish, as well as cover important spawning gravels. The insertion and removal of the impermeable barrier can contribute to increased sediment entering the waterbody, as can bank destabilisation.

The digging of sediment will result in increased levels of suspended sediments and the potential for associated dissolved oxygen reduction and release of natural and industrially-derived chemicals (Lasalle, 1990). Also, the fact that the dredging process often releases chemicals residing in benthic substrates will result in further water quality issues. The release of nutrients as a result of re-suspension can result in behavioural / physiological responses to enrichment (e.g. algal blooms). It can also result in high Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) levels which in turn affect species living in the aquatic environment. Fine particles re-suspended during the dredging process can remain in the water column for many hours due to their low settling velocity (CEFAS, 2010).

The works which include excavation and re-grading will most likely result in the release of sediment into the water column, thus forming a sediment plume and affecting water quality in terms of suspended sediment concentrations and associated effects on the water's turbidity and transparency. While in-river works are temporary, they may still result in sediment plumes within the water column. There will therefore be direct negative impacts on water quality and significant indirect impacts on local aquatic life.

The release of sediment will result in an increase in turbidity within the aquatic environment. This can reduce light penetration and affect species living in the river. Natural processes that occur within a river system depend on light penetration to complete these processes, and when the river is contaminated with increased sediment, these processes are unable to occur. Turbidity can also affect fish migrating upstream, with a suspended solids plume potentially acting as a migration barrier. Increased turbidity can reduce food supply and feeding successes for aquatic species. Significant increases in water turbidity for long periods of time are likely to cause adverse effects on many aquatic organisms through reduced light attenuation through the water column, re-suspended silts and sediments could also increase BOD/COD resulting in reduced dissolved oxygen levels.

The re-suspension of sediment also leads to the release of particulate matter, the release of nutrients, organic matter and contaminants, and results in reduced light penetration. This can indirectly affect macroinvertebrates that would reside in the sediment, and the fish species in the river. Sediment can cover rocks that species such as mayflies, caddisflies and stoneflies which live under (Clark, 1996). Not only does this reduce the number of attachment points for larvae but it also affects feeding success. The re-suspension of sediment can also affect other aquatic species such as pelagic fish and lampreys, by reducing feeding successes and covering suitable spawning areas.

The effects described above can be significantly reduced by effectively managing the amount of silt entering the river. In the current case this will be achieved by working in the 'dry' behind an impermeable barrier. This is likely to significantly reduce siltation, but it will not be possible to fully mitigate this impact.

Fuel / Oil Spills and the Release of Contaminants

Construction works could result in spillages and leakages entering the watercourse. Spills of construction materials may include concrete and cement, and leaks from construction equipment may include fuel, oil and lubricant. As machinery will be entering the river, even in the dry, there is a high potential for oil and fuel spillages to arise. Machinery operating within the aquatic environment, which is comprised of metal, can also contribute to heavy metals contaminating the river bed. This toxic contaminant becomes absorbed on and to re-suspended particles may partition to the water column and be transported great distances downstream in dissolved form along with dissolved contaminants in the released pore water.

The construction process poses a potential risk to water quality in the area and further downstream. Any accidental spillage of construction materials could affect water quality and, indirectly, the species present in the river. The significance of a pollution event due to an accidental spillage of construction materials is dependent on the materials involved, the scale of the spillage, the type of pollutants spilled, as well as the current levels of those pollutants already present within the watercourse.

The widening of the river and re-grading of lengths of the riverbed could result in the re-mobilisation of potentially contaminated material. However, it is noted that GI testing did not note any contaminated material in the channel. Material that is chemically contaminated released during the reflooding of the works area could result in significant negative effects to the health of faunal species of all kinds within the river.

The risk of a significant spill and/or leak can be minimised by following standard good practice with regard to pollution prevention as part of the appointed contractor's environmental management plan. Providing that pollution prevention guidelines are adhered to any risk of accidental spillages can be minimised and should result in no impact.

Fish Migration Barriers

The proposed dredging works could potentially interfere with fish migration in the river as a result of any of the following:

- Interference with fish migration routes
- lowering of water levels
- Increasing of flow velocities and narrowing of river channel while works are taking place
- Physical barriers (e.g. piling).

By working on just 50% of the width of the river at any time and providing an impermeable barrier then many of the above effects can be avoided.

Hydromorphology and Flow Regimes

As dredging results in changes in channel shape and dimensions, this can also affect hydrodynamics and sediment regimes. The hydromorphology of the river changes, in relation to the processes of erosion and deposition of sediment and the way the river flows. Pools, riffles and glides within the river are also changed as a result of this process. Changes in flow and channel characteristics can alter the structure of aquatic plant communities that recolonise

(CIWEM, 2014). Sediment in natural rivers gets deposited and transported along the river bed as it flows, and as the river bed is lowered by dredging, this sediment regime is altered and can result in sediment deposits within the lowered section of the river. The dredging works will also increase the penetration of tidal influence in the river by lowering the bed level. However, it is clear that these impacts will be localised only, and there is much scope to mitigate the impacts with an aquatic habitat restoration plan. Changes in flow regimes and increased velocities are addressed in Chapter 7 of the EIAR.

Non-native invasive species

The disturbance and the works of the proposed scheme may give rise to the potential for the introduction and spread of non-native invasive species. The introduction of these non-native species could have distressing impacts on existing riparian zones and aquatic organisms near the site. However, it is likely that the proposed scheme will have a positive impact in this regard with non-native species being controlled within the study area.

Noise and vibration

Fish can be affected by the underwater dredging sounds. The ways in which fish can be affected include behavioural responses, masking, stress and physiological responses, hearing loss and damage to auditory tissues, structural and cellular damage of non-auditory tissues and total mortality, impairment of lateral line functions and particle motion-based effects on eggs and larvae, according to Wenger *et al*. (2017). This will however be a localised effect and the impact will be reduced by working outside of the times when fish are spawning.

Species Specific Impacts

Sea Lamprey, Brook Lamprey and River Lamprey

Any Sea Lamprey ammocoetes living within the sediment of the river bed will be directly removed from the aquatic habitat during the construction phase of the dredging process. This will result in direct species loss. Due to the extent of instream works proposed there will be significant impacts on the lamprey populations within the footprint of the scheme. No Sea Lamprey ammocoetes were recorded during the 2017 survey; but they may be present within the footprint of the proposed scheme at very low densities. Dredging will also potentially include disturbance of spawning lampreys. Sea Lampreys were not recorded spawning within the footprint of the proposed scheme during the 2017 survey, but they have spawned here in the past and could potentially do so again. Sea Lampreys can spawn as late as July so will not be protected by the statutory close season for instream works. Overall dredging will result in the complete removal of lamprey nursery habitats / juvenile lamprey populations within the proposed scheme area. Migrating lampreys could also potentially become trapped behind the impermeable barrier during the construction phase. Although works will be undertaken during the summer months when flows are low, during flood conditions velocities will be increased on the opposite side of the river to the impermeable barrier. However, flood conditions during the summer months would be infrequent and short-term. Nonetheless, this could impact lamprey migrating and commuting in this stretch of the river. This is noted in Chapter 7 of the EIAR, and it’s stated that these increases in velocities will be localised and short-term and will return to normal following the removal of the piling. The proposal includes 5 no. fish pools which would create suitable spawning habitat for lampreys, and therefore would be a positive impact. Water quality impacts will also potentially affect Sea Lamprey populations in the River Slaney. Impacts on all three lamprey species would be significantly negative, medium-term and at a county geographical scale.

Allis/Twaite Shad

The current status of Allis/Twaite Shad in the River Slaney is uncertain. No evidence of these species was recorded during the 2016 survey. If it is assumed that they occur in low numbers, it is noted that they would have free access up as far as Clohamon weir so could spawn anywhere along this stretch. Therefore, it is not clear if this species is still present in the River Slaney. Shad could be potentially affected by habitat loss, water quality impacts and disturbance. Shad present in the River Slaney estuary could be vulnerable to water quality impacts downstream of the scheme. Impacts on Twaite Shad would be significant negative, medium-term and at a county geographical scale.

Atlantic Salmon and Brown/Sea Trout

Juvenile salmon and Brown/Sea Trout are present throughout the scheme area and the dredging will result in the loss of their habitat. However, the habitats are sub-optimal and no Young-of-the-year (YOY) salmon were found during the 2017 survey. Sea trout may also be present here and therefore would be subject to similar impacts. Potential salmon spawning habitat is present upstream of the railway bridge, and also at the island at the upper end of the scheme. Adult salmon using the scheme area and were observed during the 2017 survey. It is possible that due to flooding in the winter of 2015/16 that the Enniscorthy area was not suitable for spawning Salmon, and it is possible that they could spawn here during drought winters (e.g. winter of 2016/17). It is important to note however that that Salmon spawn throughout almost all of the Slaney catchment and the area of potential Salmon spawning habitats affected by the scheme is insignificant. Water quality impacts from dredging could affect all aquatic species, including salmon which are very sensitive to siltation and other pollution form dredging works. Adult salmon, juvenile salmon and brown/sea trout are likely to become trapped behind the piling during the construction works. Translocation mitigation is required. The scheme footprint is not an important salmon spawning area and works will take place outside the salmon spawning season. As dredging results in changes in channel shape and dimensions, this can also affect hydrodynamics and sediment regimes. The hydromorphology of the river changes, in relation to the processes of erosion and deposition of sediment and the way the river flows. Pools, riffles and glides within the river are also changed as a result of this process. Changes in flow and channel characteristics can alter the structure of aquatic plant communities that recolonise. Hydromorphology changes can affect Atlantic Salmon and Brown/Sea Trout populations. This would open these species up to angling pressures, but it would also provide resting places for the fish that do not currently exist in the urban area of Enniscorthy as the River Slaney at this point is a heavily modified waterbody. Fish can be affected by the underwater dredging sounds. The ways in which fish can be affected include behavioural responses, masking, stress and physiological responses, hearing loss and damage to auditory tissues, structural and cellular damage of non-auditory tissues and total mortality, impairment of lateral line functions and particle motion-based effects on eggs and larvae. This will however be a localised effect and the impact will be reduced by working outside of the times when fish are spawning. Impacts to Atlantic Salmon and Brown/Sea Trout are similar. However, migrating Salmon could potentially become trapped behind piling during the construction phase. The piling works will also result in increasing of flow velocities and narrow the river channel while works are taking place which could act as a barrier for these fish. Although works will be undertaken during the summer months when flows are low, during flood conditions velocities will be increased on the opposite side of the river to the piling. However, flood conditions during the summer months would be infrequent and short-term as noted in Chapter 7 of the EIAR 'Hydrology'. Turbidity can also affect fish migrating upstream, with a suspended solids plume potentially acting as a migration barrier Impacts on Atlantic Salmon and Brown/Sea Trout would be significant negative, medium-term and at a county geographical scale.

European Eel

The European Eel could be significantly impacted by the construction works as they leave the estuary in early spring, and will migrate upriver from May/April through to September; therefore, will be present in the Slaney during the proposed works. Eels have the potential to be impacted both directly and indirectly by the development. Eels may become trapped and killed during the installation of impermeable barrier for the dry works area, in particular, eels which are small and difficult to mitigate for potential impacts. It is noted that during the day eels will typically hide under rocks which make them particularly vulnerable to dredging works on a river bed. Impacts on European Eel would be significant negative, medium-term and at a county geographical scale.

6.4.11.2 Operational Phase Impacts

The impacts likely to arise during the operational phase are detailed in this section. The most common impacts to aquatic species include disturbance due to scheme maintenance works, sedimentation, and alteration in flow regime and flooding.

Habitat loss and Disturbance

The scheme will be subjected to maintenance works which will largely be restricted to the debris trap and sedimentation deposition area at the northern floodplain. The design of the scheme negates the need for large scale dredging throughout the extent of the scheme. This work can be expected to target silt deposits and these areas will have been recolonised by lamprey ammoecetes so these will again be potentially removed from the river and their habitats destroyed. The current proposal includes a silt deposition area which will encourage silt to settle in a smaller area, thus eliminates the need for extensive maintenance along the reach of the River Slaney. This will assist in providing mitigation – which will include only removing deposited silt from dewatered areas. Lamprey ammocetes will need to be translocated out of these areas before silt removal.

Water quality and biosecurity

Maintenance works has the potential to cause all the same water quality impacts as the construction phase but would be much reduced in magnitude. Similarly, the same issues in relation to biosecurity will apply to the operational phase in relation to machinery used for maintenance.

Fish spawning gravels

Removing and lowering the river bed during dredging will also affect fish spawning habitat. This may encourage fish spawning gravels to fill into the areas in which the river bed was lowered. Even if spawning gravels are protected; the displaced sediment and / or increased sediment load resulting from dredging activities can smother fish eggs and juveniles (CIWEM, 2014).

Hydromorphology and Flow Regimes

After the construction phase of the dredging process, the lowering of the river bed can result in changes in flow rate within the river system. As part of the works is located in a freshwater tidal area, the lowering of the river bed at this point could encourage the tide to come further up the channel than previously. These structural changes in the river bed will also change the hydromorphology of the river and encourage sediment to fill the areas of the river bed that were lowered during the dredging process. Changes in flow rates can also alter oxygen levels in the water body, which can in turn affect aquatic species and vegetation. Removing and lowering the

river bed during dredging will also affect fish spawning habitat. This may encourage fish spawning gravels to fill into the areas in which the river bed was lowered. Even if spawning gravels are protected; the displaced sediment and / or increased sediment load resulting from dredging activities can smother fish eggs and juveniles (CIWEM, 2014). This can also cause physical / mechanical stress to River Lampreys.

Species Specific Impacts

Sea Lamprey

The only operational phase impact to Sea Lamprey would be physical removal of lamprey nursery habitat during the maintenance works. The maintenance works will only take place at the sediment trap in the northern floodplain, expected to be required approximately every 5 years. Operational phase impacts to Sea Lamprey would be significant negative, short-term and at a local geographical scale.

Brook Lamprey

As above for Sea Lamprey.

River Lamprey

As above for Sea Lamprey.

Allis/Twaite Shad

No operational phase impacts to Allis/Twaite Shad are envisaged to arise. The maintenance works to the sediment trap in the northern floodplain will result in very localised impacts unlikely to affect Allis/Twaite Shad. Operational phase impacts to Allis/Twaite Shad would be significant negative, short-term and at a local geographical scale.

Atlantic Salmon

As above for Allis/Twaite Shad.

European Eel

As above for Allis/Twaite Shad.

6.4.12 Freshwater Pearl Mussel

A total of 51 live FPM were recorded in the River Slaney in the surveyed stretch between the upper and lower extent of the surveyed stretch. With the exception of nine individuals, all live FPM were recorded in the uppermost 500m stretch of the scheme extent.

There are numerous records, recent and historical, of this species in the Slaney Catchment from the 19th Century onwards. The wider Slaney Catchment population is important as there is a wide distribution of *Margaritifera* through the main channel and through 3 of its tributaries. The distribution of the mussel in the Slaney main channel has been described as one of the largest in history, and could have supported up to 50 million individuals in the past (Moorkens, unpublished data), but the Derreen River is the last area where successful juvenile recruitment was recorded (Moorkens, 1996), and the Derreen sub-population is the limit of the location of the environmental objectives as a qualifying interest in this SAC

The 51 live mussels within the proposed works area include 41 mussels that have been washed into unsuitable habitat for the species, and 10 mussels living in habitat that is suitable for the species, both adult and potentially juveniles, although the current condition of this habitat

renders it unsuitable for juvenile mussel survival. All of these mussels are part of the Slaney River population, and these mussels are protected under the Wildlife Act, not under Article 3 of the Habitat's Directive, although they are located within the Slaney River Valley cSAC, Therefore, the impact assessment considers both the impact on the protected species within the proposed works area, and any potential impact on the SAC population in the Derreen River upstream. The only contribution that these 51 mussels could make to the Derreen River SAC is through the encystment of larvae on to a salmonid that is moving upstream from Enniscorthy to the Derreen River.

6.4.12.1 Construction Phase Impacts

Habitat Loss & Fragmentation

The impact of the proposed works without mitigation would be negative, i.e. the loss of the species from the extent of the works area, which is the lowest part of their distribution in the Slaney Catchment. This includes the loss of the small area of permanent juvenile and adult habitat from the uppermost end of the scheme through changes to the flow regime, and the larger area of river bed that currently supports adult mussels, but with no habitat to support juvenile recruitment, through changes to the flow and river bed structure from deepening.

The current contribution of the majority of mussels is to provide larvae that could attach to host fish travelling in an upstream direction. The small area of juvenile habitat currently has the potential to support both adults and juvenile mussels.

Habitat degradation - water quality

During construction, if unmitigated, contaminated surface water runoff and/or an accidental spillage or pollution event into any surface water could negatively affect any living *Margaritifera* that remained in the river bed in undisturbed areas during the construction process. The effects of short-term pollution (minutes) can be severe stress and loss of sperm or glochidial larvae. A repeated or more prolonged pollution event can result in death to mussels through the inability to feed or through lack of oxygen from prolonged clamming.

Habitat degradation - hydrology (e.g. flow and flooding regime)

During construction, methodologies that temporarily change flow patterns (such as creating temporary barriers in the river), changes in flow can cause living mussels to be scoured out of their habitat and washed downstream where flows are increased, or to be subject to inappropriately low velocities impacting on oxygen and food availability where flow is temporarily lowered.

Disturbance/displacement

Without mitigation, the disturbance to the mussels within their river bed habitat would result in the loss of the species from the extent of the works area, which is the lowest part of their distribution in the Slaney Catchment.

Mortality Risk

Without mitigation, the loss of the species from the extent of the works area during construction is likely to be total. This would not be reversible without mitigation.

6.4.12.2 Overall Construction Impacts

The overall significance of the construction impacts without mitigation would be significant and negative at a county geographical scale.

6.4.12.3 Operational Phase Impacts

Habitat Loss

The impact of the proposed works is the inevitable loss of the species from the extent of the works area, which is the lowest part of their distribution in the Slaney Catchment. This includes the loss of the small area of permanent juvenile and adult habitat from the uppermost end of the scheme through changes to the flow regime, and the larger area of river bed that currently supports adult mussels, but with no habitat to support juvenile recruitment, through permanent changes to the flow and river bed structure from deepening.

The current contribution of the majority of mussels is to provide larvae that could attach to host fish travelling in an upstream direction. The small area of juvenile habitat currently has the potential to support both adults and juvenile mussels.

The areas where adult mussels are currently supported in non-juvenile habitat are faster flowing, shallower areas of river bed. These areas are unlikely to develop following the proposed works. Over time, some small areas may build up that may support a few adult mussels washed downstream, in areas with no sediment maintenance, but the functional design of the river bed proposed by these works is incompatible with permanent FPM habitat.

Habitat degradation - water quality

The operational phase of a wider and/or a deeper morphological structure in the works area is incompatible with functional FPM habitat. Deeper, slower water facilitates the deposition of physical and organic silt which would be incompatible with either juvenile mussel habitat or with brooding adult mussels. River widening results in a decrease in flow velocities where the water is spread over a wider area during low, mid and high discharge scenarios. The habitat loss and habitat degradation are both associated with flow changes at the microhabitat level where mussels are found within the river bed substrate (see below).

Functional flow changes to river bed through river widening and deepening.

Margaritifera is a species of preferential high flow at lower discharge conditions, and of suitable flows at mid and high discharge conditions to facilitate the maintenance of clean substrate but without severe scour. The individuals found within the works area are associated with patches of preferential flow through the presence of small gravel bars or islands that facilitate high velocities at low discharges and become submerged and spread the intensity of flow during high discharges. These favourable patches of river bed habitat are dependent on good flows and these are unlikely to be retained at their present near-bed velocities due to the river widening at the opposite bank.

The overall impact of the operational stage is severe, negative and permanent.

6.4.12.4 Overall Operational Impacts

The overall impact of the operational stage is severe, negative and permanent at a county geographical scale.

6.4.13 Duck Mussel

The duck mussel *Anodonta anatina* was recorded in low numbers (4 live mussels recorded) close to the side channel inflow and towards the proposed works area (between Enniscorthy Bridge and Seamus Rafter Bridge). This is the most upstream record for live *Anodonta anatina* in the Slaney catchment; there are records of other individuals downstream of the proposed works in faster flowing habitat near Oilgate (D. Berridge, pers. Comm).

6.4.13.1 Construction Phase Impacts

Habitat Loss & Fragmentation

The impact of the proposed works without mitigation would be negative, i.e. the loss of the species from the extent of the works area, which is the likely upper known location for the species in the River Slaney.

Habitat degradation - water quality

During construction, if unmitigated, contaminated surface water runoff and/or an accidental spillage or pollution event into any surface water could negatively affect duck mussels downstream in undisturbed areas during the construction process. While duck mussels live in much finer sediment beds than *Margaritifera*, they are associated with clean open water. They are sensitive to severe silt contamination in flowing water, as they need to take in oxygen and food on a continuous basis. Processing water contaminated with inorganic fine sediment requires the expense of high levels of energy stored in the mussel body. Use of stored energy resources over a prolonged period can lead to stress, impaired muscular function, and death.

Disturbance/displacement

Without mitigation, the disturbance to the mussels within their river bed habitat would result in the loss of the species from the extent of the works area.

Mortality Risk

Without mitigation, the loss of the species from the extent of the works area during construction is likely to be total. This would not be reversible without mitigation.

6.4.13.2 Overall Construction Impacts

The overall significance of the construction impacts without mitigation significant and negative at county scale.

6.4.13.3 Operational Phase Impacts

Habitat Loss

The impact of the proposed works is the inevitable loss of the species from the extent of the works area. Over time, some small areas may build up that may support duck mussels in areas with no sediment maintenance.

Habitat degradation - water quality

The operational phase of a wider and/or a deeper morphological structure in the works area may facilitate the deposition of physical and organic silt which, if severe, would be incompatible with a healthy duck mussel population.

6.4.13.4 Overall Operational Impacts

The overall significance of the operational impacts without mitigation significant and negative at county scale.

6.5 Cumulative Impacts

A search area of 5km from the proposed scheme was considered appropriate to assess potential cumulative impacts from nearby granted or proposed schemes in-combination with the proposed scheme. Potential cumulative impacts are likely to arise from developments which may affect the surrounding environment of the proposed scheme, water quality within the River Slaney and where construction would occur simultaneously with the construction works of the proposed scheme.

The developments considered in this assessment include the ongoing construction of the M11 Gorey to Enniscorthy PPP Scheme and the Enniscorthy Waste Water Treatment Plant.

A number of other single dwelling or similar scale developments are proposed within a 5km radius of the proposed scheme, however, were not considered to be of a magnitude to cause perceptible changes to the aquatic or terrestrial features that could result in potential in-combination effects with the proposed scheme.

The Gorey to Enniscorthy PPP Scheme, like any other construction works within a river catchment, has the potential to contribute to run-off and the proposed bridge across the River Slaney is upstream of the proposed works. This proposed scheme was subject to a Natura Impact Statement which provided appropriate robust mitigation measures for the protection of water quality. The majority of the construction works for this development will also have been completed prior to the proposed Enniscorthy Flood Defence Scheme.

The upgrade to the Enniscorthy Waste Water Treatment Plant is expected to be completed in Q2 of 2019 and therefore will be largely complete prior to the commencement of the Scheme. The improvement in discharge standards will have a positive impact by improving water quality within the River Slaney.

The ‘Enniscorthy Town & Environs Development Plan 2008-2014 as extended’ includes zoning for “open space and amenity” which flanks the River Slaney up and downstream of Enniscorthy ‘town centre’ zoning, it also includes a corridor along the River Urrin and Motabeg watercourse which both confluence with the River Slaney downstream of the proposed scheme. “New residential” zoning and “industrial and commercial and related uses” zoning both extend outward from existing developments within Enniscorthy.

Although Enniscorthy and its environs are included in a separate development plan, the ‘Wexford County Development Plan 2013-2019’ does cover the wider River Slaney catchment that falls within Co. Wexford. The County Development Plan has defined rural area types within the county and has defined Enniscorthy town and the wider surrounding area and areas east and west of the River Slaney downstream of the scheme as having “strong urban influence”.

6.5.1 Habitats

The Gorey to Enniscorthy PPP Scheme, like any other construction works within a river catchment, has the potential to contribute to surface water run-off and could lead to impacts on water quality within the River Slaney affecting instream and fluvial fed habitats. However, as the construction of the Gorey to Enniscorthy PPP Scheme and the proposed scheme will largely not overlap both spatially and temporally, there is low risk of potential for cumulative impacts on water quality within the River Slaney and associated fluvial fed habitats. Cumulative habitat loss within developments mentioned above is not considered to change the overall impact assessment, as habitat loss associated with the proposed scheme is minimal.

6.5.2 Mammals

Cumulative impacts on water quality within the River Slaney are not predicted. It is unlikely that the territories of otter recorded within the scheme extent will overlap with the zone of influence of the above considered developments. Therefore, cumulative impacts on otter are not considered to change the over impact assessment.

6.5.3 Bats

The proposed scheme will not result in the loss of important bat habitat or result in fragmentation of foraging or commuting habitat. Cumulative impacts are therefore not considered to change the overall impact assessment of the proposed scheme on bats using the extent of the scheme or wider area.

6.5.4 Birds

No significant interactions between this development and/or the Gorey to Enniscorthy PPP Scheme and birds assessed for the proposed scheme are anticipated.

6.5.5 Aquatic Species

The Gorey to Enniscorthy PPP Scheme like any other construction works within a river catchment, has the potential to contribute to surface water run-off. This proposed scheme was subject to ecological impact assessment and provided appropriate robust mitigation measures for the protection of water quality. The construction works for this development will also be undertaken at a different time to the proposed Enniscorthy Flood Defence Scheme. The Enniscorthy Waste Water Treatment Plant upgrade will result in the cessation of discharge of sewerage to the eastern side of the River Slaney in the southern floodplain at c. Ch4+600 which will improve water quality. Therefore, no negative cumulative impacts affecting Sea Lamprey, Brook Lamprey, River Lamprey, Allis/Twaite Shad, Atlantic Salmon and Brown/Sea Trout are predicted.

The cumulative impact assessment included an assessment for the potential *Margaritifera* translocation site, approximately 5.5km upstream at Scarawalsh Bridge. There are no major plans or projects at present that are likely to conflict with the translocation effort, apart from the current level of intense land use that is present throughout the Slaney Valley. The nearest quarry (Ballingale Quarry) is 4km upstream of the proposed translocation area and within 500m of River Slaney channel, and the next (Drumderry Quarry) is 14km upstream, within 50m of River Slaney channel. The negative cumulative impacts from these existing pressures on the translocation potential is deemed to be relatively low.

6.6 Mitigation Measures

6.6.1 Habitats

The following measures will be implemented to protect habitats within the scheme extents. Additional measures are detailed for Annex 1 habitats in Sections 6.6.2-6.6.4 below.

- Demarcate the working area prior to the commencement of works to reduce disturbance and damage to adjacent habitats;
- Areas of temporary habitat loss will be reinstated. The deposition area in the northern floodplain will be re-seeded with a dry calcareous and neutral grassland seed mix and compound channel replanting will include Reed Canary grass *Phalaris arundinacea* and

Branched Bur-reed *Sparganium erectum,* and planting along the back channel. A detailed Habitat Management Plan will be developed prior to commencement of works;

- The current grazing regime in the northern and southern floodplains will continue post works to maintain the existing grassland characteristics; and
- The provisional Invasive Species Management Plan will be updated by the Contractor to form the detailed Invasive Species Management Plan which will form part of the Contractors EOP for the proposed scheme.

6.6.2 Water Quality

Mitigation measures protecting the water quality of the scheme's hydrological environment are included in Chapter 7 of this EIAR. Mitigation measures below include standard mitigation measures will be employed during the construction phase of the proposed scheme. Chapter 7 may include additional measures that are not covered in this section.

- Pollution control measures will be designed, installed and maintained in accordance with CIRIA guidance for 'Environmental Good Practice on Site' (C741) and 'Control of Water Pollution for linear construction projects'. Technical guidance (C648) and under the supervision of an EnCoW. Measures include but are not limited to the following;
  - Re-fuelling of construction equipment and the addition of hydraulic oil or lubricants to vehicles /equipment will take place in designated bunded areas within the temporary storage yard, where possible, and not on-site. Bund specification will conform to the current best practice for oil storage such as 'Best Practice Guide BPGCS005 Oil Storage Guidelines,' Enterprise Ireland.
  - All waste oil, empty oil containers and other hazardous wastes will be disposed of in conjunction with the requirements of the Waste Management Acts 1996, as amended.
  - Spill-kits and hydrocarbon absorbent packs will be stored in the cabin of each vehicle and operators will be fully trained in the use of this equipment.
  - The risk of pollution of the watercourses from losses of mortar and concrete must be managed and controlled in accordance with IFI Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters and with CIRIA C532: Control of water pollution from construction sites Guidance for consultants and contractors.
  - A visual inspection of all watercourses, downstream of the works areas shall be conducted daily. Visual inspection should show no indication of increased sediment deposition on the watercourse bed and no visible hydrocarbon film.
  - In order to avoid the risk of pollution of the River Slaney SAC, fuelling and lubrication of plant and equipment will not be permitted within 50m of a watercourse.
  - Exposed areas of soil within works areas which are located within 5m of a drainage ditch will be covered with a soil erosion protection (e.g. erosion control blanket/ mat), soil erosion must be installed in accordance with the manufacturers specification and must be installed immediately following the exposure of works areas to soil erosion and continued to be maintained in place until works are complete and the soil has been re-established.
  - Silt control curtains/straw bales cannot be used in naturally-flowing permanent water courses as they are likely to be quickly overcome. In addition, the establishment of dry works areas as shown on the accompanying drawings in Appendix A of the EIAR and the phased approach to the deposition of material on the island will prevent siltation through runoff. It is also proposed that a silt fence will be required at the perimeter of the flood defence walls works areas and including around the perimeter of soil depositional zone located within 5m of the back channel. This fence will be installed in accordance with

manufacturers specifications and must be installed prior to commencing the works. The silt fence will have the following design features;

  - The geotextile fabric must be entrenched at least 100mm into the ground with ends upturned;
  - The fence posts will have a maximum spacing of 2m to prevent sag on the fence; and
  - The geotextile fabric will be anchored to the fence posts as opposed to wrapped.
- The location of the fence will be set out in agreement with the suitably qualified/experienced EnCoW. Daily inspections of the silt fences will be carried out by the EnCoW to assess the effectiveness of the measure, to carry out maintenance, and to determine if there has been any damage/breach to the control measure. The silt fence will be also inspected immediately following heavy rainfall or strong winds. Where repair is necessary, this will be carried out immediately and may require replacement of any damaged/degraded material.
- Accumulated silt will be removed regularly from the base of the silt fences. Silt will not be permitted to build up such that it reaches half the height of the fence or exceeds 15cm in height (whichever is the lesser value). Commercially available fences will show a maximum height which should not be exceeded. Silt fences must remain in place until the disturbed areas within the sites have been reinstated and revegetated. Silt fences must only be removed during dry weather and following approval of the EnCoW. Any accumulated silt along the fence must be removed immediately in advance of removing the silt fence from the site. The removal of the silt fences will be carried out under the instruction and supervision of the EnCoW.
- Daily monitoring of all control measures will be required and will carried out by the EnCoW to assess the effectiveness of the measures including onsite water treatment system, to carry out maintenance, and to determine if there has been any damage /breach to the control measure. Daily inspections of the impermeable barrier will also be carried out the contractor.

- Installation of the impermeable barrier will be carried out in the instream open season between June-September only.
- A Water Quality Monitoring Plan will be developed prior to the commencement of works. Daily visual inspections and trigger thresholds will be set up, above these thresholds works will be directed to stop until parameters return to baseline conditions. Weather conditions will be monitored throughout the construction period by the contractor. Works will not be carried out during extreme rainfall or high flow events.
- When the instream works are complete in an area the impermeable barrier will be removed from the river and flow will be reinstated. Prior to removing the barrier, the new river beds will be scarified to minimise the de-compaction of the river bed, this will be carried out by a toothed bucket of an excavator. The removal of the barrier has the potential to increase the turbidity levels directly downstream of the works areas. This increase is considered to be temporary and flushing would occur. As noted previously, the use of silt control measures in a permanent watercourse if not effective and, as such, the programme of removal will be carried out to minimise turbidity levels downstream and levels will be monitored, and works will stop where exceedance are recorded and recommence only following consultation with the EnCoW.

6.6.3 Annex I habitat- Alluvial Woodland [91E0]

- The bridge will span an area of Annex I priority habitat - alluvial woodland. The construction area to be marked out prior to construction under supervision of a woodland ecologist. Any

fencing installed should not cause damage (temporary fencing may be best). The fencing should include the wet ditch adjacent on the western side of the woodland.

- Other than the works specified in the project design, no construction work, storage or dumping of material to be undertaken in the 91E0 exclusion area.
- Tree pruning to be undertaken in late winter/ early spring (November to March) under supervision of a woodland ecologist. This includes the initial tree-pruning during construction and maintenance pruning works post construction.
- Measures to be taken during tree pruning (during construction and ongoing maintenance) to ensure that there is minimal disturbance to the ground, field and shrub layers in the 91E0 woodland by the contractor. Work to be supervised by woodland ecologist.
- During construction work, dead wood should not be removed from site. Branches and wood removed during pruning activity (during construction and ongoing maintenance) to be placed in various locations within the woodland (as advised by a woodland ecologist) to increase the dead wood present.
- No landscape planting within or adjacent to woodland.
- Area of woodland along the eastern bank will be removed here. This is adjacent to an area of Annex I priority habitat 91E0 alluvial woodland. The alluvial woodland will be protected during construction and may need temporary fencing which should be erected under supervision of woodland ecologist.
- No construction work, storage or dumping of material to be undertaken in the 91E0 exclusion area.
- Monitoring and condition assessment of 91E0 woodland and, if necessary, invasive species management. This should be undertaken for a minimum of five years as some impacts (e.g. spread of invasive species), may not be immediately apparent. The results of the 5 years of monitoring should be used to assess whether further monitoring or management action is required (e.g. if the monitoring relevé(s) fail or shows an unfavourable trend.

6.6.4 Annex 1 Habitat- Floating River Vegetation 3260]

- A final Floating River Vegetation (FRV) mitigation plan will be created by an experienced macrophyte ecologist once contractors are appointed (and construction plan finalised). The outline of what this plan must include as a minimum is as follows and in the points below: 1) identification of areas where macrophyte vegetation can be protected during construction works, e.g. 'buffer' zones' at edge of channel where no widening/ dredging is to be undertaken (to facilitate recolonisation post construction); 2) areas with low cover of Elodea species (less than 5% cover) where the top level of sediment can be removed and stored dry for replacement post-dredging, 3) any other relevant measures. This will be undertaken by specialist macrophyte ecologist;
- The top 10cm sediment will be removed from selected areas pre-dredging. These areas will be identified during pre-construction surveys. Sediment will only be removed from areas with less than 5% cover of Elodea species (as identified by grapnel or other suitable survey method undertaken by an experienced macrophyte ecologist). Sediment will be stored dry, away from the riverbank. Post-dredging, this will be replaced in dry works areas which will be dredged to a depth of greater than 10cm. The 'source' sediment areas and 'recipient' areas will be clearly identified in the Floating River Vegetation mitigation plan;
- In-stream works will be undertaken from July to December each year. As the period of July to September is during the main growing season for FRV, some works will be undertaken in the growing season. However, as all aquatic plant material will be removed from each dry works areas and regeneration will be from the propagule bank and recolonisation from

upstream/ adjacent areas (once the central barrier is removed), this will not impact vegetation recolonisation. Growth of aquatic macrophytes in the early growing season (May to June) will ensure that there is recent vegetative material in the sediment of each dry works area, prior to works. As only half the channel will be disturbed at any one time, there will always be some FRV regeneration during the construction period;

- The top layer of sediment and any macrophytes present in each dry works section to be removed and stored away from the river. Sediment from areas with low Elodea cover will be stored dry and replaced post-dredging as outlined above. All other sediment will be disposed of away from the river. This is to prevent sediment and fragments of invasive macrophyte species being transported downstream to *Callitriche truncata* sites; and
- Measures to restore sediment after compaction during use as dry works area. Monitoring of recovery of FRV vegetation within scheme area. This should be continued until the 2016 distribution FRV is achieved and the vegetation is typical of the 2016 species composition (species and relative abundance). This may require annual surveying for up to and beyond five years as FRV populations can fluctuate.

6.6.4.1 Downstream populations of *Callitriche truncate*

- Proven sediment control measures and instream monitoring during construction will be developed as part of a Sediment Management Plan included within the Construction Environmental Management Plan (CEMP) and implemented accordingly during the works to minimise and contain any silt plumes travelling downstream when dry works areas are re-flooded. This is to prevent silt travelling downstream and depositing on *Callitriche truncata* sites. This is likely to include monitoring at 500m, 1km and 1.5km downstream of the works, this threshold could be monitored hourly or as frequently as required and works suspended if thresholds are exceeded;
- Monitoring of the three *Callitriche truncata* sites closest to the proposed scheme extent (Bormount House (1,2) and Edermine Bridge (3)) and the closest site where *Callitriche truncata* has most recently been recorded (c. 6.3km downstream from the proposed scheme near Jamestown Nature Reserve). The aim is to monitor the condition of the habitat, with particular attention to the presence and abundance of non-native invasive macrophytes and any negative impacts of siltation. The results of the 3 years of monitoring should be used to assess whether further monitoring or management action is required (e.g. if the monitoring shows an unfavourable trend in habitat condition or population). This will only be undertaken if pre-construction surveys record the presence of *Callitriche truncata* populations in these sites; and
- Although *Callitriche truncata* was not recorded during 2016 surveys, pre-construction surveys up to 2km downstream of the scheme extent (e.g. historic sites at Bormount House and Edermine Bridge) will be carried out to identify any new records of this species within the scheme zone of influence.

6.6.5 Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]

- 91A0 Annex I habitat to be fenced prior to construction to protect remaining habitat (91A0 exclusion area). This must be undertaken under supervision by a woodland ecologist who can identify the 91A0 habitat area. The fence should remain in place during operation to prevent recreational disturbance within the 91A0 woodland.
- No construction work, storage or dumping of material to be undertaken in the 91A0 exclusion area.
- No landscape planting within or adjacent to woodland.

6.6.6 Otters

- Pre-construction surveys will be carried out to identify any new otter holts/resting places within the scheme extents and monitor existing holts/resting places to determine if active.
- Prior to the commencement of works, a 20m buffer will be demarcated around active holts to reduce disturbance.
- Prior to the commencement of works, signage will be erected if necessary along the haul route to raise awareness of otter.
- Limit hours of construction lighting and use of directional lighting with minimal lighting over riparian habitats.
- Include the provision of mammal ladders in dry works area in main river channel so any trapped otter or other mammal can escape.
- In line with the derogation licence, if required construct artificial otter holt along the new back channel in the northern floodplain during re-profiling and habitat enhancement works.

6.6.7 Bats

- Carry out pre-removal checks of trees and structures identified as Potential Roost Features (PRFs).
- If necessary pre-removal roost emergence/re-entry surveys at trees and structures identified as PRFs may be required to determine use of the feature by bats.
- If bats are recorded using these trees or structures and in line with a derogation licence, the provision of bat boxes along dark corridor of new road bridge, new pedestrian bridge and along the restored back channel will be included
- Ensure the provision of the back-channel restoration works in the northern floodplain includes habitat features suitable for commuting, foraging, and potentially roosting bats.

6.6.8 Birds

- An artificial nesting wall will be provided for Sand Martins on the east bank of the Slaney at CH 6280 – 6300, at the approximate location of the colony recorded in 2003 (Goodwillie, 2003, Appendix 6 of River Slaney (Enniscorthy) Drainage Scheme Environmental Impact Statement, 2009) and is detailed in Drawing 355741-MMD-01-XX-DR-S-0050. The wall design is based on the UK Environment Agency Best Practice Guidelines for artificial bank creation for Sand Martins and Kingfishers (Hopkins, 2001). The wall will be built within the dry works area scheduled for year 1, using in-situ cast concrete. Nest holes 50mm diameter will be drilled through the wall, with a slight slope of 1:60 downwards towards the river, to allow drainage of nest chambers. Sixty nest holes will be provided.
- The detail design of the nesting structure will be carried out in consultation with the EnCoW to ensure the successful occupancy by Sand Martins and longevity of use of the nesting structure. The detailed design will have regard to the installation of wing walls at the upstream and downstream ends of the wall, installation of measures to prevent tall vegetation becoming established at the base of the wall.
- Construction-phase monitoring of Sand Martin nesting at the northern floodplain will be developed as part of a construction monitoring plan. It is recommended that annual monitoring continues until the third year after the completion of construction, so that the effectiveness of the mitigation provided can be assessed and any future management requirements determined and implemented.

Mitigation measures for Kingfishers

- A detailed landscape planting plan will be set out in consultation with the suitably qualified/experienced EnCoW and the project landscape architect. The plan will seek out planting opportunities within the works area for planting willow and alder to facilitate perching habitat for Kingfisher. Wherever possible, it is recommended that existing river bank willow scrub and Alder trees are coppiced and retained or replaced along the river bank i.e. along the Back Channel, North Island and on the west bank of the River Slaney between CH 4350 and CH 4600. It is recommended that Alder whips are planted in any gaps, and that native genetic stock is used. This mitigation measure is also a mitigation measure for the retention of visual screening.

Mitigation measures to enhance bird habitat in the restoration of the North Island Back Channel

- A detailed landscape planting plan will be set out in consultation with the suitably qualified/experienced EnCoW and the project landscape architect. The plan will seek out planting opportunities along the existing back channel as detailed here to facilitate riparian habitat establishment and enhancement for birds. Reed Canary grass *Phalaris arundinacea* and Branched Bur-reed *Sparganium erectum*, which are dominant marginal plants along the existing back channel, are beneficial to Mallard and Teal providing a food resource in autumn and winter, cover for broods during the breeding season, and good invertebrate habitat. These plants are suitable to growing in submerged conditions and grow in water up to 1m deep. It is recommended that rooted plant material is transplanted on newly worked back channel margins into soft un-compacted soil along the waterline in late spring when plants are in active growth. Plants establish quickly in these circumstances and root growth will assist in stabilising the back channel and reducing potential downstream siltation impacts. Additionally, where possible Willow, Birch and Alder will be planted where tree cover is required along the riparian edge of the back channel.

Mitigation measures to enhance vegetation and waterbird habitat recovery rates in proposed compound channels

- A detailed landscape planting plan will be set out in consultation with the suitably qualified/experienced EnCoW and the project landscape architect. The plan will seek out planting opportunities along the existing back channel as detailed here to facilitate riparian habitat establishment and enhancement for birds. Reed Canary grass *Phalaris arundinacea* and Branched Bur-reed *Sparganium erectum*, which are dominant marginal plants along the existing back channel, are beneficial to Mallard and Teal providing a food resource in autumn and winter, cover for broods during the breeding season, and good invertebrate habitat. These plants are suitable to growing in submerged conditions and grow in water up to 1m deep. It is recommended that rooted plant material is transplanted on newly worked back channel margins into soft un-compacted soil along the waterline in late spring when plants are in active growth. Plants establish quickly in these circumstances and root growth will assist in stabilising the back channel and reducing potential downstream siltation impacts. Additionally, where possible Willow, Birch and Alder will be planted where tree cover is required along the riparian edge of the back channel.

Mitigation measures to reduce siltation impacts arising from compound channel works downstream of the River Urrin

- Control measures will need to be implemented during the construction phase to ensure that the works are completed in an environmentally responsible manner. Silt control measures cannot be used in naturally flowing permanent water courses as they are likely to be quickly overcome. All instream works will be carried in a dry works area. The management of silt

during the construction works will set out in the CEMP and agreed with the suitably qualified/experienced EnCoW.

Mitigation measures to identify and minimise hydrological impacts on wetland habitats important for waterbirds on the Bare Meadow

- The compound channel in the Bare Meadow has been designed so that the existing profile of the riparian edge level and existing soils profile is recreated. The design of the bankside will have regard to dimensions and vegetation cover of the existing riparian edge and will be replicated as part of the construction works following consultation with the suitably qualified/experienced EnCoW. This mitigation measure will also ensure the retention of existing visual screening of waterbirds from disturbance arising from recreational boating and canoeing on the River Slaney.

Mitigation measures to minimise disturbance to waterbirds in the southern floodplain

Bridge works area

- The bridge works area will be fenced off during set-up of this temporary works area, and no construction machinery will be permitted to enter the Bare Meadow.

River dredging and compound channel works

- Works will be restricted in the southern floodplain between October-May inclusive to protect waterbirds using the wetland habitats during the winter and nearby nesting Grey Heron from disturbance. Instream works in the western section of the river channel will be carried out in June and July and in the eastern side will be carried out in August and September, by which time any late brood Grey Herons are expected to have fledged and juveniles relatively mobile and independent.
- The proposed schedule of channel widening and dredging works in the southern floodplain is set out in Chapter 4 of this EIAR. Instream works adjacent to the southern floodplain will commence at the downstream end, in order to limit the duration of disturbance impacts to waterbirds on the Bare Meadow. Following re-watering of the channel, all access to the impermeable barrier for monitoring and for the removal, shall be required to be carried out from boats, barges and pontoons.
- No machinery tracking along the east river bank will be permitted in the southern floodplain, and all machinery will be excluded from the Bare Meadow on the southern floodplain to the south of CH4700. This exclusion area will be clearly indicated by temporary fencing prior to the commencement of works and will be notified to all contractors. All machinery and personnel will work and move within the dry works area provided in the river channel to the north of the River Urrin Inflow.
- Pegging out of compound channel construction areas near the river bank will be carried out by or advised by the EnCoW.
- The compound channel in the Bare Meadow has been designed so that the existing profile of the riparian edge and existing soils profile is recreated. The design of the bankside will have regard to dimensions and vegetation cover of the existing riparian edge and will be replicated as part of the construction works following consultation with the suitably qualified/experienced EnCoW. This will ensure the retention of existing visual screening of waterbirds from disturbance arising from recreational boating and canoeing on the River Slaney, during the construction and operational phases.
- Wherever possible, the existing Alder treeline screening on the west bank opposite Bare Meadow will be maintained by coppicing and replacement, rather than by tree removal, in order to ensure continuity of screening of waterbirds using the River Slaney channel and

adjoining Bare Meadow from recreational use of the west bank promenade by walkers and dogs.

Mitigation measures to avoid land use changes on the Bare Meadow during and post construction

- Seasonal horse grazing at the current stocking densities will be facilitated on the Bare Meadow during construction, by the provision of gated access and provision of an agreed route through the new road bridge temporary construction area adjoining the east bank of the Slaney. The land owner will be contacted in this regard prior to construction.

Mitigation to minimise waterbird collision risk at proposed new road bridge over the Slaney

- During the construction phase, 2m high Harris fencing with visual screening will be provided at the temporary works areas boundaries of the bridge working area in the southern floodplain. Visual screening will be white or pale grey and will incorporate reflective material to enhance its visibility to Grey Heron and other waterbird species flying in the vicinity in poor light conditions and during the hours of darkness. While some existing background lighting is provided by public lighting along the N11, it is recommended that additional lighting is provided on tall construction equipment and on bridge pier structures under construction to minimise collision risk. Additional construction lighting will be agreed in consultation with the suitably qualified/experienced EnCoW and will be designed to avoid significant impacts on other mammals i.e. otters and bats.
- Painted steel handrails and pedestrian guardrails on the proposed new bridge are considered to be more visible to waterbirds in flight during poor light conditions and during the hours of darkness, in comparison to stainless steel. A bright cream colour is recommended to maximise visibility and will be agreed in consultation with NPWS. This mitigation measure refers to the construction phase and to the operational phase.

6.6.9 Aquatic Species

6.6.9.1 Construction phase

Water Quality Protection

- Works will be carried out in the dry and behind an impermeable barrier, which will minimise the potential for significant water quality impacts involving sedimentation. A silt fence will be required at the perimeter of the full length of the works areas and including around the perimeter of the soil depositional zone located on the North Island. The works will be carried out in dry sections on one side of the river behind an impermeable barrier, with the other side of the river being allowed to flow normally. The impermeable barrier will then be moved to the next section when appropriate and when works on one section of the river is completed.
- Daily inspections of the silt fences will be carried out by the EnCoW to assess the effectiveness of the measure and to determine if there has been any damage / breach to the silt fences. The silt fence will also be inspected immediately following heavy rainfall or strong winds. Accumulated silt will be removed regularly from the base of the silt fences.
- To minimise the risk of significant spill and/or leak, standard good practice will be followed with regard to pollution prevention as part of the appointed contractor's environmental management plan.
  - Any concrete pouring and filling works will be monitored, and spill prevention and remediation measures must be in place to minimise the risk and extent of spills and to rapidly deploy clean up equipment.

- Re-fuelling of construction equipment and the addition of hydraulic oil or lubricants to vehicles / equipment will take place in designated bunded areas within the temporary storage yard, where possible, and not on-site.
- All waste oil, empty oil containers and other hazardous wastes will be disposed of in conjunction with the requirements of the Waste Management Acts 1996, as amended.
- All of the construction machinery operating near any watercourse will be systematically checked in order to avoid leaks of oils, hydraulic fluids and fuels.
- Spill-kits and hydrocarbon absorbent packs will be stored in the cabin of each vehicle and operators will be fully trained in the use of this equipment.
- A visual inspection of all watercourses, downstream of the works areas will be conducted daily. The risk of pollution of the watercourses from losses of mortar and concrete must be managed and controlled in accordance with relevant guidelines.
- Any stockpiling of material, top soil or spoil will be within the proposed site compound. All storage and stockpiling of material must be at a minimum of 10m from any surface water drainage on the site. Oil booms will be installed around the dredging area to avoid oil / fuel spillages to enter the aquatic environment. Waste management procedures will be employed to reduce the potential for construction waste to enter the aquatic environment.

Bio-security

- Any plant or equipment that may have worked in environments where invasive species are present shall be suitably cleaned by high pressure hose before being used on site to prevent the spread of invasive species. Water used for this washing process shall always be intercepted and prevented from draining back into watercourses.
- The provisional Invasive Species Management Plan will be updated by the Contractor to form the detailed Invasive Species Management Plan which will form part of the Contractors EOP for the proposed scheme.

Timing of Works

- Instream works will not be undertaken during the times when fish are spawning. The most sensitive period for River/Brook lampreys is the period October to March when they are migrating, and April to June when they are spawning / ova are developing. Lampreys have only been recorded spawning in the upper section of the scheme area (upstream of the existing railway bridge).
- It is possible that Sea Lampreys will not spawn until June/July so will not be fully protected by this window. However, Sea Lampreys were not recorded spawning in the study area during the 2016 survey. If at construction time any Sea Lampreys are spawning in the area, then instream works may have to be delayed. The role of the EnCoW is of importance here to ensure that any spawning activity is detected prior to commencing instream works.
- No salmonids spawned in the study area in 2015/16 as evidenced by the 2016 survey results. However, salmonids will be protected by the statutory close season for instream works to ensure that River Lampreys migrating through the area from October to March are fully protected.
- No instream works will take place after the 30th September each year (as per statutory close-season).
- The timing of works is fundamental in order to avoid impacts on migratory fish in the study area. Table 6-12 below details the migrating and spawning seasons of each species to be avoided. Instream works are permitted from July to September only.

Table 6.12: Details of Migrating and Spawning Seasons to be avoided.

Common Name	Life cycle stage	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
River Lamprey	Upstream migration												
	Spawning and ova development												
	Downstream migration (juveniles)												
Brook Lamprey	Spawning and ova development												
Sea Lamprey	Upstream migration												
	Spawning and ova development												
	Downstream migration (juveniles)												
Atlantic Salmon	Upstream migration												
	Spawning and ova development												
	Downstream migration (juveniles)												
Sea/Brown Trout	Upstream migration												
	Spawning and ova development												
	Downstream migration (juveniles)												
Twaite/Allis Shad	Upstream migration												
	Spawning and ova development												
	Downstream migration (juveniles)												
European Eel	Upstream migration (juveniles)												
	Downstream migration (adults)												
European Flounder	Upstream migration												
	Downstream migration												

<u>Species Specific Mitigation</u>

- Instream rehabilitation / enhancement programme
- Instream works take place outside spawning seasons
- Fish / mussel translocation / salvage programme
- Juvenile lamprey translocation / salvage programme
- De-watering appropriate sections along the river while works are ongoing

- An outline method statement for the translocation of lampreys has been prepared. This will be completed using electrical fishing following standard lamprey survey effort - 1 min per m2. Captured lampreys will be held in oxygenated bins and then transported upstream for released (possibly to areas around Scarawalsh).
- Lamprey salvage will also be undertaken during the works as required. This will involve checking dredged spoil for the remaining lampreys and removing them by hand.

- An instream rehabilitation plan will be prepared to design and re-establish nursery and spawning areas for lampreys in the main channel.
- Other features should be placed all along the river as habitat restoration / enhancement features. Some examples of the types of features that would be included to enhance juvenile lamprey habitats are as follows:
- Root wads
- Brushwood mattresses
- Tree crucifixes

Such features would be put in all along the channel wherever possible – but especially upstream of the railway bridge. These are also suitable for the tidal reach.

- Flow deflectors proposed along the River Slaney will be designed to leave space on the downstream end to allow silt (ammocoete habitat) to develop. These features would also provide daytime refuge areas for migrating lampreys. Small piles of boulders could also be placed into the river at intervals to provide daytime refuge areas, and this would also create habitat for salmonids.
- The development of habitat for juvenile lampreys (eddies, backwaters and associated deposition) will be promoted by diversifying flows within the altered channel prior to removing the impermeable barrier. This will be achieved with the introduction of features such as boulders and deflectors. The location and nature of these features will form part of an overall ecological enhancement plan for the affected reach of the river. Rock, cobble and gravel removed from the river should be stockpiled. Likewise, such substrates should be removed from the riverbed where infilling is proposed, and stock-piled. Where possible, this native material be used to cover the bed of the new channel during rehabilitation works. Any rehabilitation works or design should not feature obstacles that could impede the migration of lampreys, in light of their poor swimming ability. In areas where river widening is proposed, it is recommended that bank profiles be kept low. Low bank slopes are favourable as they are less prone to erosion and allow the accumulation of fine substrates (juvenile lamprey habitat) along the margins. Bank sinuosity is preferable to straight.
- Taking account of their migration from the sea into freshwater in April / May and with spawning / dispersion of larvae extending into June, no instream works should be carried out at these times to avoid disruption. The instream works proposed will result in the removal / infilling of habitats used by juvenile / larval lampreys. In advance of any instream works, juvenile lampreys should be removed from all parts of the river with soft substrates, including silt beds and sandy margins along the margins of the channel. This work would be carried out by electrical fishing where an attempt to remove all lampreys would be undertaken. Juvenile lampreys would be collected ideally during low water, and at low tide within the tidally influenced stretch of the river. It will not be possible to remove lampreys from soft substrates in deeper areas by conventional electrical fishing. In areas where electrical fishing cannot be undertaken, juvenile lampreys could be recovered by sifting through excavated material placed on the riverbank. Juvenile lampreys captured will be translocated to areas upstream to a predetermined area in consultation with IFI and NPWS. The lampreys will be transported promptly in aerated containers and released in suitable habitat. This translocation of lampreys will be conducted by a specialist lamprey ecologist.
- A site-specific maintenance plan should be drawn up to fully take account of the requirements of Lampreys.
- Maintenance of the sediment trap during construction works will be carried out in the dry works area. Site-specific protocols for the management of lampreys will be put in place for

drainage maintenance. Maintenance works will need to be balanced with an instream rehabilitation plan.

Brook Lamprey

- Instream works must take place outside the lamprey spawning season, a juvenile lamprey translocation / salvage programme is to be in place and an instream rehabilitation / enhancement programme that would take the requirements of lampreys into account is established prior to the project being complete. Translocation and instream rehabilitation mitigation is discussed above. Continuous monitoring of water quality and of fish stocks is required to reduce adverse impacts. These mitigation strategies will improve the conditions for all lamprey species.

River Lamprey

- Brook Lamprey are resident in the affected stretch of river, with both adults and juveniles (Lampetra spp.) recorded during the 2016 survey. The recommendations given above for Sea Lampreys would also apply to this species. This species spawns in during the April-June period. Brook Lampreys are widely distributed in the Slaney catchment (Gallagher et al, 2016) and only a very small area of the habitats they used within the catchment would be affected by the proposed scheme.
- It is suggested that instream works take place outside the lamprey spawning season, a juvenile lamprey translocation / salvage programme is to be in place and an instream rehabilitation / enhancement programme that would take the requirements of lampreys into account is established prior to the project being complete. Translocation and instream rehabilitation mitigation is discussed above. Continuous monitoring of water quality and of fish stocks is required to reduce adverse impacts. These mitigation strategies will improve the conditions for all lampreys.

Allis/Twaite Shad

- Although there is no evidence of Allis/Twaite Shad using this section of the River Slaney, necessary migration strategies need to be in place to ensure Allis/Twaite Shad is protected. The timing of the works outside of the spawning season for Lamprey species will also ensure that any Allis/Twaite Shad spawning effort during this time period will also be protected.

Atlantic Salmon

- Adult and juvenile salmon were recorded in the study area during the 2016 aquatic ecology survey. Suitable flow and substrate conditions ideal spawning habitat for salmonids were observed at upstream of Enniscorthy at the upper end of the study area and elsewhere along the River Slaney. Therefore, mitigation measures will be employed to protect this species.

6.6.9.2 Operational phase

<u>Species Specific</u>

Sea Lamprey, Brook Lamprey and River Lamprey

- When maintenance of the sediment trap is to be carried out, it will be done outside of the spawning season as with the construction phase of the project. Before maintenance works, Lampreys will be translocated by a specialist lamprey ecologist. No more than 50% of silt will be removed during maintenance works to ensure some protection of suitable lamprey habitat.

Allis/Twaite Shad

- When maintenance of the sediment trap is to be carried out, it will be done outside of the spawning season as with the construction phase of the project.

Atlantic Salmon

- When maintenance of the sediment trap is to be carried out, it will be done outside of the spawning season as with the construction phase of the project.

Fisheries Redevelopment Plan

- The restoration of the North Island Back Channel is also proposed in an area of low-lying land on the east side of the river. This back-channel restoration project will provide new habitat for aquatic species. This design will include woody deflectors, fish refuge areas, suitable pools and riffle areas for spawning grounds amongst other features. This project will further ensure suitable habitat is created for all aquatic species following the Flood Defence Scheme.
- An instream rehabilitation plan will be prepared to design and re-establish nursery and spawning areas for lampreys in the main channel

6.6.10 Freshwater Pearl Mussel

6.6.10.1 Construction phase

- As the proposed works are not compatible with FPM survival, mitigation for the living mussels currently living within the works area involves translocation to FPM permanent habitat upstream.
- Translocation is a last resort method of mitigation that has a high risk of failure but is the only option for the mussels in these locations. There is strong potential for failure to occur due to circumstances linked to the effects of chronic stress during translocation and establishment phase (Dickens et al. 2010, Teixerra et al. 2007). A protocol for translocation and monitoring is provided in Appendix C.13. An additional stage in the translocation process involves captive breeding a cohort of juvenile mussels from the translocation animals according to the technique of Moorkens (2017). Translocating a higher number of individuals, both juvenile and adult, ensures that the resulting receptor population is significantly higher than the group of donor mussels used. A survey of the potential receptor site has demonstrated its suitability for the translocation of adult and captive bred juvenile mussels. The study for the receptor site suitability is provided in Appendix C.13. Numerous young of the year salmon and trout were recorded at Scarawalsh during the surveys carried out in 2016 (Appendix C.8), which will provide a better salmonid host source than is currently present at Enniscorthy.

6.6.10.2 Operational phase

- The mitigation measures for the operational stage will concentrate on the translocation receptor area/s, to monitor the progress of the receptor site habitats and the adult (and potentially juvenile) mussels. The sites will be monitored for habitat condition, condition and survival of adult mussels, and levels of success of survival of any juvenile mussels in the receptor habitat.

6.6.11 Duck Mussel

6.6.11.1 Construction Phase

- The only mitigation for the few living duck mussels found living within the proposed scheme area is their translocation a very short distance upstream of the highest point of the proposed

works. This is a means of maintaining the distribution of duck mussels in the river as the other known site for the species is downstream in the Oilgate area.

6.6.11.2 Operational Phase

- The mitigation measures for the operational stage will concentrate on the translocation receptor area/s, to monitor the progress of the receptor site habitats and the adult mussels moved, in the context of any wider population present at the receptor site.

6.7 Residual Impacts

6.7.1 Habitats

There are no significant residual impacts on habitats identified within the scheme extent.

6.7.2 Annex I habitats Old Sessile Oak Woodland [91A0]

There are no significant residual impacts on the area of Annex I Old oak woodland.

6.7.3 Annex I priority habitat: Alluvial Woodland [91E0]

There are no significant residual impacts on the area of Annex I Alluvial woodland.

6.7.4 Annex I habitat: Floating River Vegetation [3260]

There will be a short-term negative impact at a local geographic scale on floating river vegetation as a result of disturbance to above-ground plants. However, with the implementation of the mitigation measures, there will be a long-term significant positive impact as a result of recovery of the macrophyte populations and creation of the additional suitable floating river vegetation habitat.

6.7.5 Rare aquatic flora: Callitriche truncata

There are no significant residual impacts on *Callitriche truncata*.

6.7.6 Otter

There are no significant residual impacts on otter populations using the scheme extent.

6.7.7 Bats

There are no significant residual impacts on bat populations using the scheme extent.

6.7.8 Birds

The residual effects on birds would be temporary displacement during works and subsequent riparian and aquatic habitat recovery. This residual effect would be short-term (one to seven years) slight negative. In the medium to long term, residual effects would be neutral.

6.7.9 Aquatic Species

The residual impact to aquatic species would be a minor loss of habitat in the proposed works area. Mitigation measures proposed are considered sufficient to avoid any significant impacts. With the river rehabilitation and the creation of a back channel / distributary channel upstream of the town, suitable habitat will be created for aquatic species to mitigate for the loss of habitat. Residual impacts would be negative.

6.7.10 Freshwater Pearl Mussel

The residual impact to the freshwater pearl mussel would be a loss of range at the lowest part of the Slaney Catchment. As a suitable receptor area not far upstream is suitable for translocation and augmentation with juvenile mussels, the residual impact would be minor negative for the range of mussels in the Slaney main channel, and positive for the genetic exchange with the Derreen River designated SAC sub-population. The positive impact for the SAC population would be due to the enhanced numbers of mussels produced through captive breeding and their location in better habitat than the current donor site.

If the donor mussels are found to be no longer brooding through stress or old age, the captive breeding will not be successful. If so, the residual impact will be neutral, as non-brooding mussels are not contributing to either the population in the Slaney main channel, or to the SAC designated population in the Derreen.

6.7.11 Duck Mussel

The residual impact to the duck mussel would be a loss of range at the lowest part of the Slaney Catchment. If a suitable receptor area not far upstream can be found for the few individuals and augment a site with other individuals, the residual impact would be negligible.

6.8 Monitoring

Post construction monitoring will be carried out to measure the effectiveness of the proposed mitigation strategy and to ensure the mitigation has been implemented by the contractor correctly and in accordance with the mitigation design set out in this document and informed by pre-construction surveys. Monitoring will identify for example where, due to incorrect implementation, failure to achieve the desired outcome has not been reached and where required corrective action will be agreed and executed by the OPW and WCC.

The proposed monitoring measures have been agreed to ensure that the implementation of the mitigation of impacts is recorded and also that any background changes to the attributes of the European Site are taken into account:

- A Water Quality Monitoring Plan will be developed in consultation with the suitably qualified/experienced EnCoW prior to the commencement of works. Daily visual inspections and trigger thresholds will be set up, above these thresholds works will be directed to stop until parameters return to baseline conditions. Weather conditions will be monitored throughout the construction period by the contractor. Works will not be carried out during extreme rainfall or high flow events;
- Monitoring of recovery of FRV vegetation will take place within scheme area. This should be continued until the 2016 distribution FRV is achieved and the vegetation is typical of the 2016 species composition (species and relative abundance). This may require annual surveying for up to and beyond five years as FRV populations can fluctuate otherwise in agreement with NPWS. The newly created areas of habitat will have lower in situ propagule banks and may take longer to recolonise than areas where FRV was previously abundant. At five years post-construction a review of macrophyte recolonisation will be undertaken (species composition, abundance and distribution within the channel). If the vegetation has not shown to be typical of the 2016 species composition during this time, then appropriate action will be taken. This would include a review of potential habitat enhancement options;
- Proven sediment control measures and instream monitoring during construction will be developed as part of a Sediment Management Plan included within the CEMP and implemented accordingly during the works to minimise and contain any silt plumes travelling

downstream when dry works areas are re-flooded. This is to prevent silt travelling downstream and depositing on *Callitriche truncata* sites. This is likely to include monitoring at 500m, 1km and 1.5km downstream of the works, this threshold could be monitored hourly or as frequently as required and works suspended if thresholds are exceeded;

- Monitoring of the three *Callitriche truncata* sites closest to the proposed scheme extent (Bormount House (1, 2) and Edermine Bridge (3)) and the closest site where Callitriche truncata has most recently been recorded (c. 6.3km downstream from the proposed scheme near Jamestown Nature Reserve). The aim is to monitor the condition of the habitat, with particular attention to the presence and abundance of non-native invasive macrophytes and any negative impacts of siltation. The results of the 3 years of monitoring should be used to assess whether further monitoring or management action is required (e.g. if the monitoring shows an unfavourable trend in habitat condition or population) otherwise in agreement with NPWS. This will only be undertaken if pre-construction surveys record the presence of *Callitriche truncata* populations in these sites;
- Although *Callitriche truncata* was not recorded during 2016 surveys, pre-construction surveys up to 2km downstream of the scheme extent (e.g. historic sites at Bormount House and Edermine Bridge) will be carried out to identify any new records of this species within the scheme zone of influence;
- Bi-annual monitoring of area of Annex I habitat type 91A0 adjacent to construction area to assess long-term impacts so that management actions can be undertaken if required (e.g. invasive species removal). This will follow the standard 91A0 habitat condition assessment methodology. This should be undertaken for a minimum of 5 years as some impacts (e.g. spread of invasive species), may not be immediately apparent otherwise in agreement with NPWS. The results of the 5 years of monitoring should be used to assess whether further monitoring or management action is required (e.g. if the monitoring relevé(s) fail or show an unfavourable trend);
- Monitoring and condition assessment of 91E0 woodland and, if necessary, invasive species management. This will be undertaken for a minimum of five years otherwise in agreement with NPWS, as some impacts (e.g. spread of invasive species) may not be immediately apparent. The results of the 5 years of monitoring should be used to assess whether further monitoring or management action is required (e.g. if the monitoring relevé(s) fail or shows an unfavourable trend);
- Monitoring of translocation of FPM will be required, to monitor the progress of the receptor site habitats and the adult (and potentially juvenile) mussels. Initial site receptor surveys in high flow and low flow conditions have been carried out and are provided in Appendix C. The favoured receptor site was found to have suitable locations for the translocation of adult and juvenile mussels. The sites should be monitored for habitat condition, condition and survival of adult mussels, and levels of success of survival of any juvenile mussels in the receptor habitat. If habitat condition is better in some pockets of habitat compared to others, some local movement of mussels may be recommended. If translocated mussels are found to be not brooding, it may be due to the stress of living in sub-optimal conditions in Enniscorthy. Therefore, brooding checks would be carried out after one year in their translocation receptor site, and if brooding, a cohort of captive bred juveniles should be produced and translocated. If mussels are again found to be not brooding after 12 months in the new receptor site, it is unlikely that they will recover and thus no further intervention should be attempted; and
- A detailed monitoring programme to monitor waterbird numbers and distribution will be developed prior to the commencement of construction and will include monitoring of wintering, passage and resident waterbirds otherwise in agreement with NPWS. Grey Heron breeding surveys and monitoring of waterbird movements and flight height at new road bridge will be included in the monitoring programme. Monitoring will continue throughout the

construction phase and for at least one year post construction. A review of the monitoring survey results will be carried out to identify any change in waterbird numbers and distribution using the area, if a significant change is detected appropriate action will be taken.

7 Hydrology and Geomorphology

7.1 Introduction

The proposed flood defence measures have been designed by developing a hydraulic model for the River Slaney to understand the nature and extent of flooding events in Enniscorthy. Any effects of the proposed scheme on the upstream and downstream flooding risk have also been examined through this modelling approach. The proposed alleviation measures have been modelled for the design flood flow of a 100-year return period. The details of this modelling approach and results are given in the 2015 OPW Report on the River Slaney (Enniscorthy Town) Drainage Scheme Flood Study Feasibility Study and the Geomorphological Assessment Report (2016).

The Chapter has been structured as follows;

- **Section 7.2**- Outline the assessment methodology. The section summarises the desktop modelling and baseline surveys that were carried out within the study area;
- **Section 7.3**- Describes the baseline environment within the study area and provides results of the baseline surveys and describes the value of the study area in terms of historic mapping, physical extent of the tidal range, water quality and Water Framework Directive Status, considers the water levels and flows within the river channel and describes the fluvial geomorphology of the River Slaney;
- **Section 7.4**- Provides technical information on the principal elements of the proposed scheme and examines the specific elements of the scheme which might affect hydrology and geomorphology;
- **Section 7.5**- Considers the proposed scheme in terms of cumulative impact on the hydrology of the area;
- **Section 7.6**- Describes the proposed mitigation measures for the proposed elements of the development mitigation measures. Measures that are ‘embedded’ in the overall design of the scheme are already assessed in the impact assessment Section 7.4.; and
- **Section 7.7**- Summarises the potential for significant residual effects.

7.2 Assessment Methodology

This assessment involved desktop research supported by a review of water survey and modelling data. The hydraulic modelling scope facilitates the assessment of impacts on the River Slaney freshwater body only. The development of the scheme has been informed by hydraulic modelling, and geomorphological analysis as described below.

7.2.1.1 OPW Hydraulic modelling

To assess the effectiveness of various flood risk management measures and to determine the impact that these measures could have on river flows, velocities and depths both upstream and downstream of the scheme, the OPW developed a hydraulic model of the Slaney as it flows through Enniscorthy.

The hydraulic model was constructed using the HEC RAS modelling package[35]. The model was constructed using survey data gathered on the existing river channel flood plains and bridge

[35] Hydrologic Engineering Center's River Analysis System

structures in the Study Area. The model extends from approximately 1.5km upstream of Enniscorthy to Edermine Bridge, which is approximately 5km downstream of Enniscorthy. The model was calibrated to known flood events in Enniscorthy. The calibrated model represented the flood extents generated by known flood flows, giving confidence that the model would accurately represent the flood levels and extents generated by more extreme flows.

Extreme flows in the Slaney and its tributaries the Urrin and the Boro were determined using various hydrological methods. These included a statistical analysis of recorded flows at Scarrawalsh, which is located on the Slaney upstream of Enniscorthy, Flood Studies Report (FSR) methodologies and Flood Studies Update (FSU) methodologies (OPW). The extreme tidal levels at Edermine was determined by a statistical analysis of extreme tide levels recorded at Assaly, which is located South West of Wexford Harbour, and deriving a relationship between Assaly and Edermine for extreme tides. These extreme flows and tidal boundary conditions were used to model alternative flood events of varying degrees of probability with reasonable confidence.

7.2.1.2 Geomorphological Assessment

A geomorphological assessment has been undertaken to evaluate the current bed morphology and sediment processes in the River Slaney, and to assess how the proposed scheme will impact these features. A catchment desk top review was carried out. This review included a review of existing reports including information on fluvial geomorphology and catchment characteristics of the River Slaney. In addition, ecological baseline reports were reviewed to help inform the assessment, specifically the aquatic ecology survey and Freshwater Pearl Mussel baseline study. Likewise, a review of current and historical maps of the reach and wider catchment were examined. These include;

- Historic maps information viewed on http://maps.wexford.ie./maps;
- Ordnance survey Ireland maps viewed on http://www.osi.ie

Sediment analysis

Outputs from the design hydraulic model (HEC-RAS) for 1yr and 100yr flow return periods were used to undertake quantitative geomorphological calculations (Hjulstrom curve and Stream power). This improved the understanding of the principles driving current sediment transport processes and patterns in the River Slaney. To assess whether the proposed river bed reprofiling works could significantly change sediment transport through the study reach, the baseline scenario model outputs were compared to the scenario with the proposed flood scheme design in place (i.e. with the amended bed levels and wider cross-section).

7.2.1.3 Field Surveys

Field surveys undertaken to inform the design were reviewed to inform this assessment. These included;

Topographical and River Channel survey recordings

A topographical survey of the study area was carried out to inform the design of the proposed scheme. The scope of the surveys included river channel survey at 200m intervals along the extent of the study area.

Bathymetric Survey

A detailed Bathymetric Survey was carried out within the study area in 2017. The purpose of the survey was to provide an accurate survey of the river bed profile and quantity the volume of material to be dredged. The survey was recorded at 1m grid intervals in both the transverse and the longitudinal sections.

Geomorphological Survey

The geomorphological walkover survey was conducted on the 6-7 April 2017. A 3.5km stretch of the river was surveyed on foot.

7.2.1.4 Evaluation Criteria

The magnitude of a potential impact on morphology would depend upon whether the impact would cause a fundamental, material or detectable change. The impact assessment methodology was adapted from the NRA Guidelines on Procedures for Assessment and Treatment on Geology, Hydrology and Hydrogeology for National Road Schemes (NRA 2009), The assessment also takes into consideration of the guidance set out in the EPA Guidelines on the Information to be Contained in Environmental Impact Statements (draft 2017).

The sensitivity of the baseline environment to each impact has been assessed using a combination professional judgement and predefined criteria as set out in Section 2 of this EIAR. Sensitivity of receptors is categorised in the Table 7.1.

Table 7.1: Definitions used to categorise the sensitivity of receptors.

Receptor Sensitivity	Criteria	Definitions
Extremely High	Receptor has a high quality or value on an international scale	Receptor is a high international ecological value and exhibits a strong hydrological dependence. Receptor is a critical national asset Receptor has sediment regime which provides a diverse mosaic of habitat types, with highly varied morphological features and no sign of channel modification River displays natural fluvial process and natural flow regimes which would be highly vulnerable to change
Very High	Receptor has a high quality or value on a regional or national scale	Receptor is of high ecological importance national and regional value and has a strong hydrological dependence Receptor has an overall WFD status/potential of Good or high Receptor is a public or private water supply Receptor is at high risk from flooding Receptor has sediment regime which provides highly varied habitat types with varied morphological features and very limited signs of modification
High	Receptor has a high quality or value on a local scale	Receptor is of high ecological importance local value and has a limited hydrological dependence Receptor has an overall WFD status/potential of high or moderate Receptor is a public or private water supply Receptor is at high risk from flooding Receptor has sediment regime which provides varied habitat types and appears to be largely in equilibrium. Receptor exhibiting natural

Receptor Sensitivity	Criteria	Definitions
		range or morphological features with limited signs of artificial modification
Medium	Receptor has a moderate quality or value on a local scale	Receptor is at moderate risk from flooding but does not act as an active floodplain Receptor has an overall WFD status/potential as moderate Receptor has sediment regime which provides some habitat types and appears to have some natural processes occurring. Receptor exhibiting some natural range or morphological features with obvious signs of artificial modification
Low	Receptor has a low quality or value on a local scale	Receptor is at low risk from flooding. Receptor is not used for any water supply. Receptor has an overall WFD status/potential of poor or bad Soil type of receptor is not sensitive to changes in the hydrological regime

The River Slaney in Enniscorthy is considered to be of extremely high/very high sensitivity. This is because the River Slaney in Enniscorthy is designated a Special Area of Conservation, however it is noted that the river channel at Enniscorthy has been historically modified and is currently constrained by development on both banks (refer to the River characterising survey).

The criteria for assessing the magnitude of potential impacts are categorised below.

Table 7.2: Definition of effect magnitude

Magnitude of Impact	Definition
Large	Total loss of or alteration of key features of the baseline environment such that post development characteristics or quality would be fundamentally or irreversible changed
Moderate	Loss of, or material change to, key features of the baseline resource such that post development characteristics or quality would be materially changed
Small	Small changes to the baseline resource such that post development characteristic or quality would be materially changed.
Negligible	A very slight change from baseline conditions which is barely distinguishable and approximates the no change scenario. These changes are close to or below the limit of detection

Probability, duration, and proximity to infrastructure would be considered to determine the magnitude of an impact.

In determining significance of environmental effect regard is also made to the EIA matrix as set out in Section 2 of this EIAR.

7.2.1.5 The Study Area

The study area for the purpose of this Chapter considers an area as modelled by the OPW Feasibility Study. This area extends from Edermine Bridge to 1.5km upstream of the Railway Bridge.

This section describes the existing aquatic environment in the study area and assesses the impact the proposed scheme may have on the quality of both surface water and groundwater along with the hydrology and hydrogeological regimes of the study area.

7.3 Receiving Environment

7.3.1 Baseline Conditions

This section describes the baseline conditions within the study area in terms of:

- Historic Mapping;
- River Slaney Catchment;
- Physical extent of the tidal range;
- Water Quality and WFD status;
- Water levels and flow (details on the MHWS and MLWS, locations of gauges); and
- Baseline fluvial geomorphology.

7.3.1.1 Historic Mapping

A review of historic maps (dating to the mid-19th century), reveals that the River Slaney as it flows through Enniscorthy appears to have retained a relatively stable channel form. The river's planform has not changed measurably for the past 150+ years, which indicates at a broad scale that the Slaney has been geomorphologically inactive for this period, although more localised changes in the river bed may have occurred during high flows.

The Slaney's relatively non-dynamic channel through Enniscorthy is partly a product of the bedrock constraints on the right bank of the river. The exposed bedrock outcrop on the outer meander of the channel north of the railway bridge has prevented the channel from migrating to the north-west. In addition to this geological constraint, the limited evidence of channel dynamics indicates a low energy river, primarily due to the very low slope in this part of the catchment. Alluvial floodplain sediments and fluvioglacial terraces in the wider valley indicate the river has been active in the past. Contemporary (present-day) flow and sediment supply is lower, and the channel has reached a state of relative stability or 'equilibrium'

Table 7.3: Historical Map Review

Map	Key features
OS Ireland 6-inch colour 1829 - 1842	• River channel through Enniscorthy is almost identical to present day, no major planform differences • 'Overflow channel' on floodplain just north of Enniscorthy, flowing adjacent to railway line (as it does in the present day) • Mid-channel bar / depositional feature as the river meanders right just north of the town, feature approximately 20/30m upstream of present location
Cassini 1830's – 1930's	• Channel through Enniscorthy retains the same planform features • 'Overflow channel' on floodplain just north of Enniscorthy • Mid-channel bar / depositional feature in same location as present day, but appears as part of the left bank rather than mid-channel • Depositional/marginal habitat feature on left bank north of railway bridge, corresponds with present day marginal reeds • Floodplain on both banks (below confluence with River Urrin) noted as 'liable to flooding'
OS Ireland 25-inch colour 1888 – 1913	• Channel through Enniscorthy retains the same shape and planform features • 'Overflow channel' on floodplain, area where channel splits is 'liable to floods' • Mid-channel depositional feature is not so clearly defined on this map, there appears to be a depositional area/overflow channel on the left bank

Map	Key features
	• Distinctive overflow / cut-off channel on left bank, at southern end of the meander (north of the railway line), this feature can be identified in the present day as a 'dipped' or 'two-stage' part of the floodplain • Floodplain on both banks (below confluence with River Urrin) noted as 'liable to flooding'

Source: Ordnance Survey Ireland GeoHive (2017)

7.3.1.2 Catchment overview

The River Slaney is approximately 120km in length, and drains an overall catchment of 1980km^2[36]. The Slaney rises on the western side of the Wicklow Mountains, with headwaters flowing down from Lugnaquilla Mountain in a westerly direction through the Glen of Imaal towards Knockanarrigan and Stratford on Slaney. After approximately 15km, the river changes direction, flowing south through the towns of Baltinglass and Tullow. As the river flows through Tullow, it is approximately 20m in width and the surrounding land use is predominately agricultural. Between Tullow and Scarawalsh, the River Slaney flows through several towns and increases in size as it picks up flow from five tributaries; the River Dereen, River Clashavey, Derry River, River Clody and River Bann. As the river flows through Scarawalsh, it is approximately 35m in width. South of Scarawalsh, the river flows south, meandering across agricultural land for 6.5km towards Enniscorthy. The last major tributary input upstream of Enniscorthy is the confluence with the River Ballyedmond.

The River Slaney flows through the centre of Enniscorthy Town, where the river bed and banks have been previously modified and substantial parts of the floodplain built upon. At Enniscorthy, the Slaney starts to have a tidal influence. South of Enniscorthy, the Slaney continues to flow and has confluences with two further tributaries, the Rivers Urrin and Boro. Each of these tributaries flow in from the west, transporting water and sediment from the Blackstairs Mountains.

Just over 4km downstream of the confluence with the River Boro, the morphology of the Slaney changes, as the channel becomes significantly wider and partly braided in the more active estuarine zone as it approaches the coast. Along this reach there are multiple in-channel depositional bar features as the tidal influence on flow increases. Just over 30km downstream from Enniscorthy, the Slaney enters a wide estuary and discharges into the Irish Sea at Wexford Harbour.

Land Use

The Slaney catchment is comprised mostly of extensive agricultural land (a mix of both pasture and arable, with more of the former in the upper and the latter in the lower catchment). There are several urban areas, the largest being Enniscorthy in the lower reaches of the Slaney, and Wexford town situated on the estuary. Other urban areas include Baltinglass, Tullow and Kilane.

Based on observations from the upper catchment spot checks, there appears to be high potential for nutrient rich fine sediment inputs into the River Slaney within the upstream reaches, mainly via surface run-off across agricultural land and/or poaching/trampling of banks by livestock. Observations from during the survey and from aerial photography suggests that there are limited buffer strips to reduce fine sediment inputs into the watercourse in the upper catchment, which would benefit reduce sediment transport down to Enniscorthy.

[36] Slaney catchment statistics obtained from http;//www.catchments.ie/data/#/catchment/12

Topography

The Slaney catchment has a varied topography, with mountains in the north and western boundaries. The headwaters of the river form between 600 -800m AOD, flowing west towards Stratford on-Slaney and Baltinglass at approximately 140mOD. By the time the river reaches Tullow, its headwaters drop to approximately 100mOD, and by Scarawalsh its around 50mOD. Through Enniscorthy, and beyond the town the river flows at approximately sea level. It is a further 30km downstream to the sea at Wexford, which means the River Slaney has substantial length where the bed level is at or lower than sea level. This is a major control on sediment transport and geomorphological processes through its lower reaches.

Throughout its course, the River Slaney has relatively limited floodplain extents, partly caused by high ground to the west of the catchment. These conditions mean that the River Slaney is a 'flashy' river that responds quickly to precipitation inputs and has limited floodplain attenuation during flood events.

There are two floodplains within the project study area, namely the North Island and Bare Meadows. The northern floodplain is located on the eastern extent of the River Slaney, upstream of the town. The southern floodplain also located on the eastern extent of the River Slaney. Both floodplains are currently used for animal grazing.

Hydraulic modelling carried out by the OPW indicates currently that both floodplains flood with high frequency. Modelling indicates that in the existing situation (the current baseline), the North Islands floods more frequently than once a year.

Flood hydraulics on the Bare Meadows in the southern floodplain also currently flood with high frequency. Part of this floodplain lies within the northern edge of the Wexford Harbour and Slobs Special Protection Area (SPA) (Site Code: 004076) and it is noted that this floodplain supports a wide diversity of waterbird population. The key habitat features supporting these populations are the wetland habitats in the southern floodplain. The potential for impact on these birds and their habitat is provided in Chapter 6 of this EIAR.

The existing ground level in the Bare Meadows ranges from 0.3-3.2mOD. The lowest point on the floodplain is in the centre, where there is generally water standing year-round. This wet land feature is illustrated on the OSi mapping for the study area. An existing channel drains the Bare Meadows, this channel discharges at the downstream end of the Bare Meadows. The ground level rises to the east and west from the centre of the floodplain. At the existing river bank the levels varies between 1.8m and 2.5mOD. The predicted flood level at the Bare Meadows for the existing scenario for the 1 in 1-year flood event at this floodplain is approximately 2.2mOD. When the water level in the River Slaney rises during a flood event, water flows back up the drainage channel into the Bare Meadows and floods out into the Bare Meadows outwards from the low point in the centre of the floodplain. This flow mechanism ensures, that during a flood event, the water level on the Bare Meadows will equal the level in the River Slaney at the discharge of the drainage channel. During the existing scenario, in a flood event, the hydraulic gradient in the River Slaney is such that the low point in the Bare Meadows will have a water level of 170mm below that of the River Slaney until the flood passes over the river bank and flows into the Bare Meadows. This situation is currently predicted to occur in a 1 in 1-year flood event. It is also noted that this reach of the River Slaney is subject to tidal influence. Currently, during a low flow condition the sea level at Wexford dictates the water level in the River Slaney and at the Bare Meadows. The tidal range is discussed further below.

7.3.1.3 Tidal Range in Enniscorthy

The tidal and freshwater boundary defined under Section 10 of the Fisheries (Consolidation) Act 1959, is the Old Bridge in Enniscorthy. The water level record at Enniscorthy Bridge confirms that the River Slaney is tidal at Enniscorthy. During high tides, the river discharge can be delayed in moving downstream, with a degree of a tidal 'impounding' effect through Enniscorthy. Due to its salt content, seawater is heavier than freshwater water, and as a consequence, tidal waters force the freshwater to run on top and therefore, at a higher level it would otherwise need, i.e. it reduces channel efficiency. This effect has been linked to flooding when high tides coincide with a large river flow.

Detailed examination of the record of 250 fluvial and/or tidal events carried out by OPW, found tidal influences in the flow record up to a level of 3.56mOD. The low tide at Enniscorthy varies between -0.75m- and -0.2m. this gives an estimated low flow depth of between 0.6m and 1.1m at the lowest point of the River Slaney at Enniscorthy bridge. A typical high spring tide is 0.75m AOD. As the influence of tide and flow dictates the river level in Enniscorthy there is no "normal" river level but if you used the high neap tide level as an indication of a normal level then the entire reach of the Slaney between Chainages 6500 and 4725 would have a depth of less than 1.5m at high neap tide. Between chainage 4725 and 4400 the depth at high neap tide would be between 1.5m and 1.63m.

As the flood water levels increase, the hydrograph record shows that the tidal effect gets smaller, and became almost unnoticeable, at levels approaching 3.56mOD. Consequently, the effect of the tide at Enniscorthy does have a definite upper limit and this is less than 6.2mOD. By comparison, extreme river floods reach levels significantly higher than this tidal limit of 3.56m OD, the 1965 flood reached 6.23m OD, the November 2000 event reached 4.91mOD, and the December 2015 event reached 4.5mOD.

History of Flood Events in Enniscorthy

Over the years the town has experienced significant infrequent flooding, the most recent flooding event occurring on 30 December 2015. The town has suffered from at least five significant flood events in the last century, these occurred in 1924, 1947, 1965, 2000 and 2015.

The most recent flood event occurred in 2015. Hydrograph data obtained from Hydrometric Station 12002 at Enniscorthy Bridge recorded a peak water level of 4.464m at 13:00 hours. This water level corresponds to that level predicted to occur during a return period of 8-year event. The peak flow is estimated to be approximately 372m^3/s.

Figure 7.1: 2015 Flood along Shannon Quay

Source: Skypix.ie

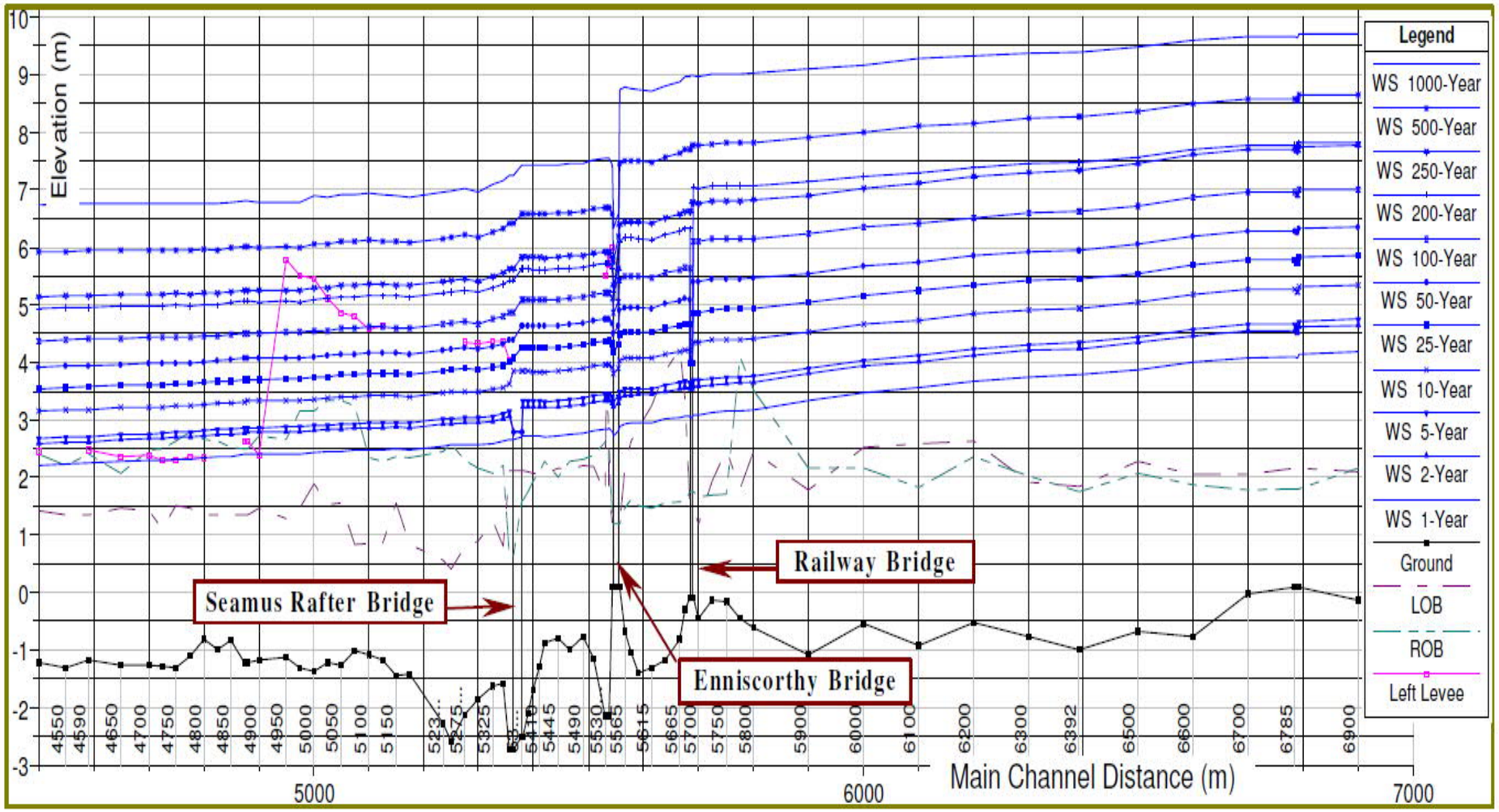
The peak flow of the 100-year hydrograph at Enniscorthy, is estimated to be 515.9m^3/s. The 1965 peak flood flow is estimated at 535.1m^3/s, and the November 2000 peak flood flow is estimated to be 404.3m^3/s. it has been estimated that the November 2000 event has a return period of 1 in 37 years, and the 1965 flood's return period is 115 years. Table 7.4 below presents the return period flows predicted for 1-year to 500-year events, and Figure 7.2 presents the water level estimates predicted for the return period flood flows in the current scenario pre-works. The proposed scheme is designed in line with OPW best practice to fully achieve the required standard of protection for the 1% AEP fluvial event (100-year flood event), with a peak flow of 515.9m^3/s at Enniscorthy.

Table 7.4: Return Period Flows on the River Slaney at Enniscorthy

Return Period (Years)	Predicted Peak Flows at Enniscorthy (m^3/s)
1	195.0
2	238.2
5	249.0
10	312.8
25	372.8
50	434.2
100	**515.9**
200	623.7
250	665.3
500	820.9

Source: OPW Engineering Report 2016

Figure 7.2: Estimates of the predicted Return Period Water Level Profiles through Enniscorthy in the current scenario pre works



Source: OPW Engineering Report 2015

7.3.1.4 Water Quality

The River Slaney (EPA code 12S02) catchment is located in Hydrometric Area 12 in the South-Eastern River Basin District (SERBD). The River Slaney flows through the towns of Baltinglass, Rathvilly, Tullow, Bunclody and Enniscorthy. The River Slaney has several tributaries including the Carriggower, Deereen, Derry, Clody, Bann, Urrin, Clonmore, Ballyvoleen and the Boro which collectively drain a catchment of 1631km^2 (O'Reilly, 2004).

Downstream of the Railway Bridge, the River Slaney enters a 19km long estuary before discharging into Wexford Harbour at Wexford Town. This transitional water is dived into the Upper Slaney Estuary (Code IE_SE_040_0300) and the Lower Slaney Estuary (Code IE_SE_040_0200). The Upper Slaney Estuary waterbody is a transitional waterbody and has been assigned good status for the period, while the Lower Slaney Estuary (Transitional) is assigned poor status.

The Wexford Harbour Waterbody is a coastal waterbody and has been assigned moderate water status for the period 2010-2015.

Both waterbodies are identified as protected areas, as they lie within the River Slaney Valley Special Area of Conservation (SAC), Wexford Harbour and Slobs Special Protection Area (SPA).

The 'Upper Slaney Estuary' waterbody is also identified as 'At Risk', which indicates that the waterbody is at risk of deteriorating or being less than 'Good' status in the future. Although there is no specific reason stated for the waterbody being 'At Risk', the 'oxygenation conditions' were assessed to be 'moderate' under the 2010-2015 WFD classification phase. The 'Slaney 170' waterbody is not identified as 'At Risk', but the 'dissolved oxygen' element was assessed as a 'fail' in the 2010-2015 WFD classification phase, whilst 'nitrate' and 'nitrogen conditions' were assessed to be 'moderate.

Table 7.5: WFD status

Waterbody name and ID	Type	Protected area?	WFD risk	WFD status (2010- 2015)
Slaney 170 IE_SE_128022300	River	Yes	Not at risk	Ecological status - good Chemical surface water status - good
Upper Slaney Estuary IE_SE_040_0300	Transitional	Yes	At risk	Ecological status – good Chemical surface water status – good

Source: www.catchments.ie

Chapter 6 – Biodiversity of this EIAR assesses the ecological sensitives of the River Slaney. It is noted that the footprint of the proposed scheme provides an important habitat for River Lamprey (a key conservation interest for the River Slaney Valley SAC). Adult and juvenile salmon were noted to be present in the river. The results from the River Hydromorphology Assessment Technique, (RHAT) undertaken by the project ecologist noted that the river has been modified within the study area, and that there are some areas of erosion upstream between Clohamon and Enniscorthy. It was also noted that a major source of silt and fine sediments in the river are from farming activity within the upper catchment.

7.3.1.5 Baseline fluvial geomorphology

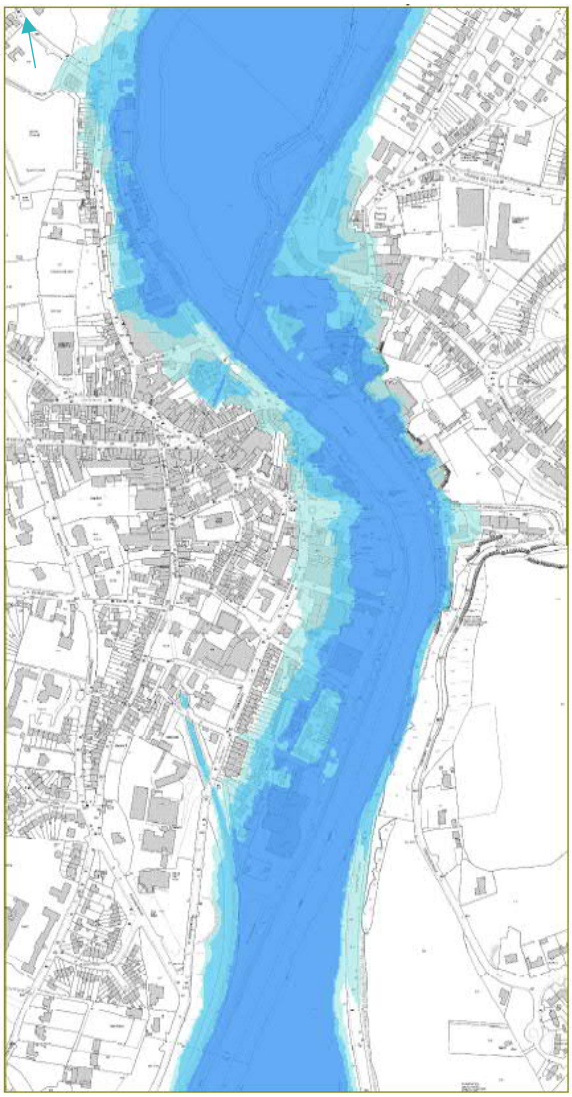
The River Slaney through Enniscorthy is considered to be a low to moderate energy system. This is due to the river's relatively straight planform and shallow long profile along this reach.

Limited erosion activity appears to be occurring within the study reach. However, the Slaney is also relatively confined within its valley, which means that it responds quickly and with high energy during flood events and is therefore capable of transferring considerable amounts of sediment through the Town during flood flows when the entire valley bottom is inundated. A summary of the baseline geomorphological features and processes observed during the walkover is provided within the Geomorphology Study in Appendix D.

7.3.2 Do-nothing Scenario

In the do-nothing scenario, the existing river channel would remain as it is. Maintaining the present-day condition is to accept risk of flooding in the town. The estimated extent of the 1 in 100-year flood event envelope is shown in the Figure below.

Figure 7.3: Estimated outline of flood envelopes using the major flood profiles in Enniscorthy (1 in 100-year event shown in light blue, 1 in 1000-year event shown in aqua blue)



Source: OPW Engineering Report 2016

When considering the effects that the proposed scheme might have on both short term and long-term river hydrology and geomorphology in the Slaney, specific elements of the scheme which might affect hydrology and geomorphology have been assessed. These are:

- Pre-construction enabling works forming dry works areas in the channel;
- Reprofiling the riverbed / modifying the bed slope;
- River widening plus creation of a sediment trap and debris trap;
- Bridge removal; and
- Water quality.

7.4 Assessment of Impacts

7.4.1 Construction Phase

The deepening of the channel bed has the potential to generate silt and suspended solids during the works. In order to reduce the risk of discharging sediment into the Slaney during the river dredging and widening operations, it is proposed to carry out all of these works in a dry works area. The dry works area will be formed by isolating the works area from the Slaney by installing an impermeable barrier between the flowing river and the works area. No more than 50% of the river channel width will be impacted by the dry works area at a time. Water pumped from the dry works area will be treated to remove sediment prior to discharging this back into the Slaney. The existence of a temporary impermeable barrier within the channel, will have a direct impact on the cross section of the channel and is expected to give rise to localised changes in water depth, velocities and sediment erosion/deposition. These changes are expected to be temporary and the effects are expected to be confined to the study reach only.

The magnitude of temporary works impact is determined primarily from assessment discussed in Section 7.4.3 below. The assessment considered two scenarios, during a normal and high flow boundary condition. Under normal conditions, the River Slaney is a low energy river; a product of its relatively straight planform and shallow long profile. This is reflected in minimal erosion or other geomorphological activity occurring in the river. This is different during flood conditions, as the River Slaney responds quickly and with high energy because it is confined within its valley and has limited floodplain extents. The installation of the impermeable barrier within the river channel will have a direct impact on the cross-section profile of the river, it is also expected to mobilise fine sediments within the water column during high flow events and will result in deposition of bed sediment downstream of the works area. It is also worth noting that the bottom materials in this stretch are generally coarse with cobbles, gravels and coarse sands very prevalent. Having regard to the Hjulstrom analysis and sediment analysis deposition of the sediment is predicted to be localised and expected to settle just downstream of the works area at a maximum 500m -2km downstream, fine (silt-sand) sediments are consistently transported by the river. As such, under average conditions the magnitude of impact is considered moderate resulting in an effect of moderate/major adverse significance. The removal of the barrier has the potential to increase the turbidity levels downstream of the works areas. This increase is considered to be temporary and flushing would occur and, as such, the magnitude of impact is considered minor, the resulting effects are not considered significant.

During larger flows, some gravel may be transported, but the analysis completed suggests that once deposited the river will only have energy to move it again in very significant flood events. The proposed works are scheduled within the summer time and it is considered that the probability of such flows occurring is low, and would be of short duration if they did. As such, the magnitude of impact is considered low adverse impact resulting effects are not significant.

Risk to the North and Southern Floodplains

It will be necessary to transport excavated material from the areas upstream of Seamus Rafter bridge to the North Island where it will be placed in the North Island deposition area. To facilitate the construction of the permanent deposition of material on the north island, topsoil from the designated area will be removed in a phased approach and placed in temporary stockpile. Depositional material will be placed on exposed subsoil and compacted with compaction plant (roller). The volume of material to be deposited on the north Island is approximately 71,343m^3. The depositional zone is expected to be engineered with a 1:2 slope approximately 1.5m above the existing ground levels. Approximately 100,000m^3 of material will also be disposed off-site at a licenced facility.

The site enabling works will potentially lead to exposure of bare ground and the potential for generation of silt laden run off in works areas along the river bank. The management of the depositional zone and temporary works areas during construction phase to prevent siltation through runoff will be required. Deposition of material will only commence following the establishment of the dry work area along the eastern side of the River Slaney. The bank along the eastern section of the River Slaney will be prepared, topsoiled and seeded first. Following this, work will progress eastwards towards the centre of the island. This approach will ensure the establishment of material adjacent to the River Slaney in the first instance prior to removing the impermeable barrier and commencing works on the western side of the River. As such, the magnitude of impact is considered medium adverse resulting in moderate significance of effect.

Material excavated from the areas downstream of Seamus Rafter Bridge that are potentially contaminated by invasive plant species will be transported to the North Island for treatment in accordance with the Invasive Species Management Plan. The other material excavated from the areas downstream of Seamus Rafter Bridge will be taken off site for disposal to a licensed facility via the Bare Meadows and the N11.

As noted previously, the River Slaney lies within the River Slaney Valley SAC (Site Code 000781) and part of the Bare Meadows lies within the northern edge of the Wexford Harbour and Slobs SPA (Site Code: 004076). Baseline ecological surveys concluded that the entire Bare Meadows support a high diversity of waterbird species that are conservation interests of the SPA. Access to the Bare Meadows will be required to facilitate the construction of the new bridge and for ingress and egress of the instream works downstream of the Seamus Rafter Bridge.

The proposed works are not anticipated to alter the hydromorphology of the Bare Meadows. Numerous substances used on construction sites have the potential to pollute water if not properly managed and treated. Such substances include fuels, lubricants, cement, silt and other substances which arise during construction. Accidental spillage or leakage of fuel or oil has the potential to contaminate soils, groundwater and surface water. Such substances entering the watercourses could damage habitat and local populations of fish, birds and aquatic invertebrates. The potential impacts are discussed in Chapter 6 of this EIAR.

The potential risk of flooding in the town during construction is addressed in Chapter 5 of the EIAR. To facilitate the construction of the proposed scheme, advance relocation of the public water and sewer pipes along the quays will be carried out. The relocation of water services (public water and foul waters) has the potential to generate large amounts of suspended sediment during their insertion, unless adequately mitigated.

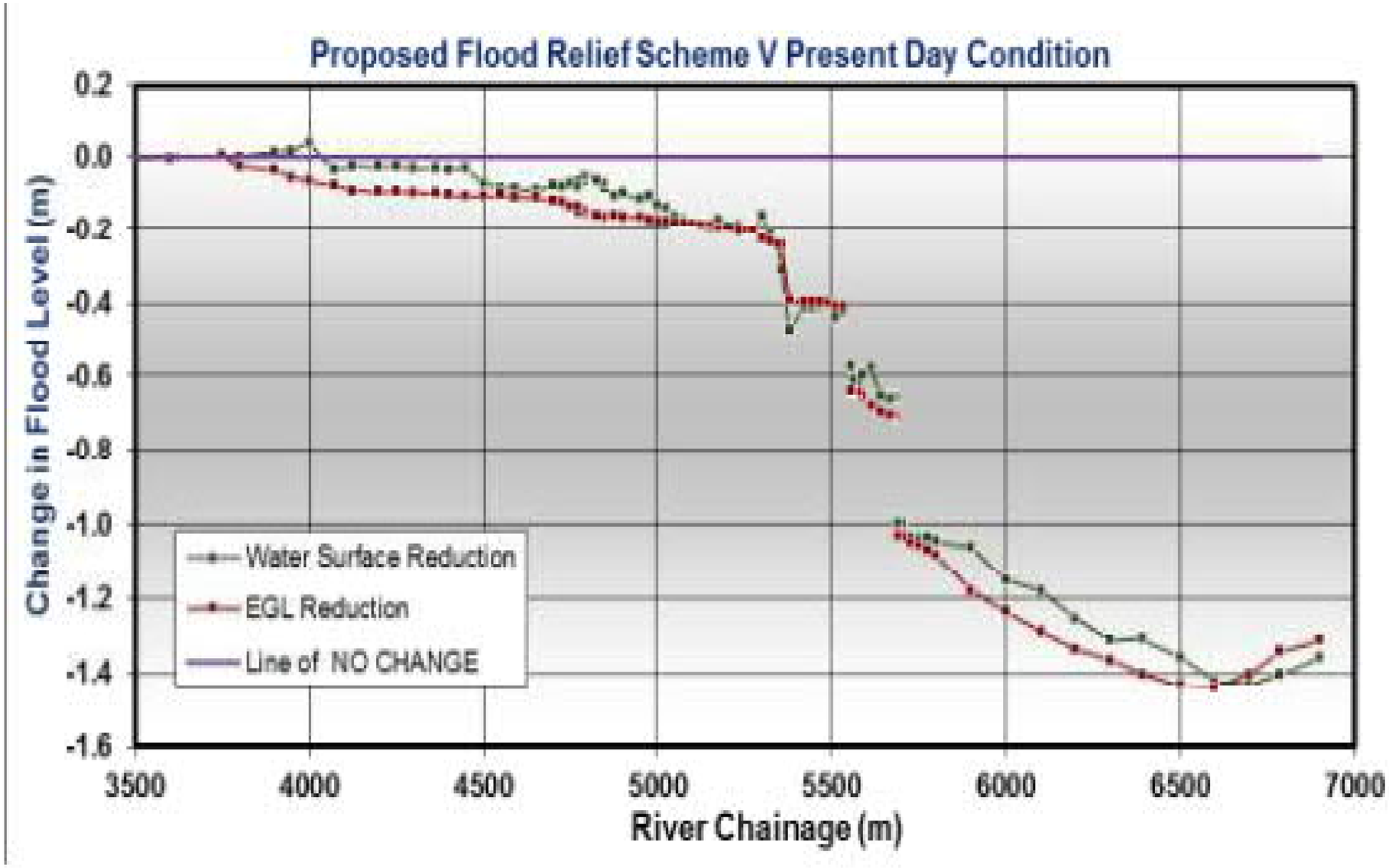
7.4.2 Operational Phase

The principal impacts during operation are those that the scheme has on changes to water depths and velocities. These will be permanent. Changes to water levels and velocities may result in changes to sediment erosion and deposition. The significance on ecological receptors is assessed in Chapter 6 Biodiversity. The potential impacts due to changes in the morphology of the river are discussion hereunder;

Flood Levels

Following the completion of the scheme, between 1m and 1.5m of gravel deposits will have been removed from the river bed upstream of both Enniscorthy Bridge and the Irish Rail Bridge. These works will reduce river levels upstream of Enniscorthy Bridge for the full range of flood flows considered. In Figure 7.4 which shows the surface of the water for 1 in 100-year event both prior and post the construction of the scheme, the flood level has been reduced by 1-1.5m. It also shows that the removal of Seamus Rafter Bridge will lead to a 0.4m reduction in flood level at this location. Downstream of Seamus Rafter Bridge the impact that the scheme has on flood levels reduces. During the 1 in 100-year event predicted flood levels are reduced by between 0.2m and 0.1m over the length of the river widening. Downstream of the river widening the impact that the flood scheme has on the 1 in 100-year flood level is negligible. It is predicted that as a result of the scheme, the peak flood level at Edermine Bridge will increase by 6mm during the 1 in 100-year event.

Figure 7.4: Estimates of the predicted Water Level Profiles for current situation vs post works



Source: OPW Engineering Report 2015

Flow velocities – flood conditions in Enniscorthy and downstream

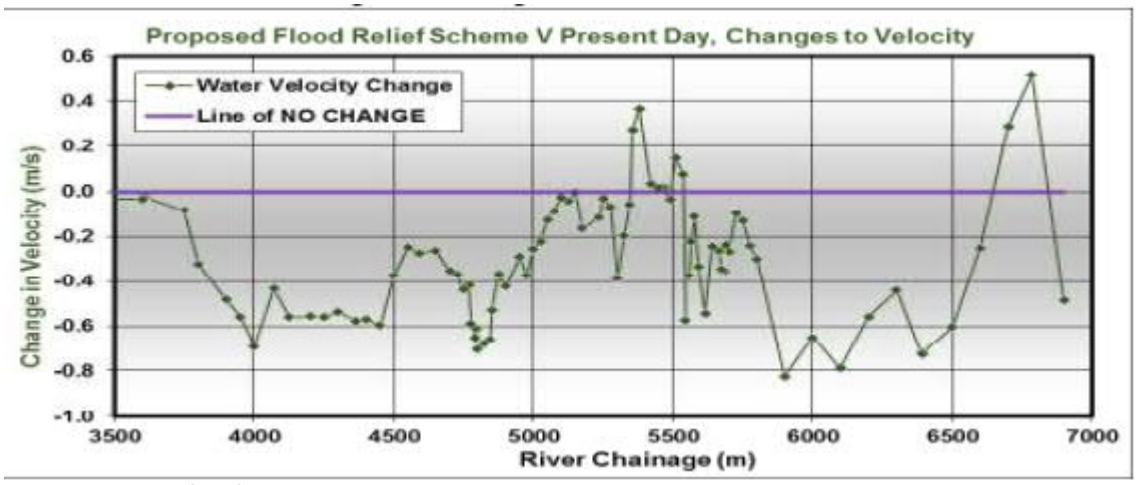
The hydraulic model was used to determine flood velocities likely during various events and to determine the impact that the various flood risk management measures could have on river velocities and depths upstream and downstream of the proposed scheme.

The model predicted that during a 1 in 100-year event, in the pre-works scenario, the highest velocity of 2.5m/s is under Seamus Rafter Bridge where flow is forced through the bridge opening under pressure. Similarly, the velocity is predicted to be 2.2m/s at Enniscorthy Bridge.

In the open sections of river channel, the velocities are lower. Between Enniscorthy Bridge and Seamus Rafter Bridge the velocity is predicted to be approximately 1.9m/s and downstream of Seamus Rafter Bridge the velocity is approximately 1.8m/s. Following the construction of the proposed scheme it is predicted that velocities will generally be lower during the design event. For example, the velocity where Seamus Rafter Bridge was changes from 2.5m/s pre-works to 2.1m/s post works

Figure 7.5 below captures the change in mean channel velocity along the scheme as a result of the works during a 1 in 100-year event.

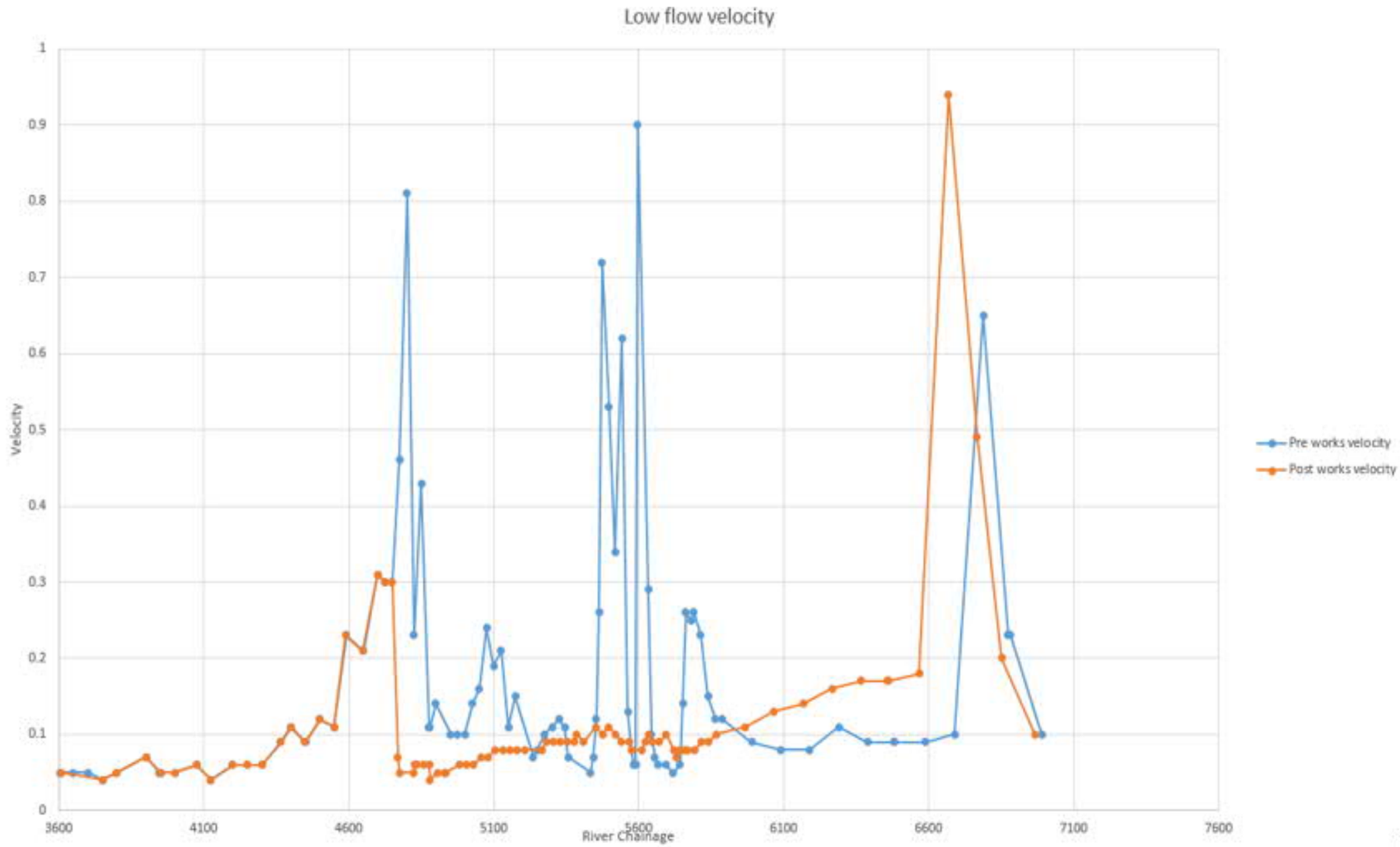
Figure 7.5: Change in velocity for the 1 in 100-year event.



Source: OPW Engineering Report 2015

The graph in Figure 7.6 captures the average low flow velocity along the scheme. The graph illustrates the difference between the pre and post works scenarios. With the scheme in place, it is predicted that there is negligible/ low difference in velocities during a low flow scenario. In the open sections of river channel, the velocities are predicted to be less variable, however the differences are expected to have a minimal change downstream of Seamus Rafter Bridge. Most of the predicted changes in velocity are considered minor and, changes in velocity will become less pronounced as the tide rises and fills the river channel. This is to be as expected with the wider cross-section and more gradual bed slope.

Figure 7.6: Average flow velocity levels during a low flow condition pre and post works.

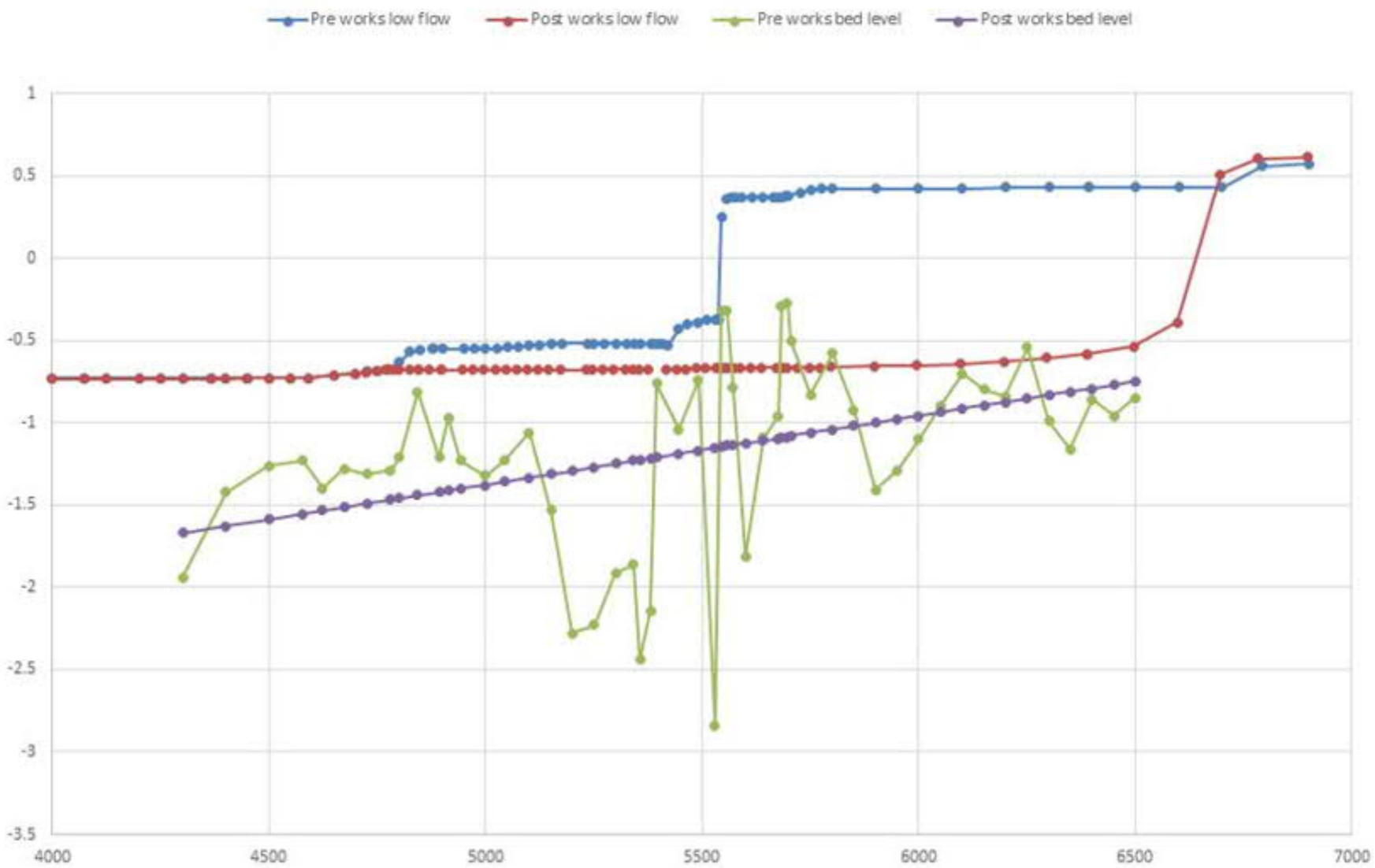


The proposed scheme requires interventions by means of underpinning the existing bridges. The dredging required for the proposed scheme could give rise to an increased risk of scour to the remaining bridge structures in the River Slaney. This arises at the river bed level at these structures which are being lowered by between 1 and 1.5m exposing the piers and foundations of these structures to scour forces during high velocity flow events. In order to mitigate this risk, it is proposed to construct scour protection aprons at the bridge locations. These concrete structures will span between the piers and abutments of the bridge structures and will prevent high river velocities from scouring the river bed and exposing the foundations of the bridge to damage.

Flow Level in Low Flood Condition

Figure 7.7 below captures the impact that the scheme could have on levels during a low flow event. This is based on a $2m^3/s$ event which corresponds with the drought experienced in the Slaney during the 1970s. Having the regard to the graph, it is apparent that the scheme will reduce low flow water depths by up to 1m upstream of Enniscorthy Bridge. Pre-works, it appears accretions of gravel deposit at the Old Bridge in Enniscorthy currently act an obstacle to flow. It should be noted that the tidal and freshwater boundary is currently at the Old Bridge in Enniscorthy and changes in low flow levels will become less obvious as the tide rises and fills the river channel up to high tide level, which is typically 0.75m AOD. It is considered that the possibility of such low flows occurring is low and would be of short duration if they did occur. As such, it is noted also that post works, there is negligible change in the low flow river conditions from upstream of the Bare Meadows Floodplain (river chainage 4750) onwards. It is also noted that changes in water level will become less evident as the tide rises and fills the river channel downstream of the Rail Bridge.

Figure 7.7: Predicted water levels during a low flow conditions pre and post works



7.4.2.1 Sediment Transport Analysis

An analysis of sediment transport processes in the River Slaney was undertaken using two simple geomorphological techniques; the Hjulström curve and stream power analysis. These methods were used because they use a combination of field observations and hydraulic model data inputs without requiring additional sampling and are based on straightforward principles of flow velocity and river energy and their effects on sediment transport.

The Hjulström curve analysis provides a semi-quantitative description of sediment erosion, transport and deposition processes depending on grain size and velocity, and the stream power analysis provides a semi-quantitative assessment of energy available in the channel to erode/deposit sediments.

The results from these simple geomorphological methods can be used to assess:

- Current sediment transport processes in the river; and
- Whether these processes could be significantly affected by proposed riverbed reprofiling.

To conduct the analyses, quantitative data for relevant parameters was obtained from the HEC RAS hydraulic model. The output values from this model are averages for each cross-section so they do not show variations in velocity from the centre of the channel compared to the banks. Data for thirteen model chainages within the scheme extent were used, including locations of most potential sensitivity to bed level changes.

Sediment transport does not usually occur during low flows, as the volume and speed is not competent to erode and transport particles from upstream. There is no model information available for velocities at low flow, therefore this assessment has not considered low flow scenarios.

7.4.2.2 Hjulström Curve Analysis

To determine indicative thresholds for erosion, transport and deposition, the Hjulström curve has been used. The Hjulström curve indicates an empirically evidenced relationship between sediment particle size and flow velocity, based on limited field observations. The curve provides a simple way of indicating if a river is likely to erode (entrain), transport (in suspension or bedload) or deposit various size particles at any given velocity.

To conduct the Hjulström curve analysis, velocity data was reviewed, and for the 1yr and 100yr flow return periods. These events provide an indication of a high but relatively frequent ‘in-bank’ flow (1yr), that can be most relevant for sediment transport, and also a very large flood event (100yr). As a method of validation, observations of sediment size from the geomorphology walkover survey were compared to the Hjulström analysis results to ground-truth the findings.

The results from the Hjulström curve analysis are provided in the Appendix D. Model results show velocity in a typical range of 1 to 1.5 m/s^{-1}, which falls within the zone of transport for particles <3mm and deposition of sediments >3mm. This suggests that gravel particles are likely to be deposited on the river bed through Enniscorthy, if flows have been sufficient to provide inputs from upstream. Notably, according to the Hjulström curve, no erosion is predicted to be active within this range of velocities.

Comparing pre and post works, most of the modelled changes in velocity predict a minor decrease in flow speed post works, as to be expected with the wider cross-section and more gradual bed slope. Two areas with a potential increase in velocity post works occur at the upstream extent of the scheme (>0.53 m/s^{-1} increase in velocity), and between Enniscorthy and Seamus Rafter Bridges (up to 0.35 m/s^{-1} increase in velocity). This is primarily as Seamus

Rafter Bridge would be removed, so it would no longer act as a constraint to flow. In all cases, the increases in velocity are less than 1 m/s^{-1} and are not predicted to result in significant erosion or transport of gravel-sized sediments.

7.4.2.3 Stream Power Analysis

To assess the energy available for sediment transport (erosion and deposition) in the river, stream power analysis has been used. Stream power is a critical geomorphic variable that uses parameters to calculate the 'energy' available within a river. Stream power is therefore an indicative measure of the rate of energy available to a river to overcome friction and transport sediment. The unit stream power is usually used for discussion, as this allows the stream power to be related directly to channel width.

In addition to velocity, other data from the HECRAS model used for the stream power calculation included:

- Bed gradient
- Estimate of 'bankfull' flow
- Peak water level
- Water surface slope

The bankfull discharge required for calculation of stream power was approximated to the 1-year return flow (volume of flow expected to happen on average once a year). This is the lowest of the modelled flow scenarios. This was checked by comparing the water level with the cross-section capacity, and for most cross sections this seemed to provide a reasonable approximation of a high 'in-bank' flow.

Average stream power values provide a useful comparison to other studied rivers and published literature[37] [38]. Research indicates that many lowland rivers are geomorphologically 'inactive', with insufficient stream power to significantly erode their banks and bed. They are likely to have stream powers ranging from 1 – 60w/m^2 (with a 15w/m^2 median). Higher stream powers indicate a more active, energetic condition with rivers usually undergoing some forms of 'erosive adjustment'. Brookes (1987) conducted a series of experiments on channel adjustment in England and Wales, finding that rivers with 'low' stream powers most often had values lower than 35w/m^2.

The results from the stream power analysis is provided in the Appendix D of the EIAR. For the pre-works (current) condition, specific stream power ranged from 12 – 66 w/m^2, with the average value at 30 w/m^2. For the post-works (post reprofiling) condition, specific stream power ranges from 0 – 59 w/m^2, with the average value at 16 w/m^2. In both sets of data, there is only one location with a high enough predicted stream power indicative of potential erosion, all other values indicate low energy areas where deposition is likely to dominate. This explains the observations of it being largely inactive in terms of present-day geomorphological adjustment, and the findings correspond well with the Hjulström analysis.

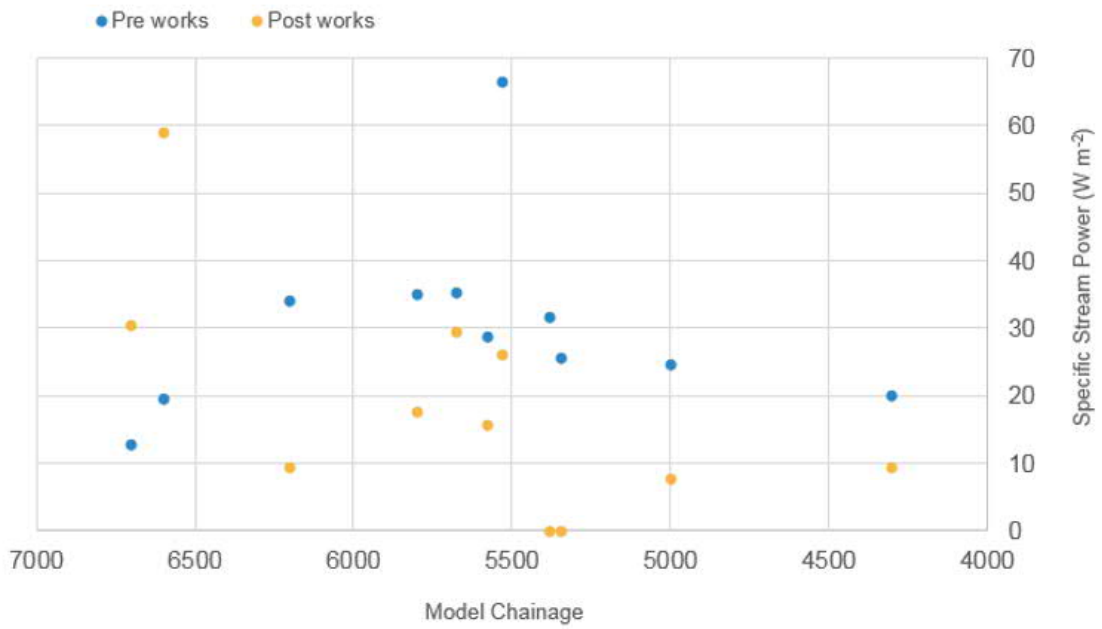
Figure 7.8. illustrates the comparison stream power values for pre and post works conditions. There is a clear predicted decrease in stream power after river bed re-profiling. These results are in line with what would be expected, indicating that river bed reprofiling (deepening and smoothing out high and low points in the channel) will reduce the river's energy as it flows through Enniscorthy.

[37] Ferguson, R.I (1981) Channel form and channel changes, in Lewin J (ed) British Rivers, George Allen and Unwin, London. Chapter 4, 90-125

[38] Brookes, A (1987) River channel adjustments downstream from channelization works in England and Wales, Earth Surface Processes and Landforms, 12: 337-351

There is one location with a predicted increase in stream power, at the upstream extent of the model at nodes 6700 and 6600. This is in the area around the existing large mid-channel bar feature. There is a naturally steeper bed slope in this reach of the channel and if the model bed levels are accurate the level drops by nearly 1m over a short distance. Bed reprofiling immediately downstream would increase the water surface slope in this location, with a corresponding increase in stream power. This was considered when designing the proposed upstream sediment trap deposition area, thereby ensuring that it is as effective as possible.

Figure 7.8: Stream power analysis results



Source; Mott MacDonald 2018

Under average flow conditions, the River Slaney is a low energy river; a product of its relatively straight planform and shallow long profile. This is reflected in minimal erosion or other active geomorphological activity occurring in the river, as there is little energy to conduct geomorphological 'work' in terms of erosion or transport of sediment. This is different during flood conditions, as the Slaney responds quickly and with high energy because it is confined within its valley and has limited floodplain extents.

The 'flashy' nature of the Slaney catchment means that the lower reaches of the river are liable to flooding within its limited floodplain, which means that floodplain flows can be fast and deep. This contrasts with typical flow conditions when the river is largely inactive. Due to the increase in flow and energy during flood events, there is some potential for sediment transport and resulting geomorphological changes to occur, although recent evidence for this was limited during the geomorphological survey.

The Slaney's planform has remained consistent over the last 150 years and it is considered to be in a state of equilibrium (i.e. it does not have either an excess or starvation of sediment supply compared to its discharge).

Sediment transport patterns and processes are a direct product of the amount of energy the river has during normal flow conditions. Stream power calculations demonstrate that the Slaney has a low amount of energy and there is minimal erosion in the channel because of the low

energy and characteristically low flow velocities that occur. During the walkover survey, observations of relatively consolidated gravel – indicating an armoured or imbricated bed - were made (embedded larger gravels covered with dark weeds/moss) indicating that the sediment has been stable for some period of time, and also that there has been limited recent fresh gravel transfer from upstream throughout the reach.

In terms of sediment transport and deposition, both visual survey observations and sediment transport analysis indicate that only fine (silt-sand) sediments are consistently transported by the river. During larger flows, some gravel may be transported, but the analysis completed suggests that once deposited the river will only have energy to move it again in very significant flood events. The velocity range for current conditions in large flows is 1 to 1.5 m/s^{-1}, which suggests that particles <3 mm will be transported, whilst particles >3 mm will be deposited. These values indicate that gravel particles (c. 10mm - 100mm) will be deposited on the river bed through Enniscorthy, as observed during the survey.

There are no significant impoundments or diversions of flow proposed as part of the proposed scheme and as a result the flow in the Slaney post scheme is not reduced. In fact, the removal of parts of Enniscorthy Town from the flood plain is predicted to increase peak flows by a small amount. This is predicted to be 1.67m^3/s or 0.3% of the peak flow.

The proposed scheme will remove some accretions of gravel that have been deposited upstream of the existing bridges in Enniscorthy. It will also apply a uniform gradient to the river bed where it is above the design bed level. Locations where the existing river bed is lower than the design level will remain as they are. The result of these works is that the depth of water in the Slaney will be lower than it currently is for a range of river flow events. The removal of the deposits of gravel at the bridges means that the level of the river will be reduced by approximately 1m upstream of Enniscorthy Bridge. Downstream of the Bridge the level will decrease by approximately 300mm and downstream of Seamus Rafter Bridge the low flow level will decrease by approximately 150mm. These decreases on water level will become less pronounced as the tide rises and fills the river channel downstream of the Rail Bridge.

In summary, the magnitude of impact that the proposed works will have on sediment transport processes in the River Slaney are considered to be low, resulting in a slight adverse significance. This is primarily because the river is a low energy river with very limited geomorphic activity occurring under current conditions, and the proposed works will not substantially change this characteristic.

There is potential for localised changes to existing erosion and deposition processes, given the significant change to the long-profile of the river by re-profiling. However, the potential changes to erosional processes are negligible under normal flow conditions, and only minor changes are likely to occur during significant flood events (1 in 100yr events) and as such is not considered to be significant.

There is potential for deposition to occur following bed reprofiling and due to the inherent controls on flow due to tidal levels. Observations suggest that upstream supply of coarser sediments through to Enniscorthy is relatively inconsistent and would only occur during large floods. As a result, deposition is not likely to take place at a rate where significant frequent repeat dredging would be needed to maintain flood defence levels. The proposal for a sediment trap/deposition zone upstream of the town will also reduce the risk of deposition.

Although the reprofiling is not predicted to result in unsustainable repeat dredging, it will have a significant ‘one-off’ impact on the river bed. The dredging will result in the loss of natural river bed features (mid-channel bars, pools, general bed undulations and riffles, and areas of marginal deposition). These natural features create niches of ecological value, and so their

removal has the potential to have a negative impact on ecology, as well as a loss of aesthetic value of varied flow type created by the bed features. The significance on ecological receptors is assessed in Chapter 6 Biodiversity The restoration of these features will be incorporated with sensitive construction procedures, such as retaining undisturbed margins (for example on the inner bend upstream of the town), and by ensuring the 'reprofiled' river bed is reinstated with suitable sediment and ensuring it is not completely smooth. The proposed scheme will have temporary high impacts on the profile of the river post works however, as described above the proposed scheme measures will ensure repetitive dredging of the channel is not required. Therefore, the scheme will have permanent positive significant effects on the hydrology of the river.

Risk to the existing floodplains

The hydraulic mechanics for each of the floodplains are discussed in Section 7.3. It is proposed to construct a compound channel along the east river bank from chainage 3800 to approximately 4900 to increase conveyance of water without reducing the low flow depth of the River. Following the completion of works the flood levels predicted during a 1 in 1-year event will change. Hydraulic modelling indicates that the water levels in the river at the low point of the Bare Meadows will be 120mm lower that the existing scenario. Following the completion of works the predicted water levels in the Bare Meadows during a flood event will reduce by 40mm. This would equate in terms of the reduction in the width of the cross section that will be flooded in the Bare Meadows to approximately 1.5m out of the total wetted cross section length of approximately 200m. This is expected to be approximately 0.75% of the flood plain width. The results of detailed geotechnical and hydrological study of the River Slaney along the full extent of the river channel and riparian land, as a part of the development of the flood defence scheme indicate that the proposed compound channel construction adjacent to the Bare Meadows will not affect the day to day functioning of the Bare Meadows as a floodplain for frequent flood events.

During an extreme flood event in the existing situation the water levels in the Bare Meadows increase within the River Slaney until the levels in the river exceed the current bank levels in the Bare Meadows. At this point flood water will flow over the river bank into the Bare Meadows from the River Slaney. In the current scenario for the 1 in 100-year flood event, it is predicted that the flood levels in this area will reach a level of approximately 4.4mOD. Following the completion of the scheme the predicted 1 in 100-year flood event the flood levels are predicted to reach approximately 4.2m. That is post works, the flood levels will be approximately 200mm lower in the Bare Meadows. At the lowest point of the Bare Meadows this would lower the depth of flooding from approximately 4.2m in the current scenario to 4.0m post works. The potential changes to flooding processes on the Bare Meadows are negligible during a significant flood event (1 in 100yr events).

The construction of the compound channel and the river dredging at the Bare Meadows is not expected to have an impact on low flow levels as these are currently governed by the low tide level. In the post works scenario this will continue to be the case.

The North Island flood plain currently suffers from frequent flooding. The level of the flood plain varies generally between 2m and 3m AOD. It is proposed to infill a large part of this flood plain with material excavated from some river banks and the river channel. Post works those parts of the North Island not infilled will continue to flood as they do now with a frequency of approximately once every year. The proposed scheme measures will result in low permanent impacts on the hydrology of the Bare Meadows and the resulting effects are not significant. An overview of the changes is provided in Table 7.9.

Table 7.9: Predicted Flood levels downstream of the New Road Bridge

Bare meadows flood levels

Approximate Chainage	Description	Return period (Years)	Pre works (m AOD)	Post works (m AOD)	Change (m)
4800	Upstream of Road Bridge	1	2.44	2.23	-0.21
	mid-point at bend	2	2.84	2.6	-0.24
	Downstream extent	5	2.93	2.69	-0.24
		10	3.4	3.18	-0.22
		25	3.79	3.57	-0.22
4300	mid-point at bend	1	2.22	2.1	-0.12
		2	2.6	2.47	-0.13
		5	2.69	2.56	-0.13
		10	3.18	3.05	-0.13
		25	3.57	3.44	-0.13
3800	outlet of channel with Bare meadows	1	2.05	2.01	-0.04
		2	2.43	2.38	-0.05
		5	2.52	2.47	-0.05
		10	3	2.95	-0.05
		25	3.39	3.34	-0.05
3610	Downstream of Bare meadows	1	2	1.99	-0.01
		2	2.37	2.36	-0.01
		5	2.46	2.45	-0.01
		10	2.94	2.93	-0.01
		25	3.33	3.31	-0.02

Risk to water quality

The proposed flood defence works pose some risk to a change in WFD status for the two identified waterbodies which are currently classed as 'Good'. This is primarily due to the significant river bed dredging activity which will directly disturb the bed and associated ecology and habitats. However, it is anticipated that the impact will be temporary and that the river bed will recover with time, reducing the longevity of impacts It is also not predicted that widescale dredging would need to be frequently repeated, which would further disturb the river bed habitats and disrupt ecological recovery. Chapter 6 provides further details on the specific ecological mitigation measures proposed, these include retaining undisturbed margins, reprofiling with suitable sediments).

Both river bank widening and accidental pollution have the potential to significantly impact ecological habitats within the river, by removing marginal aquatic habitats and niches of ecological value that exist within the riverbanks.

It is noted however that all specialist ecological technical contributors to the EIAR have reviewed the design of the proposed scheme having regard to the ecological sensitivities of the study area. Further details on the ecological assessment is presented in Chapter 6 and where appropriate mitigation measures and ecological control measures are clearly set out. These measures will be implemented and supervised by the EnCoW. Provided that appropriate mitigation and monitoring is implemented the potential impacts on the WFD objection will not be significant.

Whilst the proposed works will undoubtedly impact the river bed conditions within the study area. The level of risk they pose to the WFD status of the two waterbodies downstream is more difficult to define. The poorest ranking elements for both WFD waterbodies are associated with nutrients and dissolved oxygen, rather than hydromorphological quality. This suggests that the ecological status of each waterbody is at greater risk from changes to these elements which will remain unaffected by the proposed scheme. Therefore, whilst the proposed scheme is likely to temporarily impact the morphology of the waterbodies, the effects are very unlikely to permanently affect WFD status by causing a long-term decline in ecological status. Due to the predominant tidal influence on flow and sediment transport conditions downstream of Enniscorthy, the effects are expected to be confined to the study area only and the impact is considered low in magnitude and not considered to be significant.

The proposed scheme is not expected to materially change the flow levels within the river downstream of the Seamus Rafter Bridge and the impact is considered low in magnitude and not considered to be significant.

New Road Bridge Drainage Design

An interceptor ditch at the top of the cutting for the proposed roundabout and approach roads will ensure that all clean surface water will be collected and piped through the existing culvert under the existing N11 at Chainage 0+200 and discharge to the northern end of the woodland on the Bare Meadows ensuring that the channel maintains its current flooded state. All runoff from the proposed roads and earthwork slopes will be collected and piped through a petrol interceptor at Chainage 0+080 and discharge to the river. The proposed scheme will not change the pattern of flow from the existing surface water discharge to the drainage channel on the east of the Bare Meadow Woodland. Runoff from the interceptor ditch will feed the back channel and surface water will pass through a petrol interceptor and so the potential impacts will not be significant.

Climate Change

Climate change may result in changes to variables such as temperature, rainfall, sea/tide levels and wind. One of the most significant changes as a result of climate changes is expected to alter the frequency of future river flows and tide levels, leading to changes in erosion and deposition. It is predicted that in the Mid-Range Future Scenario that flood flows could increase by 20% as a result of climate change. It is also estimated for the same scenario that extreme sea levels could rise by 500mm. The heights of flood walls proposed as part of the scheme includes the climate change increase for the rise in sea level. In accordance with the OPW standard design, the flood walls are designed so that they are adaptable to the increase in flood level resulting from the 20% increase in flow. Both the Pedestrian and the Road Bridge are designed so that their soffits are above the flood level likely in the design event following climate change. That is the underside of the bridges will be above the 100-year flood level including a 20% increase in flood flow and a 500mm increase in sea level.

7.5 Cumulative impact

In addition to the proposed scheme there are a number of additional development projects ongoing and proposed in the vicinity of Enniscorthy that are considered in terms of cumulative impact on the hydrology of the area. These projects include;

- Gorey to Enniscorthy PPP Bypass;
- Development of Business and Technology park in Kilagoley; and
- Wastewater services upgrade.

Construction of the Gorey to Enniscorthy PPP Scheme is currently ongoing and it is expected to be complete and operational in advance of construction. As such, the mitigation proposed for the bypass would be in place in advance of the proposed scheme.

The Enniscorthy Town and Environs Development Plan (2008-2014 (as extended) sets out a bank of lands directly adjacent to the proposed scheme in the townland of Killagoley for the development of a new business and technology park. The development of this land is at early stage and therefore details of the business park are not known at the time of writing this assessment.

Construction of the Wastewater services upgrade is currently ongoing and is expected to be complete by the end of 2019. The Killagoley Wastewater Treatment Plant (WWTP) is due to be decommissioned as part of the contract. The Lucas Park WWTP which is being upgraded is located south of Enniscorthy Town on the western side of the River Slaney opposite the Bare Meadows floodplain. Access to the WWTP is from a local road next to St. Johns Villas via the N30. The existing pumping station to this WWTP is situated adjacent to the Riverside Park Hotel.

The Enniscorthy Town and Environs Development Plan emphasise the promotion and facilitation of the Enniscorthy Flood Defence Scheme within the town through its strategies and objectives set out in the Plan. It is worth noting that SW11, states all development proposals within Enniscorthy should have regard to the 'River Slaney (Enniscorthy) Drainage Scheme'.

7.6 Mitigation Measures

7.6.1 Construction Phase

During the construction phase Wexford County Council will employ a technically competent contractor who will have responsibility for all aspects of day to day operations on site.

- In advance of the commencement of construction works Wexford County Council will ensure that there is a contractual obligation for the appointed Contractor to prepare and implement a Construction Environmental Management Plan (CEMP) and Construction Traffic Management Plan (CTMP). The CEMP will summarise the actions required to implement the environmental mitigation and outcomes from the EIAR. It is assumed that the Contractors responsible for the construction will implement best practice measures to protect the River Slaney and its tributaries;
- During construction, the channel would be constricted due to the installation of a temporary dry works area, which is predicted to result in localised erosion and deposition. Mitigation is required to manage the adverse effects on morphology. A baseline bathymetric survey has been undertaken. Further surveys should be undertaken during construction at intervals of approximately 3-4 months and after any significant fluvial flood event;
- During the installation of the impermeable barrier, there will be significant adverse effects of the water body. this includes increase turbidity and subsequent reduction in light and dissolved oxygen levels within the study reach, to ensure that these impacts are minimised, as part of the CEMP, a water quality monitoring plan will be developed in consultation with the EnCoW. The plan will include water monitoring programme, at appropriate locations upstream and downstream of the proposed works area in advance of construction in order to establish the baseline and assess potential impacts. Daily visual inspections and trigger thresholds will be set up and agreed within in consultation with the EnCoW, above these thresholds works will be directed to stop until parameters return to baseline conditions. Weather conditions will be monitored throughout the construction period by the Contractor.

Works will not be carried out during extreme rainfall or high flow events. The Contractor will monitor this and other appropriate weather forecasts on a regular basis, at least daily;

- The impermeable barrier works within the instream will be carried out in between June and September only;
- Inland Fisheries Ireland (IFI) have indicated that steps must be undertaken to control surface water drainage, that may be contaminated with silt, hydrocarbons and other organic/ inorganic matter. The proposed in stream works control measures have been designed to prevent environmental pollution and minimise sedimentation on the SAC. The measures prescribed will be undertaken as best practice and are proven technologies/methods, and to this end the main works contract will utilise temporary dry works areas. The instream works will be carried out in a manner which will not impair the biological function of the waterbody and not impede more than half the width of the River Slaney. The removed water from the works area will receive on site treatment before discharge. The Contractors must have a licence from Wexford County Council under the Local Government Water Pollution Acts 1977 and 1990 to discharge water from works. A single licence for the entire site will be required and will contain specific conditions detailing the quality of final discharge. This will prevent silt or hydrocarbon related impacts to fish populations in the receiving watercourses of the River Slaney and its tributaries;
- Method Statements will be prepared by the appointed Contractor and they will incorporate the control measures detailed below. In addition to specified conditions that may be prescribed in any grant of Ministerial consent for the project, measures outlined in the Natura Impact Statement and the EIAR and any commitments given by OPW/Wexford County Council in relation to environmental protection associated with the activities set out in this document;
- Pollution control measures will be designed, installed and maintained in accordance with CIRIA guidance for 'Environmental Good Practice on Site' (C741) and 'Control of Water Pollution for linear construction projects'. Technical guidance (C648) and any updates and under the supervision of an EnCoW. Measures include but are not limited to the following;
  - Re-fuelling of construction equipment and the addition of hydraulic oil or lubricants to vehicles /equipment will take place in designated bunded areas within the temporary storage yard, where possible, and not on-site. Bund specification will conform to the current best practice for oil storage such as 'Best Practice Guide BPGCS005 Oil Storage Guidelines,' Enterprise Ireland;
  - All waste oil, empty oil containers and other hazardous wastes will be disposed of in conjunction with the requirements of the Waste Management Acts 1996, as amended.
  - Spill-kits and hydrocarbon absorbent packs will be stored in the cabin of each vehicle and operators will be fully trained in the use of this equipment;
  - The risk of pollution of the watercourses from losses of mortar and concrete must be managed and controlled in accordance with IFI *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* and with CIRIA C532: *Control of water pollution from construction sites Guidance for consultants and contractors*;
  - A visual inspection of all watercourses, downstream of the works areas shall be conducted daily. Visual inspection should show no indication of increased sediment deposition on the watercourse bed and no visible hydrocarbon film;
- To avoid the risk of pollution of the River Slaney SAC, fuelling and lubrication of plant and equipment will not be permitted within 50m of a watercourse;
- Exposed areas of soil within works areas which are located within 5m of a drainage ditch will be covered with a soil erosion protection (e.g. erosion control blanket/ mat), Soil erosion

must be installed in accordance with the manufacturers specification and must be installed immediately following the exposure of works areas to soil erosion and continued to be maintained in place until works are complete and the soil has been re-established;

- Silt control measures such as silt curtains will not be exclusively relied upon to prevent siltation in naturally flowing permanent water courses as they are likely to be quickly overcome. The establishment of dry works areas as shown on the accompanying drawings in Appendix A detailed in the CEMP document and the phased approach to the deposition of material on the island will minimise siltation through runoff. It is also proposed that a silt fence will be required at the perimeter of the flood defence walls works areas and including around the perimeter of soil depositional zone located within 5m of the back channel. This fence will be installed in accordance with manufacturers specifications and must be installed prior to commencing the works. The silt fence will have the following design features;
  - The geotextile fabric must be entrenched at least 100mm into the ground with ends upturned;
  - The fence posts will have a maximum spacing of 2m to prevent sag on the fence; and
  - The geotextile fabric will be anchored to the fence posts as opposed to wrapped.
- The location of the fence will be set out in agreement with the EnCoW. Daily inspections of the silt fences will be carried out by the EnCoW to assess the effectiveness of the measure, to carry out maintenance, and to determine if there has been any damage/breach to the control measure. The silt fence will be also inspected immediately following heavy rainfall or strong winds. Where repair is necessary, this will be carried out immediately and may require replacement of any damaged/degraded material.
- Accumulated silt will be removed regularly from the base of the silt fences. Silt will not be permitted to build up such that it reaches half the height of the fence or exceeds 15cm in height (whichever is the lesser value). Commercially available fences will show a maximum height which should not be exceeded. Silt fences must remain in place until the disturbed areas within the sites have been reinstated and revegetated. Silt fences must only be removed during dry weather and following approval of the EnCoW. Any accumulated silt along the fence must be removed immediately in advance of removing the silt fence from the site. The removal of the silt fences will be carried out under the instruction and supervision of the EnCoW;
- Daily monitoring of all control measures will be required and will carried out by the EnCoW to assess the effectiveness of the measures including onsite water treatment system, to carry out maintenance, and to determine if there has been any damage /breach to the control measure. Daily inspections of the impermeable barrier will also be carried out by the contractor;
- When the instream works are complete in an area the impermeable barrier will be removed from the river and flow will be reinstated. Prior to removing the barrier, the new river beds will be scarified to mitigate the compaction of the river bed, this will be carried out by a toothed bucket of an excavator. The removal of the barrier has the potential to increase the turbidity levels directly downstream of the works areas. This increase is considered to be temporary and flushing would occur. As noted previous the use of silt control measures in a permanent watercourse is not effective and as such the programme of removal will be carried out to minimise turbidity levels downstream and levels will be monitored, and works will stop where exceedance are recorded and recommence only following consultation with the EnCoW;
- The design of the banksides with regard to general physical and vegetation cover will be replicated as part of the construction works following consultation with EnCoW and NPWS.

7.6.2 Operational Phase

The design of the sediment trap eliminates the need for regular maintenance dredging of the entire reach of the river channel in Enniscorthy. The design exaggerates the existing natural process occurring in the River Slaney and will cause larger sediment to deposit upstream.

Gravel will have to be removed from the sediment trap periodically. Gravel will be deposited here when high velocity flows carry large sized sediment down the Slaney during a flood event. When the flow enters the sediment trap the velocity of the flow will reduce and the large sediment will drop out of suspension. It estimated that such a high flow event will occur on average once every 5-7years. The gravel will be removed from the left bank of the channel during low flows in the summer when the gravel is exposed. Works will be carried out in dry working conditions only in consultation with Inland Fisheries Ireland.

The gravel trap and the debris trap will require maintenance as required using a long reach excavator from the North Island. Maintenance will be carried out in accordance with the latest OPW Environmental Management Protocols and Standard Operating Procedures which are currently being updated by the OPW.

During flood events floating debris will be collected by flood flows from the river banks and flood plains of the Slaney. Floating debris of a size that could cause a risk of blockage at the Irish Rail bridge will be trapped in the debris trap. Following each flood event, the debris trap will be inspected and if necessary trapped debris will be removed using a long reach excavator from the left bank.

All structures require regular inspection and routine maintenance during their life and TII have developed an EirSpan Bridge Inspection and Maintenance programme. The principles of the EirSpan system will be applied to all structures on the proposed scheme. Environmental protection measures will be implemented in advance of maintenance works

7.7 Residual impacts

Residual impacts to the River Slaney, its floodplains and downstream of the Enniscorthy Flood Defence Scheme will be not significant during the construction and operational phases following adherence to the mitigation measures and best practice site management outlined above.

8 Geology and Soils

8.1 Introduction

This Chapter examines the baseline environment in terms of geology and soils and land and assesses the potential impact of the proposed works associated with the Enniscorthy Flood Defence Scheme

Mitigation measures are recommended to minimise any significant adverse impacts. This Chapter should be read in conjunction with the site layout plans, drawings and project description provided and geomorphological and hydrological assessment in Chapter 7**.**

This Chapter has been structured as follows;

- **Section 8.2**- Outlines the desk-based study was undertaken to establish the baseline soils, geology and hydrogeology information within the immediate environs of the proposed scheme works. The section also describes the site investigations surveys that were carried out within the proposed study area;
- **Section 8.3**- Describes the value of the study area in terms of both soils and geology and summarises the results of the ground investigation carried out;
- **Section 8.4**- Provides an outline on the principal elements of the proposed scheme and examines the potential impacts on the existing geology and soils within the study area
- **Section 8.5**- Describes the proposed mitigation measures to be carried out during the proposed construction phase; and
- **Section 8.6**- Summarises the potential for significant residual effects.

8.2 Assessment Methodology

The soils, geology and hydrogeology assessment was carried out with reference to the following guidance documents:

- Institute of Geologists of Ireland, Geology in Environmental Impact Statements – A Guide (2013);
- Environmental Protection Agency (EPA), Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (2003) [and revised Draft 2015 Update];
- Environmental Protection Agency, Guidelines on the Information to be Contained in Environmental Impact Statements (2002) [and revised 2017 Update];
- National Roads Authority, Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008); and
- Construction Industry Research and Information Association (CIRIA) Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors, (2001).

This assessment involved desktop research supported by a review of geotechnical investigations for the proposed study area.

8.2.1 Legislation

8.2.1.1 Soils and Geology

Whilst at the European level there were proposals for a Soil Framework Directive tabled in 2006, the Directive was never adopted and there is no specific soil protection legislation in place in Ireland.

Section 6 of the Heritage Act (1995) defines national heritage to include, amongst other things, landscapes and geology.

8.2.1.2 Hydrogeology

Water management in the EU is primarily directed by the Water Framework Directive 2000/60/EC (WFD) and its associated daughter "Groundwater Daughter Directive" (GWDD)

The requirements of the WFD and GWDD have been transposed into Irish law through S.I. No. 9 of 2010 - European Communities Environmental Objectives (Groundwater) Regulations 2010. The regulations require measures to be implemented to prevent the input of hazardous substances to groundwater bodies. "Hazardous substances" means substances or groups of substances that are toxic, persistent, and liable to bio-accumulate and other substances or groups of substances that give rise to an equivalent level of concern.

S.I. No. 9 of 2010 also limits the input of non-hazardous substances to groundwater. The input of non- hazardous substances shall be limited to ensure that such inputs do not cause deterioration in groundwater status or cause significant and sustained upward trends in the concentration of pollutants in groundwater.

With respect to groundwater, environmental damage under the European Communities (Environmental Liability) Regulations 2008 means damage to the groundwater body such that it has a significant adverse effect on the groundwater body chemical status under the Water Framework Directive.

8.2.2 Evaluation Criteria

The impact assessment methodology was adapted from the NRA Guidelines on Procedures for Assessment and Treatment on Geology, Hydrology and Hydrogeology for National Road Schemes (NRA 2009). The assessment also takes into consideration of the guidance set out in the EPA Guidelines on the Information to be Contained in Environmental Impact Statements (draft 2017).

The sensitivity of the baseline environment to each impact has been assessed using a combination professional judgement and predefined criteria as set out in Chapter 2 of this EIAR.

8.2.3 Desktop Study

A desk-based study was undertaken to establish the baseline soils, geology and hydrogeology information within the immediate environs of the proposed scheme works.

The EPA and Geological Survey of Ireland (GSI) database and mapping portals were reviewed to determine the context of the proposed scheme in terms of geology and soils, hydrogeology, geohazards and radon. The following publicly available information was reviewed and referenced on the 30th September 2017 from the GSI website https://www.gsi.ie/Mapping.htm.

- National Draft Generalised Bedrock Map;
- Soils and Subsoils Maps;

- Aquifer Maps; and
- Interim Vulnerability Map.

8.2.4 Ground Investigation Surveys

Priority Geotechnical Ltd (PGL) conducted a detailed site investigation in 2016/2017, which consisted of boreholes, trial pit excavations, grab samples, slit trench excavations, soil sampling and in-situ testing. Logs from these intrusive investigations were also considered.

8.3 Receiving Environment

8.3.1 Geology and Soils

The Irish Geological Survey map for Carlow-Wexford (sheet 19) shows the geology of the area around Enniscorthy generally comprises rocks of Lower Palaeozoic age, dating from the Ordovician period between 525 million and 440 million years ago, which makes up part of the Campile Formation. The Campile Formation is described as Rhyolitic Volcanics[39], and intermediate and felsic volcanics and grey/brown slate (Slatey Mudstones with occasional Andesitic Tuffs or Agglomerates). Dolerite was also noted north of Enniscorthy being described as Basalt and Gabbro. Structural geology indicated faulting in Enniscorthy occurring in a North-south direction.

There is one site at Greenville Townland that was recommended as a proposed NHA due to its potential value as a source of Precambrian to Devonian age palaeontology. This site lies 1km north of Enniscorthy.

8.3.1.1 Quaternary Geology (Subsoil)

According to the GSI and Teagasc online databases, Enniscorthy and its environs occur in area underlain by;

- Made Ground;
- Glaciofluvial sands and gravel;
- Glacial till derived from lower Palaeozoic shales;
- Bedrock outcropping;
- Till derived from mixed Devonian sandstones; and
- Alluvium.

8.3.2 Hydrogeology

The bedrock underlying the study area is classified by the Geological Survey of Ireland (GSI). GSI rates the aquifers of Ireland according to their productivity and their vulnerability

8.3.2.1 Aquifer Classification

The bedrock aquifers underlying the study area correspond to the bedrock formations classified by the GSI as:

- Regionally Important Aquifer-Fissured bedrock.

From the site investigation carried out, groundwater was encountered between 1.6m below ground level (bgl) and 9.2m bgl.

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8.3.2.2 Aquifer Vulnerability

The overburden geology defines the vulnerability of the aquifer. The aquifer has categorised vulnerability rating based on the subsoil type and thickness. These are reproduced below;

Table 8.1 Vulnerability Mapping Guidelines

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High permeability (sand/gravel)	Moderate permeability (e.g. sandy subsoil)	Low permeability (e.g. clayey subsoil, clay, peat)	sand/gravel aquifers only	<30m radius
Extreme (E)	0 -3.0m	0 – 3.0m	0 – 3.0m	0 – 3.0m	--
High (H)	>3.0m	3.0 – 10.0m	3.0 – 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 – 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

1. note: N/A = not applicable
2. Precise permeability values cannot be given at present.
3. Release point of contaminants is assumed to be 1-2m below ground surface

According to the GSI web-mapping the aquifer vulnerability in the study area and around study area is largely classified as HL – '*Moderate-High*.

Based on the thickness of the overburden encountered in the site investigations, the vulnerability of the bedrock aquifer is seen to decrease, with increasing overburden thickness.

8.3.2.3 Geohazards

A review of the GSI National Landslide Database for Ireland found no recorded landslides in the area.

Geohazards are, in essence, natural Earth processes that pose a risk to human life. They can range from naturally occurring radioactive gases such as radon to geological hazards including landslides, bog-bursts, coastal erosion or subsidence to hydro-meteorological hazards like floods and high tides.

Radon gas is a naturally occurring radioactive gas, originating from the decay of uranium on rocks and soils. It is a colourless, odourless and tasteless gas and its presence can only be measured using specialist equipment. Radon dissipates readily in open air and is not considered harmful. However, in enclosed spaces, such as a building, radon can accumulate to unacceptably high concentrations.

Radon is measured in Becquerel's per cubic metre of air (Bq/m^3). A Becquerel is a unit of radioactivity and corresponds to one radioactive disintegration per second. A High Radon Area is one where more than 10% of buildings are predicted to have radon levels in excess of 200 Bq/m^3. Information on radon levels around the development site was obtained from the national radon map illustrated on the website of Radiological Protection Institute of Ireland (www.rpii.ie). This map illustrates 10km x 10km grid squares which show the estimated percentage of homes above the reference level for radon. The radon measurements illustrated on this map for County Wexford indicate that the site of the proposed scheme is within between two areas; the northern part of the town is located in an area, where 1 to 5% of dwellings are predicted to have radon

levels above the reference level and the southern part of the town occurs within a high radon area, where 10% to 20% of homes are above the reference level.

8.3.3 Ground Investigations

To inform the design of the proposed scheme Priority Geotechnical Limited (PGL) carried out ground investigations in 2016/2017. The scope of the investigations included;

- Trial Pit Excavations;
- Slit Trench Excavations;
- Cable Percussion boreholes;
- Rotary Core Boreholes;
- Dynamic probes;
- Pavement cores;
- Grab Samples;
- All associated sampling and testing;
- In situ testing, including but not limited to, standard penetration testing, California bearing ratio (CBR), vane testing, plate loading tests, and permeability tests;
- Geophysical investigation, Seismic Refraction and Electrical Resistivity;
- In situ, piezo-cone penetrometer tests;
- Groundwater monitoring wells;
- Laboratory testing of soil and rock samples; and
- Chemical analysis and contaminant testing.

The location of all ground investigations is provided in Appendix E. Further details on the ground investigations works are provided in the Ground Investigation Interpretative Report which is contained in Appendix E. The following key observations were recorded.

Ground Water Conditions

Groundwater was encountered during cable percussion drilling, during rotary drilling and excavations between 1.6m below ground level (bgl) and 9.2m bgl. Eighteen 50mm diameter standpipe well installations were also installed to enable groundwater monitoring.

Ground Conditions

According to the ground investigations the following ground conditions typically characterise the conditions within the proposed works area for the scheme;

- Topsoil ranging between 0.10m to 1.0m thick;
- Made ground ranging between 0.2m to 6.3m,
- Bituminous construction material 40mm to 400mm thick;
- Concrete 0.1m to 5.0m thick;
- Undifferentiated glacial deposits of slightly sandy gravelly clay/silt, slightly to very silty, slightly to very gravelly sand and slightly silty very sandy gravel with variable cobble and boulder content to depths up to 12.8m below ground level; and
- Organic deposits of peaty clay were identified at 1.7m to 1.9m thick. Alluvial deposits of slightly sandy silt were also present.

Bedrock encountered within the study area was variable and comprised of mainly of shale and dolerite and limestone. The shale was encountered at the northern part of the site, with the

boundary between shale and dolerite occurring southeast of the railway bridge and around the location of the leisure centre. Dolorite was encountered mainly on the southern part of the site;

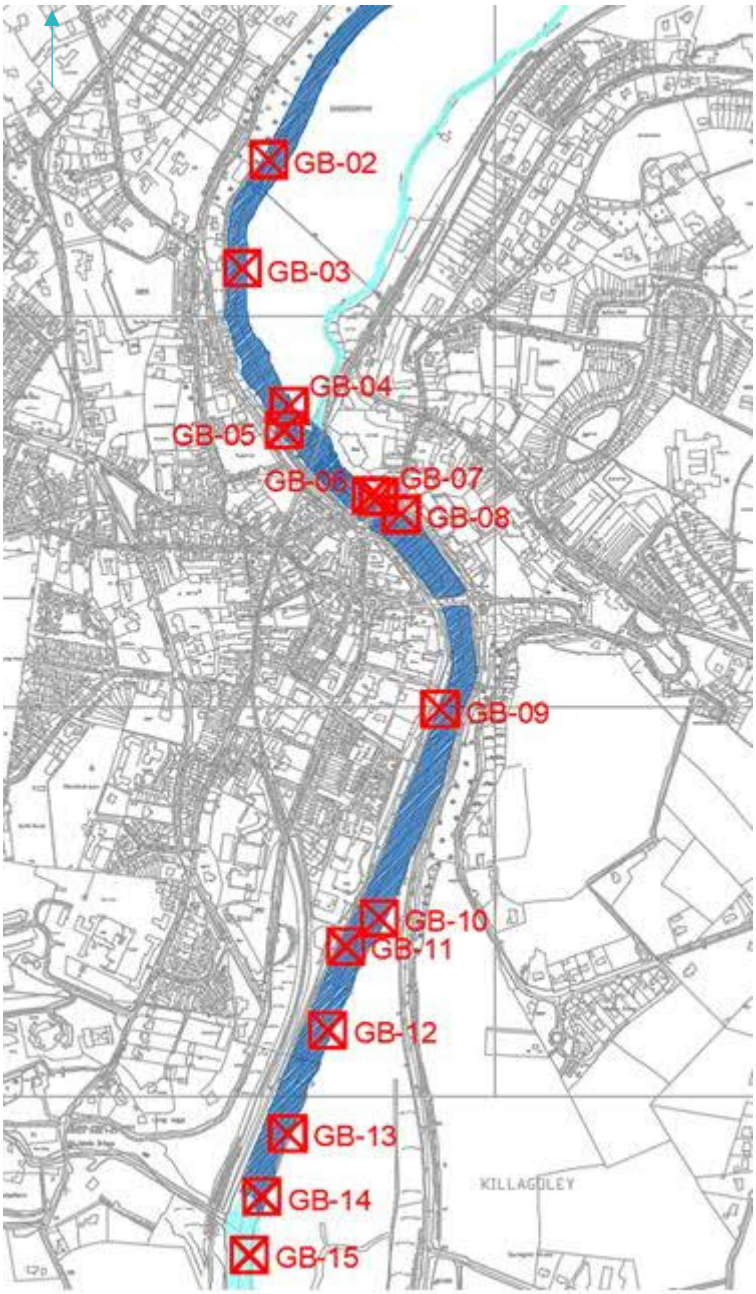
- Weak to very strong limestone located at depths 3m to 8.6m bgl;
- Weak Slately -mudstone located at depths 2.1m bgl and 7.0m bgl;
- Weak to strong Shale located at depths 5.1m bgl to 11.3m bgl; and
- Weak to very strong Dolorite 1.5m bgl to 11.3m bgl.

Laboratory testing was also undertaken to determine the classification, engineering properties and geo-chemistry of the soil and rock encountered during the ground investigations.

Grab Samples

Access to GB 01, GB 02, GB 03, GB 04 and GB 05 which are all upstream of the Rail Bridge proved to be very difficult and the only viable approach was to take samples using a Van Veen sampler from a small boat. The river gravel is very dense and only shallow samples could be taken. Downstream of the rail bridge where access was less inhibited a mini digger was used to take samples at GB 6, GB 7, GB 8 and GB 9 and further downstream a 22ton tracked excavator with a long reach arm was used to take samples at GB 10, GB 11, GB 12, GB 13, GB 14 and GB 15. Waste Acceptance Criteria tests were carried out on all of the samples taken. The grab sample locations are shown in Figure 8.1.

Figure 8.1: Location of the Grab Samples within the River Slaney



Source: Mott MacDonald 2017

The proposed construction methodology as described in Section 4.5 proposes to carry out all of the dredging in a dry works area and so the risk of contamination is minimal.

- GB01 – GB07 - It is proposed that this excavated material be deposited on the North Island. All the samples tested 'inert'; and
- GB08 – GB015- It is proposed that this excavated material be exported off site.

Some samples were taken at 1.5m below the existing river bed. In many areas the proposed dredge level is less than 1.5m below the existing river bed. Therefore, some samples were taken in material which is not proposed to be excavated.

Of the samples in material which is proposed to be excavated, thee samples tested other than 'inert' these are listed below:

- GB08 0.5m 'stable non-reactive hazardous Antimony 0.062mg/kg (10:1), Polycyclic Aromatic Hydrocarbon (PAH) 3.8mg/kg;'
- GB10 0.5m 'inert PAH 11mg/kg;' and
- GB11 0.5m 'inert PAH 8.3mg/kg'.
- GB 08 & GB 11 are very close to large surface water / combined sewer discharge points.
- GB 15 is beyond the proposed extent of dredging and downstream of the conflux with the River Urrin.

The results of the WAC tests are presented in the table below. Red text indicates samples that were taken below the proposed dredge depth.

Table 8.2: Summary of WAC test Results

Sample	Sample depth below Existing Bed	WAC Test Comment	OPW Chainage at Sample Location	Bathymetric Survey level at Sample Location	Proposed River Bed level at Sample Location	Proposed Dredge Depth at Sample Location
GB01	0	inert	6600	0.047	-0.6	0.647
GB02	0	inert	6200	-0.287	-0.88	0.593
GB03	0.5	inert	6000	-0.358	-0.96	0.602
GB04	0.5	inert	5750	0.08	-1.06	1.14
GB05	0	inert	5750	-0.043	-1.06	1.017
GB06	0.5	inert	5640	0.349	-1.11	1.459
	1	inert				
	1.5	inert				
GB07	0.5	inert	5556	0.312	-1.14	1.452
	1	inert				
	1.5	inert				
GB08	0.5	stable non-reactive hazardous Antimony 0.062mg/kg (10:1), PAH3.8mg/kg	5535	-0.463	-1.15	0.687
	1	inert				
	1.5	inert				
GB09	0.5	inert	5100	-0.951	-1.33	0.379
GB10	0.5	inert PAH11mg/kg	4900	-0.876	-1.42	0.544
	1	inert				
	1.5	inert				
GB11	0.5	inert PAH 8.3mg/kg	4800	-0.829	-1.46	0.631
	1	inert PAH7.3mg/kg				
	1.5	inert PAH7.9mg/kg mineral oil 51mg/kg				
GB12	0.5	inert	5700	-0.387	-1.49	1.103
	1	inert				

Sam ple	Sample depth below Existing Bed	WAC Test Comment	OPW Chainage at Sample Location	Bathymetr ic Survey level at Sample Location	Proposed River Bed level at Sample Location	Proposed Dredge Depth at Sample Location
	1.5	inert				
GB13	0.5	inert	4510	-1.01	-1.55	0.54
	1	inert PAH8.7mg/kg				
	1.5	inert				
GB14	0.5	inert	4410	-1.385	-1.63	0.245
	1	inert				
	1.5	inert				
GB15	0.5	inert	4290	-1.267	-1.67	0.403
	1	stable non-reactive hazardous Sulphate 1100mg/kg (10:1),				
	1.5	stable non-reactive hazardous Antimony 0.018mg/kg (10:1),				

8.3.4 Do-Nothing Scenario

In the Enniscorthy Environs Development Plan, the study area has a variety of zoning objectives ranging from residential to light industrial to public open space. The area is largely developed, with established land uses in an urban environment. In the Do-Nothing scenario, Enniscorthy and its environs would continue to be used as it is at present and the uses of the lands adjoining these roads would be developed in accordance with future development objectives set out within the plan.

In the Do-Nothing scenario, the hydrogeology of the area would be subject to the development objectives set out within the Plan. The negligible impact on the underlying geology (subsoil and bedrock) in the current scenario would continue.

8.4 Assessment of Impacts

8.4.1 Construction Phase

The construction activities are divided between two primary work streams, as follows:

- The instream works i.e. dredging and widening and infilling works within the River area; and
- The construction of the flood defence walls, demolition of Seamus Rafter Bridge and construction of new pedestrian and road bridges and the associated civil engineering works such as the surfacing, access road, drainage, fencing, and barriers etc.

Further information is these work activities is provided in the following sections. Overall, construction phase activities will result in temporary impacts which, without the implementation of mitigation measures, would result in a significant impact on the receiving environment.

8.4.1.1 Instream works

Dredging and reclamation quantities have been calculated using Autodesk Civil3D software using the bathymetry and site investigation data. These calculations indicate that a total of approximately 220,000m^3 of material will be excavated during the instream:

- 124,300m^3 of material upstream of Seamus Rafter Bridge; and

- 95,700m^3 of material downstream of Seamus Rafter Bridge.

The dredged material sourced from the River Slaney will be predominantly gravels and soft materials such as silts and clays as described in the previous sections. Instream material upstream of the Seamus Rafter Bridge will be deposited in the permanent depositional zone on the North island and on widened river bank at Island Road. To facilitate the construction of the permanent deposition of material on the North Island, topsoil from the designated area will be removed in a phased approach and placed in temporary stockpile. Depositional material will be placed on exposed subsoil and compacted with compaction plant (roller). 300m of the stored topsoil will be placed on the compacted dredged material and reseeded with an approved grass mix. The volume of material to be deposited on the North Island is approximately 71,343m^3. The depositional zone is expected to be engineered with a 1:2 slope approximately 1.5m above the existing ground levels. Approximately 100,000m^3 of material will also be disposed of off-site at a licenced facility. Material downstream of the bridge will be exported to a licenced facility. It is anticipated this will equate to approximately 95,700m^3

8.4.1.2 Construction of Flood Walls, Bridges and Demolition of Seamus Rafter Bridge.

The construction of the proposed scheme will generate large quantities of excavated material and other aggregate material mainly associated with the construction of new bridges and construction of the flood defence measures. The demolition of the existing Seamus Rafter Bridge will also generate demolition materials such as steel, concrete, timbers and masonry waste. The key impact associated with the construction phase of the Enniscorthy Flood Defence Scheme is the excavation, handling, storage, processing and transport of earthwork materials. It is estimated that the construction of the new road bridge and approach road will yield approximately 78,000m^3 of material that will required to be transported off site. It is estimated approximately 12600m^3 of fill material will be required on site. Assuming worst case scenarios all of this will need to be imported to the site. The proposed construction approach for bridges and associated infrastructure is provided in Chapter 4 of this report. The estimated volume of excavated material anticipated during the construction phase is presented above. The estimated aggregates material required is detailed below.

Table 8.2: Approximate estimates of aggregates materials

Location	Masonry m^2	Concrete m^3	Rebar tonne	Sheetpile m^2
Upstream of Enniscorthy Bridge	2270	380	25	7163
Downstream of Enniscorthy Bridge	9575	1790	78	11575

During the proposed works, there will be hydrocarbons stored and used on site to refuel earthmoving machinery. There is potential for spills and leakage to occur with subsequent localised contamination of the soil and groundwater.

A large cut is required for the proposed roundabout and approach roads. Slope stability may be an issue. Depending on material encountered, safe angle of cuts will need to be adopted to ensure slope failure does not occur during the operational (and construction) phase of the proposed scheme.

8.5 Operational Phase

As noted previously, the design of the sediment trap eliminates the need for regular maintenance dredging of the entire reach of the river channel in Enniscorthy. The design

exaggerates the existing natural process occurring in the River Slaney, and will cause larger sediment to fall out upstream.

Gravel will have to be removed from the sediment trap periodically. Gravel will be deposited here when high velocity flows carry large sized sediment down the Slaney during a flood event. When the flow enters the sediment trap the velocity of the flow will reduce and the large sediment will drop out of suspension. It estimated that such a high flow event will occur on average once every 5-7years. The gravel will be removed from the left bank of the channel during low flows in the summer when the gravel is exposed. Works will be carried out in dry working conditions only in consultation with Inland Fisheries Ireland.

General maintenance for the flood defence walls will be carried out by the local authorities general site operations.

There is potential that vehicles using the roads will leak / spill hydrocarbons onto the road surface. Hydrocarbons may potentially make their way into the underlying soils and groundwater, but more likely will be contained in the surface water environment. As the surface water runoff management measures will be improved over the existing infrastructure, this will be a positive impact.

Overall, operational phase activities will result in permanent impacts which, without the implementation of mitigation measures, would result in a medium impact on the receiving environment.

8.6 Mitigation Measures

The following mitigation measures are proposed to address the likely impacts associated with the construction phase of the proposed scheme. The CEMP and the Construction Waste Management Plan (CWMP) will be prepared and provided as part of the CEMP, the CWMP is a live document and will reviewed regularly and revised as necessary to ensure that the measures implemented are effective. All waste generated during the project will be managed in a way that ensures the relevant provisions of the Waste Management Act 1996 and associated amendments and regulations are met, particularly with regard to the use of appropriately permitted Waste Contractors and destinations for waste materials.

8.6.1.1 Waste Management Control Measures

All waste generated during the project will be managed in a way that ensures the relevant provisions of the Waste Management Act 1996 and associated amendments and regulations are met, particularly with regard to the use of appropriately permitted Waste Contractors and destinations for waste materials.

The Contractor will appoint a Waste Manager for the project. The Waste Manager will have overall responsibility to oversee, record and provide information to the relevant authorities on waste management for the project. Authority will be given to the Waste Manager to delegate responsibility to sub-contractors where necessary and to coordinate with suppliers, service providers and sub-contractors to prioritise waste preventation and salvage.

eirGeneral waste and arisings from the site clearance and construction works will include, but not be limited to, soils, rocks, stone, wood, packaging, metals, plastics, cardboard and paper. Wastes will be segregated into non-hazardous and hazardous waste categories
As noted above, all movement of waste and the use of waste contractors will be undertaken in accordance with the Waste Management Act 1996, as amended, and all associated regulations,

as appropriate. This includes the requirement for all waste contractors to have a valid waste collection permit. A copy of the permit/licence associated with the destination waste management facility will be maintained by the Waste Manager. If the waste is being shipped abroad, a copy of the Transfrontier Shipping (TFS) document will be obtained from Dublin City Council (as the relevant authority on behalf of all local authorities in Ireland) and maintained by the Waste Manager along with details of the final destination (permits, licences etc.). A receipt from the final destination of the material will be kept by the Waste Manager as part of the waste management records.

All wastes will be handled in a responsible manner with due regard to relevant legislation, codes and best practices

Measures to be implemented for specific waste types include:

Metal Waste

- Metal is highly recyclable; there are numerous companies that will accept these materials. A segregated skip will be available in the site compound for storage of metals on site pending recycling.

Hazardous Waste (i.e. organic solvents, treated wood, cement

- Storage of any hazardous wastes will be minimised, with refuelling and oil changes carried out on a regular basis off site.
- All hazardous wastes, including paint tins and nominally empty paint tins, will be contained in enclosed impermeable receptacles with due regard to compatibility. Waste containers and lids will be compatible with the waste chemicals stored in them and incompatible wastes will not be stored together.
- Hazardous waste receptacles will be clearly labelled in accordance with international standards. All materials will be stored on site will be stored in such a way as to minimise potential for environmental impacts. and the material will be stored away from the watercourses;
- Hazardous waste will be collected by a permitted hazardous waste contractor and brought to a licensed facility for disposal

Recyclable Waste

All recyclable wastes segregated on site and recycling at Enniscorthy Recycling Centre.

Non-Recyclable Waste

All non-recyclable wastes will be transferred to the site compound at the end of the working day. In the site compound there will be a general skip or other receptacle provided for non-hazardous waste not suitable for reuse or recycling. This skip will include general municipal waste (mixed food waste and food packaging), polystyrene, contaminated cardboard, contaminated plastic etc. Prior to removal, the receptacle will be examined by the Waste Manager to determine that recyclable materials have not been placed in there. If this is the case, efforts will be made to determine the cause of the waste not being segregated correctly.

- Excavated spoil will be stockpiled at appropriate heights and slope angles;
- The proposed in stream works control measures have been designed to prevent environmental pollution and minimise sedimentation on the River Slaney SAC. The measures prescribed will be undertaken as best practice and are proven technologies/methods, and to this end the main works contract will utilise temporary dry works area. To minimise the potential risk of pollution to the River Slaney and groundwater by sediment laden run off. Sediment entrainment measures will also be incorporated into

the development. These measures will include: blocking of all appropriate set back distance from all watercourses, use of silt traps etc.;

- Bunds for the storage of chemicals and hydrocarbons will be lined or constructed of materials resistant to damage by the materials stored therein. In addition, the capacity of such bunds will be a minimum of 110% of the volume of the largest container stored therein. Bunds will be designed in accordance with EPA guidance in relation to the storage of potentially polluting liquids (*"IPC Guidance Note on Storage and Transfer of Materials for Scheduled Activities", 2004*);
- Where refuelling is to take place on site it will be within a designated impermeable, bunded area, away from all drains. In the event of a machine requiring refuelling outside of this area, fuel will be transported in a mobile double skinned tank. An adequate supply of spill kits and hydrocarbon adsorbent packs will be stored in this area. All relevant personnel will be fully trained in the use of this equipment. Guidelines such as "Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors" (CIRIA C532, 2001) will be referred to;
- Portable chemical toilets will be provided for the duration of the works and all waste material will be removed from site and disposed of to an appropriately licensed facility;
- Drip trays will be used where hydrocarbons are being used for vehicle maintenance/refuelling; and
- All plant will be inspected at the beginning and end of each shift and if leaks are evident they are to be repaired immediately or removed from site and replaced.

It is expected that with the implementation of these mitigation measures there will be a medium impact on the receiving soils, geology and hydrogeology environment. This impact is associated most directly with the proposed dredging activities which is essential to ensure sufficient conveyance for flood protection within Enniscorthy. This impact is considered acceptable having regard to the history of flooding within the town.

The deposition works will also avoid flat platforms and regimental uniform slopes insofar as possible (to ensure stability and facilitate runoff) in order to provide a more naturalistic appearance that is consistent with the winding course of the River Slaney.

8.7 Residual Impacts

It is predicted that subject to the mitigation measures identified above being adhered to that there will be slight impacts on the soils, geology and hydrogeology environment during the construction and operational phases of the proposed scheme.

The need for concrete, tarmacadam and other quarry products in the construction of the development are unavoidable. The impact is lessened in that all quarries are registered and have been granted planning permission and should therefore be operating to the highest environmental standards. No significant residual effects are anticipated.

9 Landscape and Visual

9.1 Introduction

This Chapter describes the landscape/townscape in the context of the proposed works and assesses the likely impacts of the scheme on the receiving environment, in terms of both landscape character and visual amenity.

Landscape/Townscape assessment relates to changes in the physical environment, brought about by the proposed scheme, which may alter its character. This requires a detailed analysis of the individual elements and characteristics of a landscape/townscape that go together to make up the overall character of that area. By understanding the aspects that contribute to this character it is possible to make judgements in relation to its quality (integrity) and to identify key sensitivities. This, in turn, provides a measure of the ability of the landscape/townscape in question to accommodate the type and scale of change associated with the proposed scheme, without causing unacceptable adverse changes to its character.

Visual Impact Assessment relates to changes in the composition of views as a result of changes to the landscape/townscape, how these are perceived and the effects on visual amenity. Such impacts are population-based, rather than resource-based, as in the case of landscape impacts. This Chapter was prepared by Macro Works Ltd.

This Chapter has been structured as follows;

- **Section 9.2**- Outline the assessment methodology. The section summarises the desktop baseline surveys that were carried out within the study area. This section also sets out impact assessment criteria;
- **Section 9.3**- Describes the value of the study area in terms of both landscape character and visual amenity;
- **Section 9.4**- Provides technical information on the principal elements of the proposed scheme and examines the potential impacts on the archaeological and cultural heritage;
- **Section 9.5**- Describes the proposed mitigation measures and monitoring regime to be carried out in advance and during the proposed construction phase; and
- **Section 9.6-** Summarises the potential for significant residual effects.

9.2 Assessment Methodology

9.2.1 Guidance and Legislation

This assessment was undertaken having regard to the following guidance documents:

- Environmental Protection Agency (EPA) publication ‘Guidelines on the Information to be contained in Environmental Impact Statements (2002 – Revised Draft 2015) and the accompanying Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (2003– Revised Draft 2015); and
- Institute of Environmental Management and Assessment (IEMA) and landscape Institute (UK) ‘Guidelines for Landscape and Visual Impact Assessment’ (GLVIA-2013).

Although this is principally a ‘townscape’ assessment, it utilises the same outline methodology as would be employed for the more familiar Landscape and Visual Impact Assessment (LVIA) of developments in rural settings. The justification for this approach is provided below.

It is important to note that the Guidelines for Landscape and Visual Impact Assessment' (GLVIA-2013) follow the European Landscape Convention (ELC) definition of landscape: *'Landscape is an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors' (Council of Europe, 2000)*. Thus, GLVIA-2013 covers all landscapes from *"high mountains and wild countryside to urban and fringe farmland (rural landscapes), marine and coastal landscapes (seascapes) and the landscapes of villages towns and cities (townscapes)"* - whether protected or degraded.

In the case of this project, both the Principal and Extended Study Areas are overwhelmingly urban settings or 'townscapes' and this is defined in GLVIA-2013 in the following manner (section 2.7):

"Townscape' refers to areas where the built environment is dominant. Villages, towns and cities often make important contributions as elements in wider-open landscapes, but townscape means the landscape within the built-up area, including the buildings, the relationships between them, the different types of urban spaces, including green spaces, and the relationship between buildings and open spaces. There are important relationships with historic dimensions of landscape and townscape, since evidence of the way the villages, towns and cities change and develop over time contributes to their current form and character."

In this instance there is a strong interrelationship between the 'townscape' and 'cultural heritage' assessments. However, as stated in section 5.11 of GLVIA-2013:

"The sharing of relevant baseline information should not be confused with the need for separate cultural heritage appraisals such as historic landscape characterisation and assessment of historic townscape appraisal, or there will be a danger of both double handling and inappropriate judgements by non-experts. It is particularly important that responsibilities are clear in considering any effects on the settings and views for historic buildings, conservation areas and other heritage assets."

9.2.2 Definition of Study Area

The proposed scheme extends approximately 1.5km upstream of the Enniscorthy Bridge and 2km downstream of the bridge. However, the core study area in this instance is the area from where the physical changes to Enniscorthy can be seen and, within which, the townscape character may be noticeably altered. The traffic management implications of the proposed scheme are potentially broader reaching for example townscape and visual impacts in the form of altered traffic volumes may occur on surrounding town streets and approach roads.

Thus, in the interests of a comprehensive appraisal, the principal study area incorporates the landscape/townscape within 200m of either bank of the River Slaney, over the course of approximately 3km, as it approaches, flows through and exits Enniscorthy. The proposed scheme is not likely to give rise to significant landscape or visual impacts beyond this 200m distance. However, the renowned Enniscorthy landmark of Vinegar Hill, which is located more than 700m from the banks of River Slaney, has also been included in this report owing to its extensive views over the river and the town, as well as its vast and multi-layered importance to Enniscorthy and the broader county. Figure 9.1 illustrates the extent of the landscape and visual study area.

Figure 9.1: Map illustrating the Landscape & Visual study area of the scheme.

Source: Macrowork Ltd 2018

9.2.3 Site Visits

A series of site visits were undertaken by Macro Works during 2017 and January 2018. A desktop study was carried out and viewpoint locations which selected to prepare photomontages of the proposed scheme for the visual impact assessment. Field notes and photography were also captured to inform the baseline townscape setting description.

9.2.4 Landscape/townscape Impact Assessment Criteria

When assessing the potential impacts on the townscape resulting from a proposed scheme, the following criteria are considered:

- Landscape/townscape character, value and sensitivity;
- Magnitude of likely impacts; and
- Significance of landscape effects.

The sensitivity of the townscape to change is the degree to which a particular setting can accommodate changes or new elements without unacceptable detrimental effects to its essential characteristics. Landscape/townscape Value and Sensitivity is classified using the following criteria set out in Table 9.1 below.

Table 9.1: Landscape/Townscape Value and Sensitivity

Sensitivity	Description
Very High	Areas where the townscape character exhibits a very low capacity for change in the form of development. Examples of which are high value townscapes, protected at an international or national level (e.g. World Heritage Site), where the principal management objectives are likely to be protection of the existing character.
High	Areas where the townscape character exhibits a low capacity for change in the form of development. Examples of which are high value townscapes, protected at a national or regional level, where the principal management objectives are likely to be considered conservation of the existing character.
Medium	Areas where the townscape character exhibits some capacity and scope for development. Examples of which are townscapes, which have a designation of protection at a county level or at non-designated local level where there is evidence of local value and use.
Low	Areas where the townscape character exhibits a higher capacity for change from development. Typically, this would include lower value, non-designated townscapes that may also have some elements or features of recognisable quality, where management objectives include, enhancement, repair and restoration.
Negligible	Areas of townscape character that include derelict sites and degradation where there would be a reasonable capacity to embrace change or the capacity to include the development proposals. Management objectives in such areas could be focused on change, creation of townscape improvements and/or restoration.

The magnitude of a predicted landscape/townscape impact is a product of the scale, extent or degree of change that is likely to be experienced as a result of the proposed development. The magnitude takes into account whether there is a direct physical impact resulting from the loss of landscape/townscape components and/or a change that extends beyond the immediate setting that may have an effect on the townscape character.

Table 9.2: Magnitude of Landscape/Townscape Impacts

Sensitivity	Description
Very High	Change that would be large in extent and scale with the loss of critically important landscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the townscape in terms of character, value and quality.
High	Change that would be more limited in extent and scale with the loss of important townscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the townscape in terms of character, value and quality
Medium	Changes that are modest in extent and scale involving the loss of landscape characteristics or elements that may also involve the introduction of new uncharacteristic elements or features that would lead to changes in landscape character, and quality
Low	Changes affecting small areas of landscape character and quality, together with the loss of some less characteristic landscape elements or the addition of new features or elements
Negligible	Changes affecting small or very restricted areas of landscape character. This may include the limited loss of some elements or the addition of some new features or elements that are characteristic of the existing landscape or are hardly perceivable
Positive	Changes that restore a degraded landscape or reinforce characteristic landscape elements

The significance of a landscape/townscape impact is based on a balance between the sensitivity of the landscape receptor and the magnitude of the impact. The significance of landscape impacts is arrived at using the following matrix set out in Table 9.3.

Table 9.3 Impact Significance Matrix

Scale/Magnitude	Sensitivity of Receptor				
	Very High	**High**	**Medium**	**Low**	**Negligible**
Very High	Profound	Profound-substantial	Substantial	Moderate	Minor
High	Profound-substantial	Substantial	Substantial-moderate	Moderate-slight	Slight-imperceptible
Medium	Visual-substantial	Substantial-moderate	Moderate	Slight	Imperceptible
Low	Moderate	Moderate-slight	Slight	Slight-imperceptible	Imperceptible
Negligible	Slight	Slight-imperceptible	Imperceptible	Imperceptible	Imperceptible
Positive	Enhanced	Enhanced	Enhanced	Enhanced	Enhanced

Source: The significance matrix provides an indicative framework from which the significance of impact is derived. The significance judgement is ultimately determined by the assessor using professional judgement. Due to nuances within the constituent sensitivity and magnitude judgements, this may be up to one category higher or lower than indicated by the matrix. Judgements indicated in orange are considered to be 'significant impacts' in EIA terms

9.2.5 Visual Impact Assessment Criteria

As with the landscape/townscape impact, the visual impact of the proposed development was assessed as a function of sensitivity versus magnitude. In this instance the sensitivity of the visual receptor, weighed against the magnitude of the visual effect.

Sensitivity of Visual Receptors

Unlike landscape sensitivity, the sensitivity of visual receptors has an anthropocentric (human) basis. It considers factors such as the perceived quality and values associated with the view, the landscape context of the viewer, the likely activity they are engaged in and whether this heightens their awareness of the surrounding landscape. A list of the factors considered by the assessor in estimating the level of sensitivity for a particular visual receptor is outlined below to establish visual receptor sensitivity at each VRP.

Susceptibility of Receptors

In accordance with the Institute of Environmental Management and Assessment ("IEMA") Guidelines for Landscape and Visual Assessment (3rd edition 2013) visual receptors most susceptible to changes in views and visual amenity are:

- Residents at home;
- People, whether residents or visitors, who are engaged in outdoor recreation, including use of public rights of way, whose attention or interest is likely to be focussed on the landscape and on particular views;
- Visitors to heritage assets, or to other attractions, where views of the surroundings are an important contributor to the experience;
- Communities where views contribute to the landscape setting enjoyed by residents in the area; and

- Travellers on road, rail or other transport routes where such travel involves recognised scenic routes and awareness of views is likely to be heightened.

Visual receptors that are less susceptible to changes in views and visual amenity include:

- "People engaged in outdoor sport or recreation, which does not involve or depend upon appreciation of views of the landscape"; and
- "People at their place of work whose attention may be focussed on their work or activity, not their surroundings and where the setting is not important to the quality of working life".

Recognised scenic value of the view (County Development Plan designations, guidebooks, touring maps, postcards etc). These represent a consensus in terms of which scenic views and routes within an area are strongly valued by the population because in the case of County Developments Plans, for example, a public consultation process is required;

Views from within highly sensitive townscape areas. These are likely to be in the form of Architectural Conservation Areas, which are incorporated within the Development Plan and therefore subject to the public consultation process. Viewers within such areas are likely to be highly attuned to the townscape around them;

Primary views from residential receptors. Even within a dynamic city context views from residential properties are an important consideration in respect of residential amenity;

Intensity of use, popularity. This relates to the number of viewers likely to experience a view on a regular basis and whether this is significant at a national or regional scale;

Viewer connection with the townscape. This considers whether or not receptors are likely to be highly attuned to views of the townscape i.e. commuters hurriedly driving on busy roads versus tourists focussed on the character and detail of the townscape;

Provision of vast, elevated panoramic views. This relates to the extent of the view on offer and the tendency for receptors to become more attuned to the surrounding landscape at locations that afford broad vistas;

Sense of remoteness and/or tranquillity. Receptors taking in a remote and tranquil scene, which is likely to be fairly static, are likely to be more receptive to changes in the view than those taking in the view of a busy street scene, for example;

Degree of perceived naturalness. Where a view is valued for the sense of naturalness of the surrounding landscape it is likely to be highly sensitive to visual intrusion by distinctly manmade features;

Presence of striking or noteworthy features. A view might be strongly valued because it contains a distinctive and memorable landscape/townscape feature such as a cathedral or castle;

Historical, cultural and / or spiritual significance. Such attributes may be evident or sensed by receptors at certain viewing locations, which may attract visitors for the purposes of contemplation or reflection heightening the sense of their surroundings;

Rarity or uniqueness of the view. This might include the noteworthy representativeness of a certain townscape type and considers whether the receptor could take in similar views anywhere in the broader region or the country;

Integrity of the townscape character. This looks at the condition and intactness of the townscape in view and whether the townscape pattern is a regular one of few strongly related components or an irregular one containing a variety of disparate components;

Sense of place. This considers whether there is special sense of wholeness and harmony at the viewing location; and

Sense of awe. This considers whether the view inspires an overwhelming sense of scale or the power of nature.

Those locations which are deemed to satisfy many of the above criteria are likely to be of higher sensitivity. No relative importance is inferred by the order of listing. Overall sensitivity may be a result of a number of these factors or, alternatively, a strong association with one or two in particular.

9.2.5.1 Visual Impact Magnitude

The visual impact magnitude relates to the scale and nature of the visual change brought about by the proposal and this is reflected in the criteria contained in Table 9.4.

Table 9.4: Magnitude of Visual Impacts

Criteria	Description
Very High	The proposal alters a large proportion or critical part of the available vista and is without question the most distinctive element. A high degree of visual clutter or disharmony is also generated, strongly reducing the visual amenity of the scene
High	The proposal alters a significant proportion or important part of the available vista and is one of the most noticeable elements. A considerable degree of visual clutter or disharmony is also likely to be generated, appreciably reducing the visual amenity of the scene
Medium	The proposal represents a moderate alteration the available vista, is a readily noticeable element and/or it may generate a degree of visual clutter or disharmony, thereby reducing the visual amenity of the scene.
Low	The proposal alters the available vista to a minor extent and may not be noticed by a casual observer and/or the proposal would not have a marked effect on the visual amenity of the scene
Negligible	The proposal would be barely discernible within the available vista and/or it would not detract from, and may even enhance, the visual amenity of the scene
Positive	Changes that enhance the available vista by reducing visual clutter or restoring degraded features

9.2.5.2 Visual Impact Significance

As stated above, the significance of visual impacts is a function of visual receptor sensitivity and visual impact magnitude. This relationship is expressed in the same significance matrix and applies the same EPA definitions of significance as used earlier in respect of townscape impacts.

9.3 Receiving Environment

The landscape/townscape baseline represents the existing context and is the scenario against which any changes to it, brought about by the proposed scheme, will be assessed.

A description of the landscape/townscape context of the proposed site and wider study area is provided below. Although this description forms part of the landscape/townscape baseline, many of the elements identified also relate to visual receptors i.e. places from which viewers can potentially see the proposed scheme. The visual resource will be described in greater detail in Section 9.4.

9.3.1 Baseline Environment

9.3.1.1 Landform and Drainage

Set within the lowlands of County Wexford, the landform of Enniscorthy (from the Gaelic, Inis Córthaidh, meaning Island of the rocks) ranges from less than 5m AOD on the banks of the River Slaney, to 118m at the conical Vinegar Hill on the eastern periphery of the town centre. On the western periphery of the town, the elevation does not exceed 60m AOD. Thus, the landform effectively lifts and 'pinches' to either side of the Slaney along a near north-south corridor over approx. 1km, resulting in terrain varying from steep streets in the town's medieval centre, to more gentle inclines about its more northern and southern realm. Consequently, all natural drainage within the town falls towards the River Slaney, or else its tributary, the Urrin River, which feeds into the River Slaney's west bank approx. 1km south of the town's centre.

Enniscorthy is located along a distinct S-bend on the River Slaney, the 120km-long river that springs from Lugnaquilla Mountain in Wicklow and spills into the Irish Sea at Wexford Harbour, a little over 30km downriver from Enniscorthy. The river has served as the traditional life force of the settlement for well over 1000 years, reaching up to 50m width in places within the town, from where the Slaney flows at approximately sea level for the remainder of its course south to Wexford Harbour.

9.3.1.2 Land Use and Cover

For the purpose of this assessment, the study area can be largely divided in to three regions: the town's urban centre; its peri-urban margins, and rural/agricultural land further north and south of that periphery.

The town centre is primarily located on the west bank of the River Slaney, along which it runs for at least 500m, whereas the central areas of the town on the east bank stretch to less than 300m in length. Like many town centres in the country, Enniscorthy's is characterised by a compact mix of retail, cafés/restaurants/takeaways/pubs and office space, in tandem with churches, transport routes, parking lots and tourism, recreation and amenity facilities. This is spread, in places, across steep and narrow streets, as well as more spacious public spaces, especially those aligning the River Slaney. Figure 9.2 shows a photograph of the town situated along the River Slaney.

Figure 9.2: The town centre is primarily located on the hillier, west bank of the River Slaney

Source: Macroworks Ltd

The town's peri-urban margins are located on generally lower-lying and gentler inclines characterised by more extensive housing, larger retail outlets and/or supermarkets, with some small-scale industrial use and notable transport routes (e.g. the Dublin-Wexford rail line, or N11 and N30).

The rural/agricultural land in the far north and south of the study area primarily occupy a floodplain comprised of low-lying and often water-logged pasture, bound by linear pockets of native woodland at slightly higher elevations. Along the North Island floodplain (north of the town) and the Bare Meadow floodplain (south of the town) there is a general absence of riverside trees or bushes. Horses are frequently seen grazing both floodplains. In addition, Bare Meadow floodplain provides suitable foraging and roosting habitat for waterbirds. It should be noted that this rural/agricultural land use is prevalent on the east side of the River Slaney, for 1.3km south of the town and at least 500m north of the town. The west side of the river, however, has significantly more urban and peri-urban development, as well as riparian woodland. A photograph of the low-lying pastoral floodplain on the east side of the River Slaney, north of the town centre is shown in Figure 9.3.

Figure 9.3: The North Island on the east side of the River Slaney, north of the town centre

Source: Macroworks Ltd

9.3.1.3 Population and settlement

As noted in Section 9.3.1.2, the town is substantially more developed, and therefore more populated, on its western side.

There are notably few linear 'ribbon' developments along roads leading in and out of the town. Rather, the population is compacted into the town centre, or else across extensive housing developments/ estates over the last half century. These estates are prevalent west of the town centre towards Bellefield and Milehouse. East of the River Slaney and southeast of the town centre, similar housing developments are established in Drumgoold. However, these developments are located well beyond 200m from the River Slaney. North of the town centre and south of the Riverside Park Hotel, there are distinctively few properties aligning the River Slaney.

9.3.1.4 Transport Routes

Within the relatively tight confines of the study area, and the topography which defines it, several transport routes compete for space along the River Slaney's eastern and western banks. The Dublin-Wexford national primary road the N11, is the largest road to traverse the town, crossing over the River Slaney in the town centre. However, the 27km-long Enniscorthy bypass is under construction and due to be completed in 2019.

Aside from numerous local roads within the town centre, many regional ones also extend from it, including the R744, R702 and the R890. In addition, the N30, which links Enniscorthy to New Ross, aligns the River Slaney's west bank south of the town centre.

The Dublin-Wexford rail line crosses the River Slaney north of the town centre, where Enniscorthy Railway Station is located, and re-emerges in the south of the study area, where it runs alongside the western bank of the River Slaney. Furthermore, there is a bus stop at Templeshannon with connections to Waterford, Dublin, and other cities.

9.3.1.5 Public Amenities and Facilities

The public amenities and facilities in the town and along the River Slaney are described in Chapter 5. The River Slaney provides walking/running/cycling routes along its western bank, north and south of the town centre, while also presenting more passive recreation along its banks (e.g. benches, as well as fishing from its banks).

The Norman stronghold of Enniscorthy Castle dates from 1205 and is a very visible and iconic landmark upon the town's elevated skyline. It used to house the Wexford County Museum, but now, through various exhibitions, explores the development of the Castle and town from its earliest Anglo-Norman origins up until its use as a family home in the early 20th century. Also, in the town centre is the National 1798 Centre, which is devoted to the history and aftermath of the United Irishmen's 1798 Rising. However, this centre has subsequently closed. Across the river, many people walk or run to the top of the historic Vinegar Hill, while taking in the impressive views of the county from its summit.

9.3.2 Historical Context of Study Area

As described in detail in Chapter 10 of this EIAR – 'Archaeology, Architectural and Cultural Heritage', Enniscorthy was established centuries before the arrival of the Normans. Having been first settled over 15 centuries ago, the town is one of the longest continuously-occupied sites in Ireland. However, it is chiefly associated in the national consciousness as the infamous site of the Battle of Vinegar Hill.

In addition, in the 19th Century, local mills, malthouses/breweries and distilleries played a key role in employing residents, and stamping a wider, and more nuanced, identity upon the town. On a local level, aside from its perennial presence as a large and muscular watercourse, the Slaney has helped determine and define the tone of the town and its evolution over the last millennium, from one of conquest and occupation in Norman times, to one of trade and transport up until last century, to become one of much valued amenity and recreation today. Furthermore, Enniscorthy has retained most of its original streetscape, making it one of the town's greatest assets.

9.3.3 Existing Urban Context of Study Area

Since the turn of the century, Enniscorthy has largely continued to develop as a progressive and forward-thinking town, while maintaining and cherishing its proud and powerful historical links to previous centuries. It hosts a number of well-known festivals during the year some of which are noted in Chapter 5 of this Report.

Nonetheless, a range of development pressures and needs have been facing the town in order to maintain it as a successful and sustainable place to live and work for present and future generations. Chief among those needs is to permanently address the threat of flooding the town routinely experiences; a subject that has been covered in more detail in Chapter 3 of the EIAR – 'Project Need and Analysis of Alternatives.'

Nevertheless, for residents there is robust connectivity and interaction between the quays on the River Slaney, as the river has largely served the purpose of characterising and unifying the town and its image, rather than fragmenting it despite the large volumes of N11 traffic in close proximity.

9.3.4 Wexford County Development Plan 2013-2019

9.3.4.1 Green Infrastructure

Chapter 14 of the Wexford County Development Plan 2013-2019 entails the heritage of County Wexford, in which Section 14.3 entails Green Infrastructure. According to the Plan, Green Infrastructure is:

"…A concept which has been growing in prominence and importance in recent years. Natural heritage forms an important part of it but the concept of green infrastructure refers to its functionality. The term relates to the protection, management, enhancement and sensitive utilisation of urban and rural environmental resources through the identification and provision of multi-functional and interconnected green spaces.

"Green Infrastructure can be defined as an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations. It includes rivers, inland waterways, floodplains, wetlands, woodlands, farmland, coastal areas, parks and open spaces, natural conservation areas, gardens and allotments.

"Green Infrastructure is a quality of life issue with positive economic, social and health benefits. It contributes to the protection of urban and rural environments for people, biodiversity and ecosystem services, which in turn delivers environmental and quality of life benefits such as improving air, water and soil quality, flood protection, access provisions and linkages, climate change/amelioration and pollution control."

The Plan also states how a well-designed network of Green Infrastructure will help to:

- Provide a high-quality environment which will provide economic benefits by attracting inward investment and new business;
- Provide high quality open spaces which provide health and social benefits for people through the provision of play areas, safe and attractive areas and routes for meeting, walking and cycling;
- Provide opportunities and space for contact with nature which is considered essential for good health and wellbeing; and
- Allow communities to adapt to the impacts of climate change and flooding.

In terms of a Green Infrastructure Strategy for County Wexford, the Plan goes on to state how the "Council supports the concept of Green Infrastructure as an important tool in environmental protection and land use planning." Accordingly, the Council have devised the following Green Infrastructure (GI) objectives that are relevant to the study area:

Objective GI01

To ensure the protection, enhancement and maintenance of the natural environment and recognise the economic, social, environmental and physical value of green spaces through the integration of Green Infrastructure planning and development in the planning process.

Objective GI03

To identify, protect, enhance and manage Green Infrastructure in all Local Area Plans in an integrated and coherent manner.

Objective GI05

To require new developments to contribute to the protection and enhancement of existing Green Infrastructure, and the provision of new Green Infrastructure where appropriate, in an integrated and coherent manner.

Objective GI07

To require proposals for significant development to submit a Green Infrastructure Plan as part of the planning application.

It is important to note that there are three National Parks and Wildlife Service (NPWS) designations applicable to the study area:

- River Slaney Valley proposed Natural Heritage Area (pNHA) (Site Code: 000781);
- River Slaney Valley Special Area of Conservation (SAC) (Site Code: 000781);
- Wexford Harbour and Slobs Special Protection Area (SPA) (Site Code: 004076), the most northerly point of which is just south of the confluence of the Urrin and River Slaney in the far south of the study area.

Landscape

Section 14.4 of the County Development Plan entails Landscape; again, defined as "perceived by people, whose character is the result of the action and interaction of natural and/or human factors." According to the Plan:

"Landscapes are a daily presence in the lives of the county's residents and workers. The enjoyment of these landscapes can contribute to a high quality of life for the people who live and work here and promote a pleasurable experience for the people who visit the county.

"The Council recognises that landscapes are living, and that they have and will continue to change over time. The Council's broad aim is to promote and enable appreciation of the county's landscapes and to minimise adverse visual impacts on these landscapes in the interests of the common good. However, the Council also recognises that there is need for a balanced approach to ensure that future development with a definable need to locate in a particular landscape is accommodated, where appropriate.

"The county's landscapes offer a significant economic asset, in particular, the agricultural and tourism potential of the coastal, rivers, estuaries and mountain landscapes. The protection and promotion of the landscape as an economic product is therefore critical…"

In terms of Landscape Character Assessment, four landscape character units are identified in the Plan for County Wexford. Two of these, "Lowlands" and "River valley," are of relevance to the study area.

Firstly, the town of Enniscorthy is located within the 'Lowland' character unit of the county. According to the Plan:

"The Lowland area generally comprises [of] gently undulating lands and relates to extensive areas of the county. This landscape has characteristics which provide it with a higher capacity to absorb development without causing significant visual intrusion. The landscape is characterised by higher population levels and more intensive agriculture. It is punctuated by many of the county's hills and ridges, the more sensitive of which have been defined as Landscapes of Greater Sensitivity."

In Volume 3 of the Development Plan, it expands on this character unit to state that, *"The lowland unit generally has characteristics which have a higher capacity to absorb development without it causing significant visual intrusion although, care still needs to be taken on a site by site basis, particularly to minimise the risks of developments being visually intrusive."*

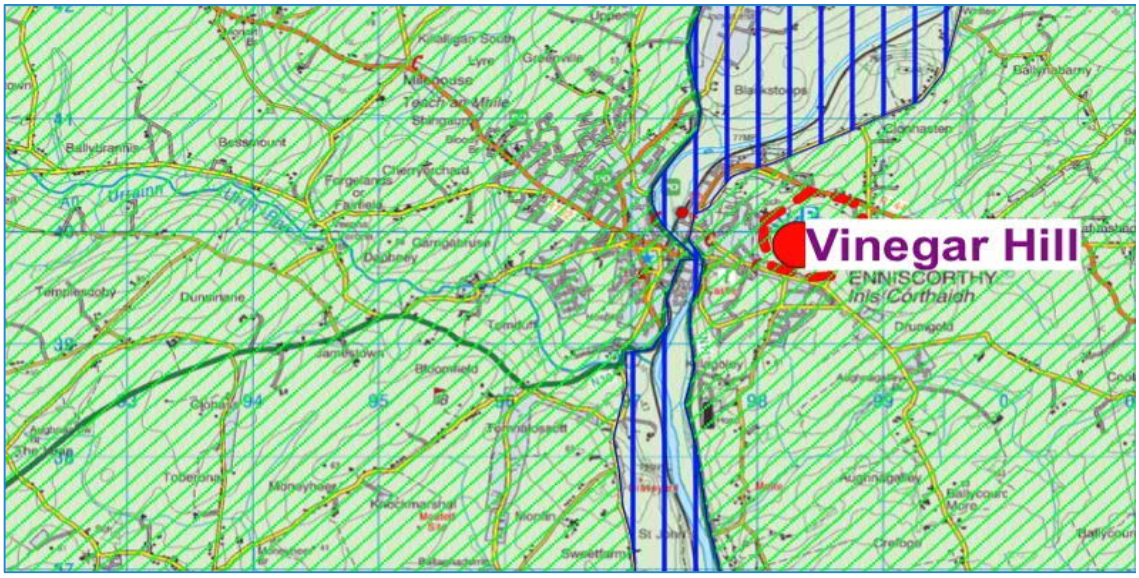
Secondly, as the River Slaney flows through the town, it and its floodplain occupy the 'River Valley' character unit. According to the Plan:

"The Slaney and Barrow River Valleys, which include the rivers and their associated riparian and woodland habitats, offer significant scenic qualities, which are sensitive to development."

Further to these four landscape character units are "Landscapes of Greater Sensitivity," as identified and designated by the Council, who state that *"they represent features in the landscape and seascape which have the most visual interest and prominence, and which are generally more sensitive to development."* This is of relevance to the study area because Vinegar Hill is designated as one such Landscape of Greater Sensitivity.

In addition, the Council states that "*where a Landscape of Greater Sensitivity, or a part of it, is located within the boundary of a town development plan or local area plan, the relevant area has not been identified on Map No. 13. However, in the case of Vinegar Hill, it was considered imperative to include it as it may be affected by development proposals outside of the Town Development Plan boundary*." An excerpt of that Map No.13 can be viewed in Figure 9.4.

Figure 9.4: An extract of Map No. 13 from Wexford County Development Plan 2013-2019 showing the landscape character units relevant to the study area



Accordingly, the Plan contains the following Landscape (LO) objectives that are relevant to the study area:

- **Objective L01** - To have regard to the Landscape Character Assessment and associated map contained in Volume 3, the Landscape and Landscape Assessment-Guidelines for Planning Authorities (2000) Draft and any updated versions of these guidelines published during the lifetime of the Plan, when assessing planning applications for development;

- **Objective L03** - To ensure that developments are not unduly visually obtrusive in the landscape, in particular in the Upland, River Valley and Coastal landscape units and on or in the vicinity of Landscapes of Greater Sensitivity;
- **Objective L04** - To require all developments to be appropriate in scale and sited, designed and landscaped having regard to their setting in the landscape so as to ensure that any potential adverse visual impacts are minimised;
- **Objectives L05** - To prohibit developments which are likely to have significant adverse visual impacts, either individually or cumulatively, on the character of the Uplands, River Valley or Coastal landscape or a Landscape of Greater Sensitivity and where there is no overriding need for the development to be in that particular location;
- **Objective L06** - To ensure that, where an overriding need is demonstrated for a particular development in an Upland, River Valley or Coastal landscape unit or on or in the vicinity of a Landscape of Greater Sensitivity, careful consideration is given to site selection. The development should be appropriate in scale and be sited, designed and landscaped in a manner which minimises potential adverse impacts on the subject landscape and will be required to comply with all normal planning and environmental criteria and the development management standards contained in Chapter 18;
- **Objective L07** - To encourage appropriate development which would enhance an existing degraded landscape and/or which would enhance and introduce views to or from a Landscape of Greater Sensitivity from public viewpoints, subject to compliance with all normal planning and environmental criteria and the development management standards contained in Chapter 18;
- **Objective L08** - To consider appropriate rural recreational and tourism related developments which would facilitate public access to and appreciation of Upland, River Valley and Coastal Landscapes and Landscapes of Greater Sensitivity in the County subject to compliance with the relevant objectives in Chapters 6, 7 and 13. Developments should be appropriate in scale and be sited, designed and landscaped in a manner which minimises potential adverse impacts on the landscape and shall be in compliance with all other planning and environmental criteria and the development management standards contained in Chapter 18; and
- **Objective L09** - To require developments to be sited, designed and landscaped in manner which has regard to the site-specific characteristics of the natural and built landscape, for example, developments should be sited, designed and landscaped to minimise loss of natural features such as mature trees and hedging and built features.

9.3.5 Enniscorthy Town and Environs Development Plan 2008-2014

The lifetime of the Enniscorthy Town and Environs Development Plan 2008-2014 will continue to have effect until 2019, or such time as a new County Development Plan is made. In addition, the Council website says it should be read together with the Wexford County Development Plan 2013-2019.

In Chapter 9 of the Enniscorthy Development Plan, the issue of Natural Heritage is addressed in Section 9.3 Part C, which states that "*The town is rich in natural, archaeological and built heritage. This heritage should be protected, as it is a valuable, non-renewable resource, which contributes greatly to quality of life.*"

In addition, the Plan states that "*it is an objective of the Joint Councils to conserve, protect and enhance in general the character of Enniscorthy as defined by its natural heritage and biodiversity, built environment, landscape and culture*."

In terms of Policy Statements relevant to the study area, the Plan states that it is the policy of the Joint Councils:

- NH7: To protect riparian zones by maintaining an adequate buffer zone (minimum 5-10m back from the riverbank) along all watercourses, with no infilling or removal of vegetation within these buffer zones.

Section 9.5 “Views and Prospects.” of the Enniscorthy Town Development Plan states that the town of Enniscorthy and its surrounding environs has a number of views, which contribute considerably to the unique character of the historic town. “*It is important as the town is developed that certain important views and vistas be first of all protected and secondly enhanced where possible*.” According to Map No. 13 in the town’s Development Plan, there are several such Protected Views that look on, across or from the banks of the Slaney. These include:

- EV010-Court Street and Friary Hill;
- EV011-Friary Hill and Lower Church Street;
- EV016-Junction of Seamus Rafter Bridge and Abbey Square;
- EV017-Slaney Bank at Mary Street, Slaney Bank up Slaney Street, Slaney Bank North along River Slaney and beyond Railway Bridge, Slaney bank across to Templeshannon, Slaney Bank South East to Enniscorthy Bridge;
- EV018-Corner of Shannon Quay and Seamus Rafter Bridge;
- EV019-Shannon Quay looking North West to Enniscorthy Bridge, Shannon Quay along to Seamus Rafter Bridge; and
- EV020-Enniscorthy Bridge and Templeshannon.

Notably, the Plan states that it is the policy of the Joint Councils to:

- EV 024-Protect views and prospects of special amenity value or interest; and
- EV 025-Ensure that all conditioned areas of public open space are developed in tandem with the construction of development.

9.3.6 Identification of Viewshed Reference Points as a Basis for Assessment

Viewshed Reference Points (VRP’s) are the locations used to study the visual impacts associated with the proposed scheme. It is not warranted to include each and every location that provides a view as this would result in an unwieldy report and make it extremely difficult to draw out the key impacts arising from the proposed scheme. Instead, the selected viewpoints are intended to reflect a range of different receptor types, distances and angles. The visual impact of a proposed scheme is assessed using up to 6 categories of receptor type as listed below;

- Key Views - from features of national or international importance;
- Designated Scenic Routes and Views;
- Local Community views;
- Centres of Population;
- Major Routes; and
- Amenity and heritage features.

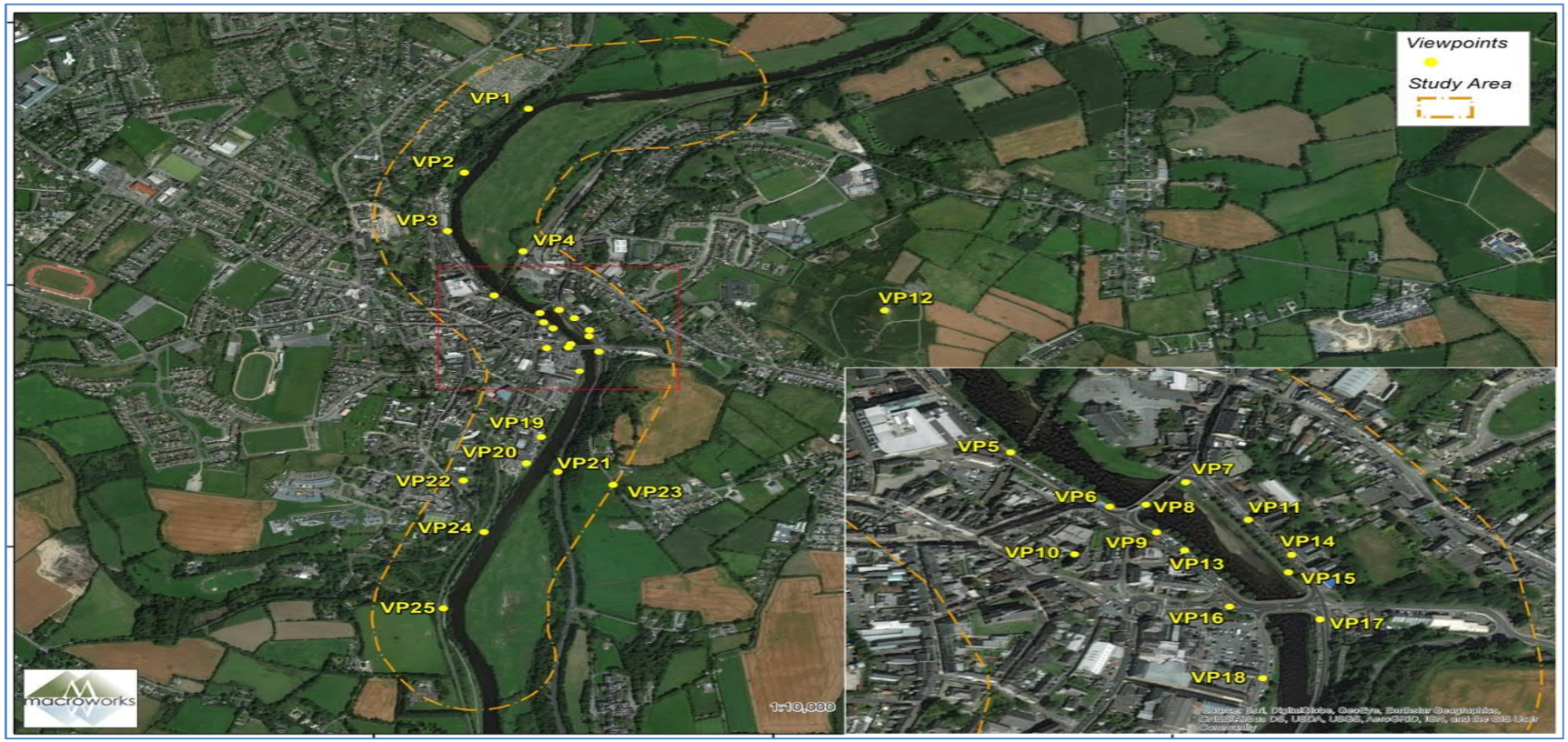
The Viewshed Reference points selected in this instance are set out in Table 9.5 and shown in Figure 9.5.

Table 9.5: Outline description of Viewshed Reference Points

VP no.	Location	Direction of View
VP1	Riverside walkway near St. Mary's Cemetery on N11	E/NE
VP2	Riverside walkway north of town	S
VP3	Slaney-side rear of residences on Island Road	SE
VP4	Enniscorthy Train Station	W
VP5	Railway bridge over Slaney at Island Road/N11	NE
VP6	Slaney Place/N11 close to Enniscorthy Bridge	NE
VP7	Corner of Shannon Quay/N11 & Enniscorthy Bridge	W/SW
VP8	Enniscorthy Bridge/N11 over River Slaney	S/SE
VP9	Abbey Quay/N11	NE
VP10	Rooftop of Enniscorthy Castle	NE/E/SE
VP11	Shannon Quay	SW/W/NW
VP12	Vinegar Hill	W
VP13	Abbey Quay	S/SE
VP14	Shannon Quay/N11	NW
VP15	Location of proposed footbridge	SW/W/NW
VP16	Junction of N30 & N11	NE/E/SE
VP17	Seamus Rafter Bridge	W/NW/N
VP18	The Promenade near Super Valu car park	N/NE/E
VP19	The Promenade south of Seamus Rafter Bridge	NE
VP20	Ballroom Terrace of the Riverside Park Hotel	S
VP21	N11 opposite Riverside Park Hotel	W/NW
VP22	Grounds of the National 1798 Centre	E
VP23	Elevated location on Esmonde Road	W
VP24	Riverside Walk south of Riverside Park Hotel	N
VP25	Riverside Walk south of Riverside Park Hotel	N

Source: Macroworks 2017

Figure 9.5: Viewpoint Selection Map



Source: Macroworks, 2018

9.3.7 Do-Nothing Scenario

The Do-Nothing Scenario would occur as a result of non-implementation of the proposed scheme. The primary effect of this would be that the impacts and effects identified below would not directly occur.

9.4 Assessment of Impacts

9.4.1 Landscape/townscape Impacts

Landscape/townscape value and sensitivity are considered in relation to a number of factors set out in the Guidelines for Landscape and Visual Impact Assessment 2013, which are now discussed relative to the study area.

9.4.1.1 Landscape/townscape quality (condition)

The quality of Enniscorthy's urban centre is branded by the River Slaney, its banks and its bridges, which have all helped imprint the tone of the town in modern times. The general condition of that urban centre is, for the most part, one of high-integrity and/or quality. For at least the last century, the town has retained most of its original streetscape and not significantly or deleteriously impacted or altered the course, quality or scale of the Slaney as it flows through the town centre.

The town centre is overwhelmingly cased within the western, hillier side of the river, along which it runs for more than half a kilometre. Along this stretch, and for at least 200m inland from the west bank of the river, the town is generally a pleasing and engaging palimpsest of centuries sustainably, tactfully, and often tastefully, overlapped and interlinked for the 21st Century. In addition, the development and escalation over the last half century of retail, cafés, restaurants and takeaways, as well as office space, car parks and arterial roads, have unquestionably impacted the fabric of the town centre, without discernibly detracting from its character in any significant way. In comparison to the majority of Irish towns of a similar size, the buildings, streetscape and public spaces of Enniscorthy Town centre are in notably good condition, and there is very limited dilapidation or degeneration evident.

The town's peri-urban margins are also of a generally high quality, although they are engendered with a more residential tone. Again, such development is primarily aligned along the Slaney's west bank. Aside from homes built in the last century, there are some larger retail outlets and/or supermarkets, some small-scale industrial use and notable arterial roads (e.g. N11, N30) that help characterise these lower-density margins. In general, these buildings and spaces are, again, of a good quality.

The rural/agricultural land in the far north and south of the study area is more difficult to categorise, in terms of quality and condition. The quality of this area is typified by the floodplain on the east bank of the Slaney, along the course of 1.3km south of the town and at least 500m north of the town. While there appears to be very limited agricultural/pastoral production in this zone, as a 'natural' outdoor amenity for the town residents (for walking, jogging or fishing, for example) this 'green buffer' is second-to-none in importance, and, once more, of generally high quality/integrity.

9.4.1.2 Scenic quality

Enniscorthy's town centre has a strong scenic quality, owing to its array of medieval and old buildings, its original, narrow streetscape and its hillside setting with a muscular river arcing between its grip. In addition, views of Vinegar Hill across the river, the lack of ribbon

development-style housing, as well as more verdant vistas visible in the northern and southern realm of the study area corridor, do much to instil a discernible scenic quality to the town. Nonetheless, while the town may be one of the more scenic ones in the county, this would not necessarily be so for the country.

It should also be noted that the town, and its centre in particular, has continued to evolve and develop over the last half century without noticeably detracting from its inherent scenic quality. This can be observed by some substantial retail and residential development along the west bank of the Slaney, such as along The Promenade, Abbey Quay and Island Road, as well as the voluminous Riverside Park Hotel in the south of the study area.

On the east bank similar development has taken place at the junction of Shannon Quay and the R744, 'The Waterfront' development backing on to the River Slaney between the rail bridge and Enniscorthy Bridge and Templeshannon near Enniscorthy Rail Station.

9.4.1.3 Rarity and representativeness

While several of Enniscorthy's buildings and streetscapes are comparable to those found in some other Wexford towns and villages, it is the landform of the town and the snaking River Slaney which lends the town its most striking point of difference, or rarity. This rarity is compounded by the conical grandeur of Vinegar Hill standing sentinel to the northeast of the town centre. The aforementioned 'pinched' effect of the landform surrounding the Slaney provides a compelling setting to the town. However, this setting lessens somewhat as one moves out of the townscape of Enniscorthy and north or south along the river.

9.4.1.4 Conservation interests

As referred to in Section 9.3.4.1, the River Slaney Valley that dissects the town centre and its peri-urban margins is subject to a proposed Natural Heritage Area (pNHA) and Special Area of Conservation. Furthermore, south of the confluence of the Urrin and River Slaneys in the far south of the study area is the Wexford Harbour and Slobs Special Protection Area (SPA).

9.4.1.5 Recreation Value

The age-old fulcrum and focal point of recreation value in the study remains the River Slaney. Owing to the landform and geography of the town, comparable natural amenities are almost non-existent. The river valley provides walking/running/cycling routes along its western bank, north and south of the town centre, which serve as a de facto 'green lung' for the town. In the town centre, the river also provides more passive and/or sedentary recreation along its banks, in the form of grass margin and benches for relaxing during the summer months, as well as fishing from its banks and bridges. When combined with the accessibility and amenity value of Vinegar Hill, Enniscorthy has one of the most abundant and accessible natural amenities of all Wexford towns.

9.4.1.6 Perceptual Aspects

On a national spectrum, Enniscorthy has been chiefly associated with 1798 and the United Irishmen, despite a settled legacy predating the that period by over 1000 years. Nonetheless, the iconic Vinegar Hill has served for many in both the county and country as a salutary landmark for that unique and fascinating period in Irish history, and visitors and residents alike are reminded of that by its highly visible form and presence, especially by road users entering or exiting Enniscorthy.

In more recent decades, however, strong national and international perceptions of the town have been deeply rooted in literature and the arts, owing to an impressive array of world-class writers, artists, designers and musicians that not only originate from the town, but have also set some of their most compelling work in it. Simultaneously, the aforementioned scenic quality and recreation value of the town and, more particularly, the river that arcs through it, layers a third layer to the wider perception of the town.

All up, these perceptions have lent the perception of Enniscorthy being a deeply historic, cultured and aesthetic Irish town. At the same time, for residents of the town and its hinterland, Enniscorthy is a place to live, work, be educated, socialise and exercise in; in other words, a real home to over 11,000 people. It's adaptive, ever-evolving identity continues to successfully and sustainably forge through the 21st Century with the Slaney remaining at its heart.

9.4.1.7 Summary of Landscape/townscape Value and Sensitivity

It is considered that whilst the landscape/townscape contained within the study area has a relatively high degree of rarity and sensitivity, the banks of the Slaney are much more robust. On balance, the landscape sensitivity is judged to be High-medium**.**

9.4.1.8 Magnitude of Landscape/townscape effects

Construction Phase

Construction of the proposed scheme is likely to cause substantial, yet short-term, effects[40]. These effects will occur over the course of at least 3 years upon an approx. 100m-wide corridor of the townscape of Enniscorthy and the landscape of its rural periphery north and south of the town centre. (Please note: this approx. 100m-wide corridor that is likely to be affected during construction phase should not be confused by the approx. 200m-wide corridor that serves as the width of the study area.).

During the construction period, the townscape/landscape along the banks of the River Slaney will undergo changes that are likely to range from low to high impact, owing to multiple construction works within and alongside the river. These works will include, but are not limited to:

- Dredging (deepening) and/or widening and filling along various sections of the River Slaney in and adjacent to Enniscorthy Town;
- Creation of one main construction compound plus auxiliary works area adjacent to the new road bridge;
- 2-3m high impermeable barrier will be used to isolate the works areas from the main channel river flow, which will be constructed sequentially along the centreline of the river along the extent of the works area;
- Presence and movement of large excavators and earth-moving machinery, including barge(s) and crane(s);
- Installation of temporary fencing, lighting and parking;
- Removal of approx. 29 mature trees from both quays between the Enniscorthy bridge and the Seamus Rafter bridge, as well as four mature trees south of the Seamus Rafter bridge along The Promenade;
- Construction of flood defence walls along approx. 1.4km of the River Slaney;

[40] Short Term i.e. a duration of effect of one to seven years, as defined by the aforementioned Environmental Protection Agency publication 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports - Draft August 2017

- Removal of Seamus Rafter Bridge;
- Construction of the proposed road bridge;
- Construction of proposed pedestrian bridge;
- Planting of semi-mature (*Pyrus Calleryana* 'Chanticleer') between Enniscorthy Bridge and proposed pedestrian Bridge;
- Raising road/ground levels along sections of the quays and the promenade;
- The deposition of approximately 100,000m^3 of dredged material to a height of up to 1.5m above existing ground levels across the permanent depositional zone located on the North island floodplain; and
- Creation/restoration of a back-channel and ecological corridor along the eastern side of the North island.

While the magnitude of these works could appear high if condensed into one limited or confined area of the town, it must be remembered that they are, in fact, spread out over 2-3km along a winding S-bend of the river. In addition, outside the approx.100m-wide corridor, the fabric of the town centre and its peri-urban and rural margins will experience little of no townscape/landscape effect during the construction phase.

On balance of these reasons, the magnitude of landscape/townscape impact during construction phase is deemed to be Medium.

Operational Phase

The landscape/townscape effects of the operational phase of the proposed works are both multiple and varied, and are a direct result of the proposed works carried out in the construction phase. In addition, the effects are considered permanent.

Proposed measures to increase conveyance include dredging and widening. currently the existing minimum bed for approximately half of the proposed works length is between 0.25 and 1.5m lower than the Design Bed Level while the remainder bed levels will need to be deepened by approximately 0.25m to 0.8m to achieve the Design Bed Level. While river widening can entail broadening the width of the River Slaney between 2.5-14m in certain places south of the town centre. While this increase could be notable in specific locations along the River Slaney, it is in the millennia-old context of a large lowland tidal river that is already 40-50m in width at Enniscorthy, while being many times that width north and south of the town, when regularly in flood. Consequently, the landscape impacts of such measures are relatively low in comparison to the impact such regular flooding has along the 3km-long landscape baseline of the study area that the 'do nothing' scenario presents.

The magnitude of landscape/townscape effects in operational phase of the permanent deposition zone is also of note in this report, as the deposition site for the excavated dredged materials will be deposited within the floodplain meadow on the north island to a height of 1.5m above prevailing ground levels. While this will have an unquestionable landscape impact, with the landscape being a receptor in its own right, this is softened somewhat by the flat ,even nature of the deposition (in keeping with the nature and appears of this floodplain), the aforementioned topsoiling and reseeding, the adherence to and respect of the present form of this ever-changing floodplain and the modest deposition depth spread over a lateral length of more than 700m, again result in operational landscape impacts that are relatively minor.

While this will likely stamp a more anthropocentric imprint upon the landscape character of the flood plain, these depositional works will also avoid engineered-looking, uniform slopes where possible in order to provide a more naturalistic landscape that is consistent with the winding course of this wide, lowland river. In addition, the riparian habitat planting proposed for the back-

channel along the eastern side of the north island will help to further ameliorate and naturalise the appearance of this deposition area.

Also, in terms of planting within the study area, the existing mature trees that will be removed from along the quays to facilitate the proposed works will be replaced with new semi-mature specimen trees (i.e. *Pyrus Calleryana* 'Chanticleer') This will ultimately, upon maturity of the trees, help strengthen the townscape, and will help to restore the townscape setting

The creation of over 2.3km of flood defence walls which range in height is likely to have a marked operational impact upon the landscape north and south of the town, as well as upon the townscape of Enniscorthy, similar to the creation of town walls over more recent centuries of the town's evolution. The raising, reinstatement and thickening of these walls must also be seen in comparison to the landscape impacts that regular flooding has upon the valued townscape of Enniscorthy, which the 'do nothing' scenario presents. The proposed flood defence walls present a more abrupt and defined transition from the river to the quays and will have a considerably more contained and controlled impact upon the townscape than the existing baseline.

Proposed new Bridges

The proposed removal of the mass concrete bulk of the Seamus Rafter Bridge and the construction of a new road bridge some 600m downstream of the Riverside Park Hotel will have a clear impact upon the landscape, though one which is deemed to be more sustainable, suitable, coherent and better designed for the townscape and wider landscape of the study area.

Similarly, the proposed new pedestrian footbridge within the town will be built across the River Slaney just upstream of the existing Seamus Rafter Bridge. It will not only ensure pedestrian flow within the town will be improved, but its architecturally advanced design, elevated pitch and light materials present a further upgrading of the river crossings created by the proposed scheme. This distinct increase in "urban design" standards of Enniscorthy's Slaney Centre has a wider knock-on effect for the town and its hinterland. Furthermore, it will help increase the interconnectivity and permeability that is an essential ingredient in the landscapes of all healthy and sustainable townscapes. Indeed, such measures represent welcome and long-overdue operational/permanent landscape impacts for the study area.

Traffic Management Works

Lastly, the proposed scheme requires raising of the ground levels on the protected side of the defences in order to limit the height of the flood walls to an acceptable level and limit the potential visual impact. However, not only are such increases very modest, but are not inconsistent with the undulating topography of the town. In addition, such raising of ground levels to either side of the Slaney within this historic townscape have, in reality, been taking place, layer upon layer, for several centuries.

The magnitude of landscape/townscape impact during operational phase is deemed to be Medium-Low.

9.4.2 Visual Impacts

Individual assessments at each of the 25No. selected representative viewpoints are contained in Appendix F of this EIAR. For the sake of brevity and in order to distil the key findings, visual effects are summarised hereunder.

Table 9.6: Summary of Visual Impacts (See Appendix)

VP no.	Visual Receptor Sensitivity	Magnitude of Visual Effects	Significance of Visual Impacts
VP1	High-medium	Low	Slight
VP2	Medium	Low	Slight
VP3	Medium-low	High	Moderate
VP4	Medium-low	Low	Slight
VP5	Medium-low	Low	Slight
VP6	High-medium	Medium-low	Moderate
VP7	High-medium	Medium-low	Moderate-slight
VP8	High-medium	Medium low	Moderate-slight
VP9	Medium	Low	Slight
VP10	High	Low	Moderate-slight
VP11	Medium	Medium low	Moderate-slight
VP12	High	Negligible	Slight-imperceptible
VP13	Medium	Negligible/Positive	Imperceptible
VP14	Medium	Medium-low	Moderate-slight
VP15	High-medium	Medium-low	Moderate-slight
VP16	Medium-low	Negligible/positive	Imperceptible
VP17	Medium	Medium-low	Moderate
VP18	Medium-low	Medium	Moderate-slight
VP19	Medium	Medium	Moderate
VP20	Medium	Medium	Moderate
VP21	Medium	Low	Slight
VP22	Medium-low	Medium	Moderate-slight
VP23	High-medium	Medium-low	Moderate
VP24	High-medium	Medium	Moderate
VP25	High-medium	Low	Slight

Source: Macroworks 2018

9.4.2.1 Visual Receptor Sensitivity

Visual receptor sensitivity tends to be in the mid to high range for the selected VP locations and this is strongly influenced by the heritage value of Enniscorthy in tandem with the iconic, and often scenic, corridor of the River Slaney. The highest level of sensitivity (High) is considered to occur at the summit of Vinegar Hill (VP12) and from the publicly accessible roof of Enniscorthy Castle (VP10). Meanwhile, the lower end of the visual receptor sensitivity spectrum (e.g. Medium-low) is representative of more urbanised/townscape views that are less influenced by views of the river corridor and more predisposed to vehicle-related infrastructure and commerce.

9.4.2.2 Visual Impacts relating to the Deposition Area on the Northern Island

Visual impacts relating to the deposition of dredged material on the North Island floodplain are assessed using VP1-5. The principal visual change will be a moderate increase in the height of the island, which will be most noticeable from vantage points of a similar elevation, as well as the widening of River Slaney channel. From more elevated and distant vantage points the fill will be less obvious. During and immediately following the construction phase works, the land cover will clearly present as being recently modified. However, in the very short period of time when that vegetation becomes established, the North Island floodplain will begin to visually integrate

and fuse with the adjacent land use and cover**,** while more closely resembling the existing floodplain.

Indeed, the appearance of the deposition area will continue to visually assimilate as the same natural processes that guided the existing island exert their influence. For these reasons, the magnitude of visual impact is not considered to exceed 'Low' for this northern realm of the proposed scheme, once the construction phase is complete. Consequently, the significance of visual impact in this area is not deemed to exceed 'Slight.'

The one exception within this northern realm, however, is from VP3 (i.e. a south-eastern view from the west bank of the Slaney), where the construction of the necessary flood protection wall blocks views of the river, the floodplain and the Templeshannon area of the town from the residences along Island Road which the wall is protecting. This resulted in a 'Moderate' significance of visual impact.

9.4.2.3 Visual Impacts relating to town centre works

The town centre between Shannon Quay and Abbey Quay will be subject to the most noticeable visual change from the proposed scheme. This is because it represents physical change to the existing setting and many of its key riverside elements, and not just the addition of new features. These changes consist of the removal of the existing Seamus Rafter Bridge and the introduction of a contemporary pedestrian bridge. The pedestrian bridge, due to its elevation above the river, requires ramps that link down to the quays on either side; these ramps are sizeable, distinct features in their own right.

An array of 12 no. representative viewpoints have been assessed within this central area of the scheme. Although each are concentrated on different aspects of the proposed scheme, with the exception of VP18 and VP6, a viewer could take in most of the aforementioned elements of the scheme from any one of them, as they are all contained within the same enclosed visual setting.

The highest levels of significance of visual impact ('Moderate') occurs where the proposed flood retention walls and/or the pedestrian bridge ramps preclude widespread visibility of the river in locations that currently afforded such views, or where the proposed scheme has a 'Medium-low' visual impact magnitude upon a 'High-medium' visual receptor sensitivity. The considerable proportion of glazed flood protection walls have a strong mitigating effect on potential visual impact, as they reduce the sense of potential enclosure and allow clearer views of the river corridor.

In addition, the high-quality finish of the cut stone walls and glazed sections is well suited to this town centre visual context, and one is seldom far from a vantage point that will afford views of the river; views that are more elevated, multi-layered and far-reaching than those offered by the visual baseline. Indeed, a new landmark view of the River Slaney to equal, if not better, that from Enniscorthy Bridge will be afforded from the proposed pedestrian bridge (see VP15). This is unburdened by any foreground screening from flood retention measures and gives a unique view north and south along the townscape sections of the Slaney.

A couple of views for which the proposed scheme is considered to result in 'Negligible/Positive' visual impact magnitude, resulting in an 'Imperceptible' significance of visual impact, are VP16 and VP13 along Abbey Quay. In these instances, the proposed scheme is deemed to represent an appreciable increase in visual amenity along this section of the Slaney's town centre west bank. The proposed high-quality design serves to create a stronger physical and visual connection to the river corridor than occurs at present on what is currently a concrete-laden, vehicle-choked thoroughfare.

All of the remaining central area viewpoints are considered to incur a 'Slight' or 'Moderate-slight' visual impact significance. This is largely due to a slightly reduced sense of visual connectivity to the river, along with an increased degree of engineered intervention on its banks, off-set by a high-quality design using high-spec materials and construction standards that are well suited to this progressive town centre setting. Though strong visual permeability and connection to the Slaney River is the most desirable outcome to any necessary flood defence scheme in such a historic town, the compromise represented by the proposed scheme is well considered and balanced.

9.4.2.4 Visual Impacts relating to the proposed N11 Road Bridge and southern bank works

Seven viewpoints were selected in order to assess the effects of the proposed N11 road bridge and the southern bank works. While VP19 is focused on the southern realm of the town centre, the remaining six viewpoints capture the context of the peri-urban context south to the Riverside Park Hotel, and beyond to the rural/agricultural hinterland further south. These include viewpoints from the riverside walk to the south of the hotel, looking north/northeast; from the Riverside Park hotel looking south/southeast towards the open floodplain, as well as elevated views from above each end of the proposed bridge.

Overall, it is considered that although the new bridge will represent a noticeable increase in built intensity - namely transport-related infrastructure across a section of the Slaney that is transitioning into a less developed rural setting - it complements this urban-rural threshold. The proposed bridge marks the urban edge of this historic town in a fresh and fitting 21st Century design that provides a much-needed sense of entrance, presence and definition, without representing an obstructive visual barrier between rural and urban.

For these reasons, the significance of visual impact is no greater than 'Moderate,' in the visual setting of the proposed N11 road bridge and southern River Slaney works.

9.5 Mitigation Measures

For many of the proposed elements of the development mitigation measures are either not required or they are 'embedded' in the overall design of the scheme already assessed in the predicted impacts section. Such 'embedded' mitigation is evident in the high level of architectural consideration given to the design of both the proposed new road and pedestrian bridges as well as the use of local stone for flood wall cladding so that they blend with the existing river walls and bridges.

It should be noted that a previous iteration of the scheme (2009) met with a large number of objections, which principally related to the reduced visual and physical connectivity to the river due to the high stone walls proposed and the consequent adverse effects on aesthetics and recreational use. The scheme has since been revised to address these issues with one of the main aspects of mitigation being the use of extensive sections of glazing within the flood walls to reduce the enclosure of the river by these walls and, in turn, maintain the visual connectivity between the river and the quays. Physical connectivity with the river corridor, although reduced from the current scenario as a consequence of the proposed flood defence works, is maintained insofar as possible with periodic access stairs and ramps. Along the western quays and the Promenade sections of road are also raised, which has the effect of reducing the perceived height of the adjacent flood wall.

Mature amenity trees that will be removed from along the quays and riverside park to facilitate the works will be replaced with new semi-mature specimen trees (*Pyrus Calleryana* 'Chanticleer'). Although replacements, these new trees will provide renewed longevity to the

riverside tree network and help to soften and assimilate the increased 'built' tone and texture of the flood walls.

Although more of an ecological mitigation measure, the riparian habitat planting associated with the back-channel along the eastern side of the north island will help to soften and naturalise the engineered appearance of the deposition area. The deposition works will also avoid flat platforms and regimental uniform slopes insofar as possible (to ensure stability and facilitate runoff) in order to provide a more naturalistic appearance that is consistent with the winding course of the River Slaney.

9.6 Residual Impacts

As the vast majority of landscape and visual related mitigation measures are 'embedded' within the overall design of proposed scheme and represented in the photomontages utilised for the visual impact assessment, 'residual impacts' can be considered the same as 'predicted impacts' for the purposes of this assessment (Sections 9.4 and 9.5 and Appendix F refer).

10 Archaeological, Architectural and Cultural Heritage

10.1 Introduction

This Chapter provides an assessment of the proposed Enniscorthy Flood Defence Scheme and its impacts on the receiving archaeological, architectural and cultural environment. Its primary aim is to assess the likely impact that the proposed scheme will have on this environment and to provide suitable mitigation measures to safeguard any monuments, features and finds which may be of cultural heritage merit within the study area. Details of the proposed scheme are provided within Chapter 4 of this EIAR.

This Chapter was prepared by The Archaeological Diving Company Ltd (ADCO) and Ivor McElveen Associates, Historic Building Consultants & Conservation engineering Services. The assessment was carried out with the express purpose of assessing the archaeological and architectural, and cultural heritage risk of the riverbed and associated land areas.

The archaeological assessment was carried out under licence from the National Monuments Service at the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs (now and hereafter the Department of Culture, Heritage and the Gaeltacht, DCHG). A baseline inspection conducted in 2016 was supplemented by a walkover inspection of the proposed road tie-ins downstream of the Seamus Rafter Bridge, an inspection of test pits cut beside the Railway Bridge, and in-water assessment of a boat-wreck feature at a downstream location. A series of features have been identified which warrant investigation as part of the proposed scheme, while the principal cultural heritage mitigation for the scheme will take place as archaeological and architectural monitoring of the construction phase works.

Archaeological figures and plates prepared and referenced in this assessment are provided in the technical Appendix G of this report.

This Chapter has been structured as follows;

- **Section 10.2-** Outline the assessment methodology. The section summarises the desktop baseline surveys that were carried out within the study area;
- **Section 10.3**- Describes the outputs of the desktop and field carried out within the study area describes the value of the study area in terms of historic and cultural heritage;
- **Section 10.4-** Provides technical information on the principal elements of the proposed scheme and examines the potential impacts on the archaeological and cultural heritage;
- **Section 10.5**- Describes the proposed mitigation measures and monitoring regime to be carried out in advance and during the proposed construction phase; and
- **Section 10.6-** Summarises the potential for significant residual effects

10.2 Assessment Methodology

A sequence of work has been completed to ensure that the Cultural Heritage assessment has been comprehensive and robust. The work has included a desktop study of known archaeological and architectural sources, a review of site investigations conducted for the wider

project, and on-site inspections and surveys which have included walkover surveys of the terrestrial elements, and comprehensive archaeological dive inspection of the riverine and sub-tidal elements

10.2.1 Consultations

The following sources of information have been consulted:

- The *Irish Antiquities Division of the National Museum of Ireland* (NMI) retains an extensive archive of small finds and objects discovered across Ireland and reported to the Museum and its predecessors since the nineteenth century. It represents a critical resource for archaeological research, where registered objects are recorded by townland in the Topographical Files. For the present project, the following townlands and town districts were assessed: Clonhasten, Enniscorthy, Killagoley, St Mary's, Templeshannon.
- *Department of Culture, Heritage and the Gaeltacht (DCHG) Sites and Monuments Record files*. The information, which is also filed according to townland, provides details relating to specific monuments and sites of archaeological importance that survive or whose site area is recorded. The record generally includes only sites that pre-date *c.* 1750 AD.
- *DCHG's Historic Shipwreck Inventory files* and *Places and Ports archive*. This information relates to the archives maintained by the National Monuments Service's Underwater Archaeology Unit for shipwreck and other maritime / riverine sites of archaeological interest. The information is located with reference to the nearest topographic locator, such as a town or headland, as well as site-specific grid coordinates where known.
- *National Inventory of Architectural Heritage* at DCHG provides an online register of historic buildings and features/street furniture that retain architectural interest and is maintained by the DCHG's architectural section. The Inventory is organized by place and townland. The Inventory complements the archaeological inventories by including buildings and features that date from the eighteenth century and more recently.

In addition, the following sources and groups of sources have been consulted:

- *Cartographic sources*, including historic maps and Ordnance Survey First and Second Edition maps. Historic and current topographical maps represent very important sources that can reveal the progress of natural erosion and human development across a landscape/riverscape over time. Such mapping in Ireland is metrically accurate from the mid-late nineteenth century.
- *National Archives*, Office of Public Works (OPW) Railway Outsize files, OPW15447/1864; OPW 13283/1869Piers and Harbour Structures files, 1708-1922 (OPW/8). This body of state records refers to aspects associated with the construction of the railway and the railway bridge in 1863.
- *Excavations Bulletin* is an annual published list of licensed archaeological intervention work conducted across Ireland. It is arranged by county and then by townland, and is currently completed to 2016.

The following relevant published and unpublished sources have also been consulted:

- Wexford County Development Plan, 2013-2019;
- Enniscorthy Town and Environs Development Plan 2008-2014 (as extended).

10.2.2 Assessment

The desktop assessment included a review of historic mapping that can reveal the development of the landscape over time, an examination of existing archival information at the NMI and

DCHG in relation to the known archaeological objects, features and sites of architectural and industrial heritage interest and a review of archaeological work conducted in the immediate vicinity of the project area from published and unpublished sources. This information combines to establish a baseline data source.

Project-specific site work was commissioned by Wexford County Council and the Office of Public Works to inform the proposed scheme, and includes:

- A cultural heritage walkover survey of the terrestrial elements (archaeology and the built heritage);
- Archaeological underwater dive inspection along the River Slaney through Enniscorthy Town, extending from the upstream limit of the proposed scheme at the Island to Chainage 4700 below Seamus Rafter Bridge;
- Site investigations were conducted and the details made available for archaeological review;
- Archaeological underwater inspection of the find location of a series of boat timbers were recovered from a Site Investigations trial pit, GI14, downstream of the Seamus Rafter Bridge, in Killagoley townland; and
- Underwater inspection of trial pits cut at the Railway Bridge to inform the nature of the riverbed beneath its surface deposit.

10.2.3 Legislation

The following legislation, standards and guidelines with particular reference to Archaeology were consulted for the purposes of this evaluation:

- National Monuments Acts, 1930-2004;
- The Planning and Development (Strategic Infrastructure) Bill, 2006;
- The Heritage Act, 1995;
- EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Report (EPA, draft 2017);
- EPA Advice Notes on Current Practice in the Preparation of Environmental Impact Statement (EPA, 2015);
- Guidelines for the Assessment of Archaeological Heritage Impacts of National Road Schemes, no date, NRA;
- Frameworks and Principles for the Protection of the Archaeological Heritage, 1999, Department of Arts, Heritage, Gaeltacht and Islands (now the DCHG);
- Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act, 2000 and the Local Government (Planning and Development) Act 2000;
- Code of Practice between Bord Gáis Éireann and the Minister for Arts, Heritage, Gaeltacht and the Islands (now the DCHG), 2002; and
- Dresden Declaration on Flood Protection for Historic Sites. Adopted at the International Conference Flood Protection for Historic Sites. ‘Integrating Heritage Conservation and Flood Control Concepts’, Dresden 2014. Heft_LX.pdf.

10.2.3.1 Limitations

The current report is based on desktop review and non-disturbance on site archaeological and built heritage assessment only. No intrusive archaeological investigations or excavations and no detailed architectural surveys have been carried out.

10.2.4 Evaluation of impacts

The category, value, quality, extent, probability of, duration of, and significance of impacts on archaeological, architectural and cultural environment from proposed scheme are described are based on criteria set out within Appendix F of the NRA Guidelines. A description of the impacts as they relate to archaeological and cultural heritage are set out in Table 10.1 below.

Table 10.1: Evaluation Criteria

Nature of impact	Type of impact	Description
Impact Type	Direct impact	When an item of archaeological or architectural heritage (hereafter cultural heritage) is located within the centreline of the proposed design and entails the removal of part, or all, of the monument or feature.
	Indirect impact	Where a feature or site of cultural heritage interest is located in close proximity of the proposed scheme.
	No predicted impact	When the proposed design option does not adversely or positively affect a site of cultural heritage interest.
Qualitative assessment	Negative Impact	Where a change that will detract from or permanently remove a site of cultural heritage interest from the landscape
	Neutral Impact	Where a change does not affect the cultural heritage site.
	Positive Impact	Where a change improves or enhances the setting of a site of cultural heritage interest.
Duration of impact	Temporary Impact	Where an impact lasts for one year or less.
	Short-term Impacts	Where an impact lasts one to seven years.
	Medium-term Impact	Where an impact lasts seven to fifteen years.
	Long-term Impact	Where an impact lasts fifteen to sixty years.
	Permanent Impact	Where an impact lasts over sixty years.
Significance of impacts	Profound	Where mitigation would be unlikely to remove adverse effects. This is reserved for adverse, negative effects only. These effects arise where cultural heritage site is completely and irreversibly destroyed by a proposed scheme.
	Significant	An impact that, by its magnitude, duration or intensity alters an important aspect of the environment. An impact like this would be where the part of a site would be permanently impacted upon, leading to a loss of character, integrity and data about the cultural heritage feature/site.
	Moderate	A moderate direct impact that arises where a change to the site is proposed which, though noticeable, is not such that the archaeological integrity of the site is compromised and which is reversible. This arises where cultural heritage feature can be incorporated into a modern-day development without damage and that all procedures used to facilitate this are reversible.
	Slight	An impact that causes changes in the character of the environment that are not significant or profound and do not directly impact or affect a cultural heritage feature or monument
	Imperceptible	An impact capable of measurement but without noticeable consequences.

The significance of effects of impacts on the archaeological and cultural heritage is assessed using professional judgement guided the criteria set out in the NRA guidelines and EPA draft guidelines (2017).

10.3 Receiving Environment

ADCO completed an assessment of the central part of the river area in 2015 for the Centre for Rebellion in Enniscorthy.[41] There is otherwise no record of previous archaeological assessment of the riverbed through the town. The project has approached the river area *de novo*, assuming no integrated corpus of existing knowledge to draw insight from. The following draws on data from cartographic and published sources along with archaeological and cultural heritage records, to assess the archaeological risk of the riverbed and associated areas. Archaeological figures and plates prepared and referenced in this assessment are provided in the technical Appendix G of this report.

The River Slaney as it passes through Enniscorthy has been an important strategic and communications asset to the town since its foundation in the medieval period if not before. The town developed on the west or left bank during the medieval period, while the presence of Vinegar Hill to the east presented a wider focus that, over time, was infilled with the growing town as it reached eastwards. The development of the riverfront and riverbed can be traced in an examination of existing sources, and existing archaeological results from work in the town help to understand the areas close to the riverfront. Until now, however, there has been little substantive factual record of the river's greater archaeological potential. The work conducted for the EIAR has helped to expose the nature and extent of these cultural heritage assets, and suggests a high archaeological potential exists within the river, despite development works that have transformed the southern tip of the Island on the north side of the town to facilitate the railway, and various bridge improvement works to ensure that Enniscorthy Bridge retains functional use into the present day.

10.3.1 Outputs of Desktop Survey

Cartographic evidence

The Down Survey for Wexford compiled between 1655 and 1659 depicts '*Iniscorthy Townne*' as a medium-sized enclosed settlement located on the west side of the River Slaney, north of where the Urrin River flows into the Slaney. An extract of this is provided in Figure 4A within Appendix G of this EIAR. The nature of the wider land holding suggests the strategic location of the town, positioned as it is in the angle of these two rivers. The barony (Scarawalsh) and parish (Shannough) maps repeat this observation but do not indicate the presence of a walled or earthen enclosure that is included on the county map (shown in Figure 4B, 4C). What is clear however is the absence of any indication of a bridge or fording point across either river from the town. This is supported by examination of the corresponding parish map for Templeshannon and Ballaghgeene on the east side of the River Slaney, which shows open land and unfortified land. The accompanying terrier describes the land in Templeshannon as having generally good soil up to the heath and furze, which we might understand as a reference to the hillside of Vinegar Hill. The terrier also notes that the river was a very good source for all types of fish, including salmon. The terrier for Templeshannon parish makes no mention of a bridge either. It describes the castle and church within the town, and notes that the wider landscape was known at the time for its provisioning of 'pipe staffs', which was its principal commodity. The 'pipe staffs' were cut from woodland and floated downstream to Enniscorthy, where they would be loaded onto vessels, and a fee paid to the town at the castle. The pipe staffs were most probably barrel staves. It is worth noting the implication that Enniscorthy marked the upper limit of river

[41] Rex Bangerter and Niall Brady, Archaeological assessment, River Slaney, Enniscorthy, Co. Wexford. 15D0025, 15R0019. Unpublished report of ADCO for the National 1798 Rebellion Centre.

navigation at the time, as it was to here that the staffs were floated from upriver, and from here that the staffs were loaded onto vessels for further use.

The absence of any depiction of a river crossing point or bridge structure in the seventeenth century is noteworthy because it conflicts with a source originating in 1581 that refers to the construction of a timber bridge at the town. The source is a works contract dated 15th September 1581 between Lord Deputy Grey and Paul Finglas, a carpenter, to build a bridge across the Slaney.[42] The bridge was to be of timber construction with a 'castell of lime and stone' in its middle portion. The bridge structure was to be made of good, sound and substantial timber and was to measure 240 feet long and 11 feet wide within the rails. It was to be supported by 14 arches, and each arch was to include three squared 'pillars', or timber posts, that measure 18 inches in diameter. Each post was to be shod in 2 stone-weight of iron. The timbers were to be braced in a certain manner, and the contract specified the nature of the bridge deck and parapets. The central stone tower was to be built on a new foundation. It was to measure 10 feet wide and 10 feet high, it was to be two-storeyed above the bridge surface, and it was to be defensible, with murder holes, presumably under the arch itself, and with draw bridges on either side to impede passage across the bridge if needed. Mr Finglas had 18 months to build the structure, which was to be completed on 25th March 1583. The contract also set the cost at £350 and set a sequence of staged payments.

To put it into context, the present-day bridge is shorter but wider. It measures some 216 feet long and is 30 feet wide. The shorter distance can be explained in terms of infill along both riverbanks over time, while the greater width suggests that the footprint of such a sixteenth-century bridge would be absorbed fully by that of the present-day.

There is no record of the 1581 bridge having been built. O'Keeffe and Simington's detailed consideration of the contract suggested that the bridge would have resulted in very closely-spaced arches and that these would have fouled easily during flood events, giving many opportunities for such a bridge to collapse. They also highlight the requirement for the stone tower to be built on a 'new foundation' as a possible indication of replacing a pre-existing structure. As they conclude, it is also possible that the bridge was destroyed in the wars of the 1640s, before the Down Survey was commissioned, and so explaining the absence of a bridge at that time. The Enniscorthy contract remains an important source; even if the bridge was never built, it shows clear intention to cross the river at this point, as one should expect given the presence of the growing town on the west bank.

Though not shown cartographically, the first stone bridge recorded across the Slaney in Enniscorthy was built in the last quarter of the seventeenth century. It was replaced by the present bridge in 1715.[43] The present bridge site is depicted on Hermon Moll's map of the Southeast in 1728, where the bridge is implied by showing the road crossing over the river at this point.[44]

It is not until the Ordnance Survey (OS) First Edition six-inch map of 1840 that detailed mapping exists (Figure 5). The map shows the town's development concentrated on the west bank side of the river, close to Enniscorthy Castle and along the roadway (Temple Street) leading north from Enniscorthy Bridge. In addition, a series of buildings is shown along Shannon Quay, located downstream of the bridge on the east bank of the river. A large dwelling annotated *Airmount Ho*. is located behind these buildings. Garden plots run down to the east side of the

[42] Peter O'Keeffe and Tom Simington, *Irish stone bridges. History and heritage*, Irish Academic Press, Dublin, 1991, pp 178-180.

[43] O'Keeffe and Tom Simington, p. 180.

[44] Hermon Moll, 'The Counties of Wicklow, Catherlogh, and Wexford', 1728, Bibliothèque nationale de France, département Cartes et plans, CPL GE DD-2987 (2668), accessed online at: http://www.europeana.eu/portal/record/9200365/BibliographicResource_1000055653176.html.

river, upstream of the bridge and along Ireland Street to the south. A *Distillery* is located to the northwest of the intersection between Island Street and Barrack Street. The waterway itself is shown as a broad channel that encompasses the foundations of Enniscorthy Bridge, which is shown as a substantial structure supported by four in-water piers, furnished with v-shaped cutwaters on their upstream and downstream sides.

Later editions of the OS map focus on the road that is carried across the bridge and does not show the bridge piers and their cutwaters (Figure 6 in Appendix G). They also convey the development within the town. By 1903, a number of large buildings have replaced the garden plots located on the east bank of the River Slaney. Industrial activity has developed here, with a Tannery, Coal Yard, etc. A series of dwellings, a *Christian Brothers' School*, and a *Malthouse* are located within the garden plots to the south. The most notable addition to the riverine landscape is the presence of the railway line that crosses the river approximately 100m upstream of Enniscorthy Bridge. The adjacent narrow channel that defines the east side of the Island has undergone considerable adaptation as part of the railway development; where the track and associated embankment resulted in a widening of the channel and a narrowing in the southern tip of the Island. The southern 120m of the narrow channel and the Island are transformed, and as such create quite a different localised area of the landscape to what would have existed previously. By 1903, the river downstream of Enniscorthy Bridge is also formally enquayed.

Illuminated evidence

Despite the events of 1798 and the recorded use of the Bridge as a defensive position during the attack of Vinegar Hill, there is no contemporary depiction of this action that records the river in detail. Among a series of historic prints that show the river area there is one by Daniel Grose dated to 1793, and a later print dated to 1837 (Figure 7 in Appendix G). Both show Enniscorthy Bridge from the downstream side. While the bridge today retains a slight central rise or camber, the early prints, perhaps somewhat romantically, suggest a more arched form or hump design. Five arches are depicted, as in the present-day bridge, but there is a central feature that juts out from the bridge as a wall-like element that rises from the bridge pier. The feature could be a central strengthening component. Given the building contract of 1581 requiring a central stone tower, it is possible that such a feature is a remnant of a pre-existing structure. As with the 1840 OS map, the bridge's cutwaters are depicted as triangular in shape, rather than the rounded/ semi-circular ones of today. These various features recorded on the historic illuminations show the modern viewer that the bridge today, which is considered to be that which was built in 1715, has been modified and upgraded over the years. Consequently, the stonework and facades that exist today are unlikely to be those that existed in the eighteenth century, even if the basic footprint remains the same.

The two prints also show how the river was used. Several river cots, probably *Slaney Cots,* are depicted, indicating the shallow draft and relatively small size of shipping that could navigate upriver to the town. While the OS maps do not show formal quaysides until the 1903 maps, the 1837 print portrays the nascent quays downstream of the bridge. A sizeable masonry quay is shown where Shannon Quay is today extending along the east bank, and a smaller stone quay gives way to timber piles on the west bank of the river.

A series of photographs help to convey a more factual perspective of the river area and all of these date from the nineteenth century. One image shows Abbey Quay sometime between 1890 and 1910, and captures a three-dimensional perspective of the details recorded on the 1903 OS map (shown in Plate 1 in Appendix G). It appears that the downstream cutwaters had assumed their circular or curving profile by this time. The formal nature of the new quays on both sides of the river is clear, with the suggested line of infill created to reclaim lands to

facilitate the works. The small-scale nature of the shipping that could use these facilities is also evident.

Descriptive evidence

The earliest factual accounts of the town that describe the river area in more detail belong to the mid-nineteenth century and are embedded in Lewis' *Topographical Dictionary of Ireland*.[45] Specific reference is made to bridge-widening works at Enniscorthy Bridge and the lowering of the road across the bridge, and the establishment of two 'spacious' quays on the downstream section the river. The narrative highlights the importance of a navigable waterway to the town, the commercial transportation of goods along the waterway, and its connectivity to neighbouring towns:

> The town is built on the acclivities of the hills on both sides of the Slaney, and in 1831 contained 1047 houses: the streets are in general narrow and in some parts inconveniently steep for carriages. The principal portion is on the south-west side of the river, which is connected by a substantial stone bridge of six arches with the other portion, which lies at the base of Vinegar Hill, and comprises the suburbs of Templeshannon and Drumgoold. The bridge is now being widened and its roadway lowered, partly at the expense of Lord Portsmouth's trustees and partly by a Grand Jury presentment; and a plentiful supply of spring water, from Sheill's well at Templeshannon, will be conveyed, by pipes inserted in the new work of the bridge, into several parts of the town, which is at present poorly supplied, and only partially paved.
>
> The River Slaney abounds with excellent salmon and trout, with which the markets are well supplied during the season. The trade principally consists in the exportation of agricultural produce, and the importation of coal, timber, slates, iron, salt, and various other commodities, for which its central situation and river navigation to the port of Wexford are very favourable. Large quantities of corn and butter are sent hence by lighters to Wexford, and also by land carriage, by way of New Ross, to Waterford.
>
> Two spacious quays have been lately constructed, at an expense of £9000, defrayed partly by the trustees of the Earl of Portsmouth's estate, and partly by subscription: the quay on the Templeshannon side is 450 feet, and that on the opposite side, which it is in contemplation to extend, is 500 feet in length. The tide flows up to the town, which is accessible to barges of large tonnage, and it is intended to apply for an act of parliament to construct a ship canal for vessels of 200 tons' burden from Pooldarrag, on the eastern bank of the Slaney, to the bridge of Enniscorthy, a distance of nearly seven British miles.
>
> It is also in contemplation to establish a communication by steam between this place and Wexford, and a subscription is in progress for building an iron steam-boat of 12-horse power, for the conveyance of goods and passengers.

National Museum of Ireland and Sites and Monuments Record archives

The National Museum of Ireland and the National Monuments Service at the DCHG are the two bodies that retain comprehensive archives of known archaeological data. The Museum will typically record artefacts that have been reported and/or deposited to that institution, while the National Monuments Service is concerned with structures and features that lie in the landscape and date to the period before *c.* 1750 AD, which are recorded on its Sites and Monuments Record files.

For the present scheme, neither institution has records relating to the River Slaney in Enniscorthy, or to the river environs of the town (Table 10.2). What is recorded relates to the

[45] Samuel Lewis, *A Topographical dictionary of Ireland: comprising the several counties, cities, boroughs, corporate, market, and post towns, parishes, and villages*, London, 1837 [assessed via www.librarayirleand.com].

wider town area, and these details serve to highlight the potential of the landscape but do not inform the river area itself (Figure 8 in Appendix G of this report). Despite river dredging works carried out to facilitate construction of the Seamus Rafter road bridge, no records of discoveries made during these works are known, and it does not appear that archaeological monitoring was conducted of these works.

Table 10.2: National Museum of Ireland registrations for Enniscorthy

Reg No	Find place	Townland	Type	Proximity to proposed scheme
4971:W59	Battle of Vinegar Hill	Enniscorthy	Copper Cup,	unknown
1929:1361	Not stated	Enniscorthy	Copper toke, 17th c	unknown
1932:5604	Note stated	Enniscorthy	Stone adzehead. Old find, long used as a paperweight before being acquired for NMI.	unknown
1975:264	Cist	Enniscorthy	Ceramic vase; food vessel (N of river, WX020-030), with cist.	300m North
1975:265	Cist	Enniscorthy	Human bone 15.5cm from W, 15.3cm from S	300m North
1983:1	Replica, gold brooch, 'The Enniscorthy Brooch'	Enniscorthy	Original from ruins of Franciscan Friary.	unknown
Record	WX020-031002	Enniscorthy	Site of Franciscan Friary, reporting in JRSAI 25, p. 407.	c. 80m West
IA/11/91	Abbey Square	Enniscorthy	Human remains, possibly originating in a cemetery attached to the Franciscan Friary.	c. 70m West
2014:297	North western slopes of Vinegar Hill	Templeshannon	Iron cannon ball	Unknown

Table 10.3: Sites and Monuments Record register for Enniscorthy Town, focussed on sites within proximity to proposed scheme works

SMR No.	Classification	Location/ Townland	NGR	Proximity to proposed scheme
WX020-031	Historic town	Enniscorthy	Various	within
WX020-031002	Religious House, Franciscan	Enniscorthy	297436E,139714N	c. 80m West
WX020-031003, -011 to -016	Castle, Tower House, includes a series of stone artefacts from neighbouring former churches	Enniscorthy	297347E,139794N	c. 70m West
WX020-031004	Church	Enniscorthy	297294E,139747N	c. 180m West
WX020-031005	Graveyard	Enniscorthy	297294E,139747N	c. 180m West
WX020-031006	Bullaun Stone	Templeshannon	297501E,140134N	c. 70m East
WX020-031007	Well	Templeshannon	297483E,139994N	c. 90m North
WX020-031008	Tannery	Enniscorthy	297135E,139800N	c. 250m West
WX020-031001	Church	Templeshannon	297501E,140134N	c. 70m East
WX020-031009	Graveyard	Templeshannon	297501E,140134N	c. 70m East

SMR No.	Classification	Location/ Townland	NGR	Proximity to proposed scheme
WX020-031010	Tannery	Templeshannon	297468E,140070N	c. 60m East

Licensed archaeological work has taken place within the town, and most of this work close to the river has been in Templeshannon townland. The nearest work to the assessment area took place on the former site of Buttle's Bacon factory prior to construction of the swimming pool and leisure complex. Three test-trenches were excavated across the site to a depth of 1.2m. Two of the trenches comprised disturbed ground and modern fill, the other containing an area of undisturbed sub-strata (yellow clay). However, no material of archaeological significance was encountered as part of the archaeological testing process. A summary of the licensed archaeological work is provided in Appendix G.

National Inventory of Architectural Heritage

The known architectural heritage record for the river area at Enniscorthy relates to the period of the late eighteenth century and later. These records are maintained as part of the National Inventory of Architectural Heritage (NIAH), which is concerned with the post-1700 architectural heritage of Ireland. The entries for Enniscorthy include;

- Enniscorthy Bridge (NIAH reference 15603154);
- The railway bridge (15603154);
- Section of retaining wall (extending between the two bridges on the south side of the river) (15603153);
- Two riverside embankments/ quays (Shannon Quay to north and Abbey Quay to the south) (15603156 and 15603157); and
- the National 1798 Rebellion Centre, which occupies the site of a late nineteenth-century monastery (15604032).

In addition, there are three other NIAH features that are located close to Seamus Rafter Bridge but are not considered further in this report as they will not be impacted by the proposed scheme works. These comprise;

- A monument (NIAH 15603104) to Seamus Rafter, located on the west side of the river;
- A free-standing cast iron vent pipe (15603215) belonging to the early 1900s and located on the east side of the river beside the Society of Friend's Meeting House (5603200), dating from the late nineteenth century.

The NIAH rates Enniscorthy Bridge as retaining architectural and technical interest of regional importance. The railway bridge is dated to 1872 and is considered to retain architectural, historical, and technical interest of regional importance.

Examination of the OPW Railway Outsize file OPW 15447/1864 that is retained in the National Archives deals with land acquisitions completed in 1863 for the Gorey to Enniscorthy portion of the Dublin, Wicklow and Wexford Railway, Enniscorthy extension. Where it includes mention of the river crossing, the document merely refers to the stream and stream bank amounting to 1 rood and 3 perches in size, on land that was owned by the Earl of Portsmouth and held in fee for £50. The second file that is relevant to the same item, OPW 13283/1869 was not available to consult.[46]. A list of NIAH sites within c. 50m of the proposed scheme are provided in appendix G.

[46] The National Archives collection was consulted by Dr Niall Brady, ADCO, on 08/02/2017.

Modern works

There is no detailed record readily available to consider the impact of modern works on the river area. However, the works associated with construction of the modern road bridge in the town for Wexford County Council in 1991 involved the strengthening and widening of Enniscorthy Bridge, and it is perhaps at this time that dredging works under the modern road bridge reduced bed levels:

> The contract involved extensive realignment, strengthening of the existing multi-span masonry river arch bridge plus extensive realignment and construction of approach roads, including traffic roundabouts and pedestrian islands, light traffic signalling and landscaping. The strengthening and widening of the 18th-century masonry arch bridge and the construction of a new reinforced concrete 50m 3-span bridge downstream of the arch bridge. This enabled a one-way traffic system to operate and relieve the traffic congestion in the town.
>
> Identical stone was used in the arch extensions as in the original bridge, and the new bridge had an arched profile to sympathise with the earlier bridge.[47]

10.3.2 Outputs of the field Surveys

Terrestrial walkover survey

This section relates to the walkover survey completed outside the river channel. Particular attention was paid to the road tie-in locations south of Seamus Rafter Bridge, where the new bridge structure will span the river and connect with the existing road at two new roundabouts. Where the structure will span the floodplain, there are no known features of archaeological interest within the footprint. The roundabout on the west bank will directly impact on the boundary of the National 1798 Rebellion Centre. The centre occupies the site the site of a nineteenth-century monastery, whose principal asset, its building is entered on the NIAH database (reference NIAH 15604032).

Riverine and underwater survey

The archaeological assessment extended along a 3.1km stretch of the River Slaney's main channel, commencing at a point 1.2km upstream of Enniscorthy Bridge (NGR 297756E, 140735N) and terminating at a point 1.9km downstream of the bridge (292466E, 139143N) (the extent of the area is shown in Figures 9-10 in Appendix G). In addition, the narrow channel on the east side of the Island was included in the survey where accessible, and the Island was field-walked.

A systematic visual survey was carried out across the full extent of the survey area and included the attendant bank structures and riverside features. Observations are summarised on Figure 17 in Appendix G. Assessment focused on the main river channel and its riverbed deposits (shown in Appendix G Figures 18, 23, 28-29). In addition, an intensive, targeted, metal-detection survey was carried out at selected locations within the assessment area (MD Areas 1-12, Figure 32). The survey was supplemented by photographic recording, above and below the water line, and a Leica Total Station EDM was used to record riverbed topography and position-fix any material/deposits/features identified as part of the survey (Appendix G Figures 9-10, 23, 28-29).

A finds retrieval strategy dealing with conservation issues, cataloguing, and locational recording was in place to deal with any artefacts recovered during the survey. The survey was undertaken

[47] http://www.jbbarry.ie/projects/transportation/enniscorthy-bridge.html.

by a team of maritime archaeologists and a dive supervisor. The in-water work was carried out in accordance with the HSE Diving at Work Regulations 1998, supported with suitable boat cover and VHF communications to the relevant authorities. A description of the river topography and accompanying photographs gathered are provided in Appendix G of this EIAR.

Archaeological features

A total of thirteen features of cultural heritage interest were identified as part the archaeological walkover, riverine and underwater surveys (Table 10.4, Figures 9-10, 23) that lie within or directly beside locations of impact from the proposed works.

Feature 1 comprises the River Slaney itself which, by its very nature, must be considered an archaeological feature that retains the potential to reveal objects and features that have not yet been observed or recorded.

The remaining features (i.e. Feature 2 to Feature 13) were observed in the course of the archaeological work conducted for the EIAR. An additional feature, Feature 14 (boat wreck), was encountered as part of geotechnical site investigations within the river. A full description of each feature is provided in Appendix G.

Table 10.4: Features of archaeological or historic interest encountered as part of the walkover survey, underwater assessment, and site investigations (the location of each feature is shown in the accompanying figures in Appendix G)

Feature Number	Existing Cultural Heritage reference	Description	NGR centre-point
Feature 01 [Figures 9-10]	none	River Slaney	Throughout project area
Feature 02 [Figure 9]	none	Ruined building; consists of one long wall orientated North-South and one end wall at right angles. The west and south walls stand. The standing structure rests on an earlier stone building	297516E, 140674N
Feature 03 [Figures 9, 24]	NIAH 15603152	Bridge; Enniscorthy Railway Bridge.	297324E,139989N
Feature 04 [Figures 23, 28]	NIAH 15603153	Retaining Wall; running between F03 and F06 on the southern side of the river.	297341E,139933N
Feature 05 [Figures 23, 28]	none	Eleven sections of collapsed bonded masonry, S1-S11, that originally formed a single structure; probable river walling (submerged).	297361E,139924N
Feature 06 [Figures 23, 29]	NIAH 15603154	Bridge; Enniscorthy Bridge / St Senan's Bridge.	287419E,139901N
Feature 07 [Figures 23, 29]	none	Sections of bonded masonry; probable bridge collapse from earlier bridge structure (submerged).	297401E,139894N
Feature 08 [Figures 23, 29]	none	Section of bonded masonry; probable bridge pier from earlier bridge structure (submerged).	297413E,139899N

Feature Number	Existing Cultural Heritage reference	Description	NGR centre-point
Feature 09 [Figures 23, 29]	none	Section of bonded masonry; probable bridge pier from earlier bridge structure (submerged).	297421E,139908N
Feature 10 [Figures 23, 30-31]	NIAH 15603156	Quayside structure; Shannon Quay.	297508E,139848N
Feature 11 [Figures 23, 30-31]	NIAH 15603157	Quayside structure; Abbey Quay.	297462E,139818N
Feature 12 [Figure 10]	none	River Walling; incorporated into retaining wall for N11.	297558E, 139721N
Feature 13 [Figure 10]	NIAH 1560432	Detached five-bay two-storey monastery, built 1894, now in use as museum. Set back from street in own grounds on a slightly elevated site with landscaped grounds to site including terraces having flights of seven (west) or five (east) steps. Stone boundary wall.	297216E, 139287N
Feature 14 [Figure 10, 32]	none	Portion of a vessel, comprising nine (9) side planks joined by four (4) lines of framing timbers. It represents one side of a timber boat that appears to be lying with its gunwale.	297246E, 138848N

Geotechnical Investigations

Geotechnical investigations were conducted of the riverbed beside the bridge in 2017. Five, machine-excavated trenches were made, and these were inspected underwater by ADCO, under licence 17E0250. A summary of the archaeological finds within the trenches provided in Table below and shown in the accompanying figures (Figures 25-27).[48]provided in the Appendix G.

Table 10.5: Location and dimensions of geo-technical investigation Trenches at Enniscorthy Railway Bridge

Trench No.	Location	NGR centre-point	Dimensions
01	South side of the bridge's north abutment	297339E, 140027N	2.5m long, 2.1m wide, 2.9m deep
02	North side of the bridge's northernmost in-water pier (Pier 1)	297336E, 140020N	3.7m long, 600mm wide, 2.6m deep
03	North side bridge's south abutment	297315E, 139961N	2.2m long, 1m wide, 3m+ deep
04	South side of the bridge's southernmost in-water pier (Pier 6)	297317E, 139969N	3.7m long, 1.1m wide, 3.3m deep

[48] Rex Bangerter MA, 'Archaeological Monitoring of Geotechnical Site Investigations at Enniscorthy Railway Bridge', Excavation Licence 17E0250, Eniscorthy Flood Defence Scheme, unpublished report of the Archaeological Diving Company Ltd, 2017.

Trench No.	Location	NGR centre-point	Dimensions
05	South side of the bridge's in-water pier (Pier 5)	297321E, 139979N	2.6m long, 800mm wide, 1.97m deep

The geotechnical investigation confirmed the presence of substantial *in-situ* timbers related to shuttering or possible coffer-damming of the bridge piers/abutments. The shuttering comprises a series of edge-set vertical timbers measuring 300mm wide x 80mm thick x 2m+ tall (vertical depth). Horizontal beams, measuring 340mm wide (vertical depth) x 100mm thick, have been placed either side of the topmost part of the structure and serve to brace the vertical timbers sandwiched within (Figure 14 in Appendix G). Forged-iron clench-pins (square profile, 30mm x 30mm) were noted in several places, running through the vertical timbers and fastening the outlying horizontal beams to one another. It was also noted that the vertical timbers appeared to have similar dimensions to the railway sleepers used in the construction of the above railway line.

Despite achieving a maximum trench depth of 3.3m (Trench 4), there was no indication of the pier's foundations; suggesting that the base of the bridge piers is located at significant depths below the riverbed surface. It is understood that bedrock is present at a depth of *c.* 4m below the existing bed-level. It is likely that this bedrock was employed as a solid platform upon which the foundations were built.

Metal-detector survey

Targeted metal-detection was carried out across twelve riverbed areas, as indicated in Figure 32 in Appendix F (Plates 105-107). Where water-depth exceeded 500mm, metal-detection was undertaken as a diving exercise, using an underwater metal-detection unit (Fisher Aquanaut 1280U). Shallower areas were surveyed by mask and snorkel using a terrestrial detector (Tesoro Compadre). The detection areas downstream of Enniscorthy Bridge were accessed at Low Water. The investigation of detection targets was limited to the upper, mobile, layers of the riverbed, approximately the first 300mm. These deposits regularly shift and do not represent a sealed context. No intrusion into the lower, undisturbed, riverbed deposits was made; and the detection survey was carried out as a non-disturbance exercise. A number of artefacts were recovered from the underwater visual survey and metal-detection survey and are presented in Table 10.6.

The metal-detection survey indicates that nine of the twelve areas surveyed are suitable for intensive metal-detector survey (Areas 3-8 and Areas 10-12), while a more general survey is possible for Areas 1, 2, 3 and 9, where inhibiting factors are present (water velocity, background metallic signature, etc.). In other words, the area immediately upstream of Enniscorthy Bridge and the area downstream of the bridge close to Shannon Quay would repay more detailed and intensive investigation under current flow conditions, but the water velocity imposes a constraint on such investigation elsewhere.

Table 10.6: List of finds retained from the archaeological assessment of the River Slaney

Find Number	Description	NGR (centre-point)
Find 01 [Plate 108]	12D0025:01, Victorian Penny, 1850s; heavily water-eroded. 27mm diam., 2mm thickness.	297432E, 139917N
Find 02 [Plate 113]	12D0025:02, Bowl fragment (shallow) from pewter spoon. Both ends of bowl broken. Also, 2mm	297409E, 139902N

Find Number	Description	NGR (centre-point)
	hole in bowl. Length 41mm, Width 30mm.	
Find 03 [Plate 114]	12D0025:03, Fob-watch (modern). 48mm diam.	297400E, 139890N
Find 04 [Plate 116]	12D0025:04, Mining token (1790s); heavily eroded. 26mm diam., 0.5mm thickness.	297517E, 139827N
Find 05 [Plate 124]	12D0025:05, clay pipe bowl fragment 'Ben Nevis Cutty'. 42mm in bowl height, bowl diam. is 27mm (external) and 21mm (internal). Bore is 3mm in diam.	297368E, 139916N
Find 06 [Plate 124]	12D0025:06, clay pipe bowl fragment 'Patrick Byrne, Market Square'. 40mm bowl height, bow diam. 27mm (external) and 17mm (internal). 32mm on stem remains, bore diam. 3mm.	297368E, 139916N
Find 07 [Plate 124]	12D0025:07, clay pipe bowl fragment, unmarked. 41mm bowl height, bow diam. 27mm (external) and 20mm (internal). 10mm on stem remains, bore diam. 2mm.	297368E, 139916N
Find 08 [Plate 125]	12D0025:09, clay pipe bowl/stem fragment, unmarked. Only base of bowl intact. 44mm of the stem remaining, semi-circular in section (9mm x 7mm) with a 2mm diam. bore.	297368E, 139916N
Find 09 [Plates 125-127]	12D0025:10, intact clay pipe, 'Maid of Erin' and 'Shamrock Sprig' motif, patriotic-style pipe (1880-1910). 1200mm in overall length with bowl diam. of 22m (external) and 17mm (internal). Stem measure 90mm in length and is semi-circular in cross section (9mm x 6mm) with a 2mm diam. bore.	297368E, 139916N
Find 10 [Plate 128	Forged iron cobbler's anvil. One arm measures 1900mm length, the other 1600mm). Foot measures 1200mm length by 550mm width (max.).	297368E, 139916N
Find 11 [Plates 129-130]	Forged iron bell measuring 450mm height and 200mm in basal diam. A 5mm-wide hole, lined with a brass ring, is located 15mm from the base of the bell. Possibly re-used as a mud-anchor.	297368E, 139916N

10.3.3 Site Investigations assessment

A programme of ground investigation was carried out by PGL, this included a number of boreholes and trial pits, and this element was monitored archaeologically.[49]

An assemblage of pottery, glass and roof tile fragments was recovered, comprising pearl ware, glazed red earthen ware, roof tile and glass. This assemblage is entirely in keeping with what

[49] The archaeological monitoring was completed under licence from the NMS, 16E0305, held by Seán Shanahan.

can expect to recover from a settled urban context, and echoes that recovered during the underwater survey. In addition, two boat timbers were identified and recovered from one Grab Sample (GS14), and these are discussed in further detail below. A small number of other timbers were recovered from the river.

Underwater inspection of boat wreck, GS14, Feature 14

ADCO carried out an in-water assessment of the find location for the timbers recovered from GS14. This work was completed on 11/10/2016, as an amendment to existing licences 16D0049, 16R0071. The underwater inspection sought to inspect the find location of the possible ship's timber, to examine the riverbed surface and deposits for the presence or absence of associated timbers and features, and to address the underlying question of whether and to what extent there is more and related material *in situ* on the riverbed. The work concluded that the find location is the site of a boat wreck, remains of which are still *in situ*. It is considered as archaeological Feature 14.

The location is at NGR: 297246E, 138848N, which is positioned at the southern end of the flood defence scheme, approximately 3m off the east bank of the river. There are no upstanding markers on the riverbank to highlight the presence of a vessel. The riverbed is accessed easily from the riverbank. A *c*. 1.5m clay bank gives way to a riverbed of shingle and cobble. Water visibility was clear, and no constraints were encountered. A description of the find including accompanying photos are provided in Appendix G.

A further timber was observed on the west/channel side, lying lower in the gravel and running the length of the exposed feature in line with the side planks. It was never fully exposed, but it is either a lower side plank or is part of a keel timber.

The timbers are for the most part dark wood but soft, suggesting they are not oak, and one of the side planks is almost a white timber, suggesting it is a soft wood. There is no indication of paintwork or caulking from the section examined.

The fixings observed are for the most part iron fixings. One or two dowel holes were observed, but a much greater number of iron pins and bolts were noted. Two examples have square-shaped nuts attached (12mm internal diameter, 22mm external), where the intervening timber has eroded away (Appendix G Plate 133).

Two other elements are noted. An array of timber and ironwork runs west from the north end of the vessel. It is partly buried but a 1.2m length is exposed, that measures 230mm wide and 180mm thick. It is a composite piece with two iron loops at one end fixed to a metal bar. The iron loops are approximately ovoid in shape and 110mm in maximum diameter. It is unclear what this mechanism functioned as. A second element lies on the south and east side of the vessel fragment. It sits between the southernmost rib (framing timber) and consists of a rectangular-shaped granite block that measures 600mm long, 120mm wide and is 270mm high. The block has a recess cut into it across its short axis, which accommodates a tightly-fitting iron/steel chain, whose links are 50mm long. It may have served as an anchoring system (Plate 134).

The remains are those of a timber-built vessel, and the fittings suggest it is not of great antiquity. There are only one or two wooden dowels visible, and the rest are of iron. There is no bronze fitting apparent, and the chain that is fitted into the granite block appears to be comparatively modern.

The timber recovered during monitoring is a composite piece, comprising one long timber and two additional pieces. The long timber is straight-sided along one side, and slightly bevelled on its other (Figure 33). The bevelled side is also broadly curved in plan-view. It measures 4.165m

long is 150mm in maximum width and 100mm in maximum thickness. It tapers to 3cm wide at one end, and 70mm wide at the other end. It is perhaps of Larch wood, but this identification needs to be confirmed. The timber has a series of mostly metal fixings, which occur at irregular intervals along its length and occur singly and in pairs. The timber is a keel timber. The two other timbers associated with it comprise two framing timbers. One is fixed to the timber at one end. It is located 710mm from one end and is 390mm long, 70-80mm wide and 100mm deep. One side extends further from the keel than the other. It is fixed to the keel with an iron pin, and a second metal fixing would have been fixed to a second keel timber. The third timber appears to be oak, but this needs to be confirmed. It is a low L-shaped framing timber that measures 730mm long, is 300mm in maximum height at the short end and only 50mm high at the long end. It retains a 90mm-wide heel-like recess on its underside, that might have retained a long timber or served drainage purposes. It was fixed to the keel timber by two iron pins, positioned 2.52m along the keel, but it has become separated from the keel since it was recovered.

These timber remains form one length of a composite timber keel, made from at least one other long timber that would have been affixed to the straight-edged side of the keel. The vessel is very suggestive of being part of an indigenous craft, the Slaney Cot. The length of the keel (4.165m or 13.6 feet) falls within the typical length of cots (20-ft long), allowing for the extended length that would be provided by an intact bow and stern section (which are missing in the piece examined). It is known that these vessels varied in size and complexity.[50] The flat bottom and the L-shaped frame are indicative of the series.

The keel timber was recovered 3m from where the still *in situ* fragment of vessel lies in the Slaney. It is reasonable to suggest that the two elements are related, but the *in-situ* element is perhaps more substantial than might be expected in a small cot. It suggests the presence of a more substantial vessel in the series, perhaps such as those working boats photographed against the quays in Enniscorthy in the early 20th century (Plate 135 in Appendix G).

The location is at approximately project chainage 4400, which is within the proposed river dredging extent and the adjacent west bank will be cut away. It is therefore in a location of direct impact from the proposed scheme works. The piece of wreckage will be further investigated archaeologically, where it will be recorded and removed in a controlled and appropriate manner before river works commence.

10.3.4 Architectural Heritage Assessment

Identified structures and the wider site were inspected. The majority of installations and buildings are typical for an Irish river town of the 19th century primarily based on the milling industry. The quays features and buildings will require an assessment for appropriate remedial works or as otherwise indicated on further assessment when working drawings are being prepared. By the intrusive nature of a flood defensive scheme, the impact on cultural heritage will not be neutral in every instance and individual compromises will be required. However, every effort will be made not to substantively affect the adjacent urban landscape. The proposed scheme has been designed to ensure where possible, new build masonry will replicate the original or vernacular of the area, using salvage or similar materials and design detailing.

[50] Darina Tully, 'The Slaney Cot', in C MacCárthaigh (ed.), *Traditional boats of Ireland. History, folkore and construction.* Collins Press, Cork 2008, p. 588.

10.3.5 Evaluation of the Archaeological, Architectural and Cultural Heritage Environment

The archaeological assessment has been comprehensive and thorough. It has presented a methodical record of that section of the River Slaney that is subject to the proposed scheme. The work has highlighted the potential for the river channel generally to retain material of cultural heritage significance. A previously un-recorded building has been identified at the north end of the Island. The riverbed deposits are generally very mobile (from an archaeological perspective) and the surface stratum consists of river cobbles. This is a dynamic river environment. Comparable contexts were recorded in the River Nore at Kilkenny, where investigations conducted in advance of the River Nore Flood Alleviation Scheme revealed complex archaeological deposits and numerous archaeological objects embedded in the riverbed strata underlying a mobile and dynamic surface layer of cobbles.[51] The same situation was identified further downstream on the Nore at Newtown Jerpoint.[52] In both instances, deposits retaining rich archaeological remains were observed at the principal bridge sites in each settlement, and while many of the objects recovered are of modern and early modern date, significant remains of medieval date were also present. There is every reason to expect that the buried riverbed deposits at Enniscorthy retain significant remains that lie at some depth below the surface stratum. The siting of the town on the west bank presupposes activity and engagement with the river channel since the town was founded and probably for a considerable period before then. The presence of substantial blocks of masonry relating to previous bridge structure underneath Enniscorthy Bridge complements this observation and indicates proof of it. The survey completed has been non-disturbance in nature; it did not actively excavate any deposits or test trenches. Despite such constraints, the work has revealed substantial material remains and it is clear that these are the upper levels of a richer narrative that has yet to be revealed.

10.3.6 Do-nothing Scenario

In the event of a Do-nothing scenario, it is likely that the features identified within the river channel will be subject to continued erosion and/or deposition from the natural river actions and would deteriorate over time. They would, however, not be subject to direct construction-led impacts, and the opportunity to study the features and learn more about the cultural heritage of the town would not take place.

10.4 Assessment of Impacts

The principal impacts arising from the proposed development will be focussed on the in-water river dredging of the channel, adjustment of the river banks, associated impacts on identified features, and the construction of embankments and related remedial measures. The works will have significant and permanent impacts on the river and its cultural heritage assets. The mitigation measures will resolve these matters and will present important opportunities to learn more about the history of Enniscorthy and its development over time.

[51] Niall Brady, 'Archaeological investigation and excavation, John's Bridge, Kilkenny. River Nore Flood Alleviation Scheme, final report, 01E0036', unpublished report of the Archaeological Diving Company Ltd, 2004

[52] Rex Bangerter, 'Underwater Archaeological Investigation, River Nore Crossing Point and Little Arrigle River, Medieval Settlement of Newtown Jerpoint, Thomastown, Co. Kilkenny', 11E029 Ext., unpublished report for the Heritage Council, Grant RO2764, 2012.

10.4.1 Construction Phase

The principal impacts on the archaeological and cultural heritage identified along this section of the River Slaney and its adjacent land areas will occur as a result of the construction of the proposed scheme. The works include a combination of cutting away the riverbank, filling in other sections, flood defence walls, river dredging, and the removal of Seamus Rafter Bridge and its replacement downstream with a new bridge with new road tie-ins to the east and west banks.

The proposed enabling works include the installation of an impermeable barrier to create dry areas which permit access while also maintaining river flow outside the bunded areas. Where such temporary works will take place in proximity to the known archaeological sites and features, archaeological resolution will be required in advance of the enabling works, and that such work will focus on resolving the footprint of the bunding.

Above ground features to be assessed for conservation remedial works, will be approached with the view being to retain as much original fabric and patrimony as feasible.

While summarising the impacts on the identified cultural heritage sites and areas of archaeological potential as known, it is implicit in Table 10.7 below that archaeological investigation and resolution of temporary works may be required in advance of the creation of such works.

Table 10.7: Summary of impacts and mitigation along the cultural heritage sites and features

Feature Number	Existing Cultural Heritage reference	Site	Impacts	Magnitude of construction impact	Significance of Impact	Mitigation
Feature 1	None	River Slaney	Dredging Filled Ground Cut Ground Flood Defence Wall	Direct, negative, permanent	Profound	Archaeological monitoring during development Preservation by record
Feature 2	None	Ruined building	Cut ground on riverside of structure Deposition on north island	Direct negative Permanent	Profound	Archaeological survey in advance of development Archaeological investigation Preservation in situ Exclusion zone around the site Preservation by record if structure must be removed
Feature 3	NIAH 15603152	Railway Bridge	Underpinning	Direct, neutral, permanent	Moderate	Archaeological and Architectural heritage survey in advance of development Monitor works
Feature 4	NIAH 15603153	Retaining Wall	Cut Ground Dredging	Direct, negative, permanent	Profound	Archaeological investigation Preservation by record Archaeological monitoring during development
Feature 5	none	Collapsed bonded masonry	Cut Ground Dredging	Direct, negative, permanent	Profound	Archaeological investigation Preservation by record

Feature Number	Existing Cultural Heritage reference	Site	Impacts	Magnitude of construction impact	Significance of Impact	Mitigation
						Archaeological monitoring during development
Feature 6	NIAH 15603154	Enniscorthy Bridge	Flood defences Dredging Cut ground up- and down-stream of bridge	Direct, negative, permanent	Profound	Archaeological and Architectural heritage survey in advance of development Archaeological investigation Preservation by record Archaeological monitoring during development
Feature 7	none	Sections of bonded masonry	Dredging	Direct, negative, permanent	Profound	Archaeological investigation Preservation by record Archaeological monitoring during development
Feature 8	none	Section of bonded masonry	Dredging	Direct, negative, permanent	Profound	Archaeological investigation Preservation by record Archaeological monitoring during development
Feature 9	none	Section of bonded masonry	Dredging	Direct, negative, permanent	Profound	Archaeological investigation Preservation by record Archaeological monitoring during development
Feature 10	NIAH 15603156	Shannon Quay	Flood defences Dredging	Indirect, negative, permanent	Significant	Archaeological and Architectural heritage survey in advance of development Archaeological investigation Preservation by record Archaeological monitoring during development
Feature 11	NIAH 15603157	Abbey Quay	Filled ground on quay Flood defences Dredging	Indirect, negative, permanent	Significant	Archaeological and Architectural heritage survey in advance of development Archaeological investigation Preservation by record Archaeological monitoring during development
Feature 12	none	River Walling	Flood Defence Wall	Indirect, negative, permanent	Significant	Archaeological investigation Preservation by record Archaeological monitoring during development
Feature 13	NIAH 1560432	Two-storey monastery inside stone boundary wall	Boundary will be impacted to facilitate road tie-in	No predicted impact, neutral, temporary	Imperceptible	Archaeological investigation Preservation by record Archaeological monitoring during development

Feature Number	Existing Cultural Heritage reference	Site	Impacts	Magnitude of construction impact	Significance of Impact	Mitigation
Feature 14	none	Boat wreck	River widening	Direct, negative, permanent	Profound	Archaeological Excavation, removal, and recording
AP1	none	Section of riverbed beneath Enniscorthy Bridge (Arch No 6)	Dredging	Direct, negative, permanent	Profound	Archaeological monitoring during development Metal detection of spoil

10.4.2 Operational Phase

No significant negative effects are anticipated during the operational Phase.

10.5 Mitigation Measures

10.5.1 Construction mitigation

Table 10.7 above details the proposed mitigation measures and monitoring to be carried out during the construction phase. A pre-construction archaeological and architectural survey will also be carried out to record the ruined building in the North Island, the Railway Bridge, Enniscorthy Bridge and Shannon and Abbey Quays to ensure a robust record of all cultural heritage assets within the development area.

Pre- construction archaeological investigation will be carried out in advance of the proposed works, to clarify the nature of the material observed and to assess its archaeological risk. Such work will be conducted at Features 3-13 as needed. The boat wreck disturbed by Grab Sample GS14 will be archaeologically excavated and removed for analysis, storage and disposal in accordance with the requirements of the National Museum of Ireland.

Archaeological investigation requires a series of archaeological licenses, the principal of which is Excavation. Archaeological licenses take a minimum of four weeks to be processed by the Department.

10.5.2 Construction Phase Monitoring

The mitigation measures will be carried out by retaining an archaeologist/s. An archaeologist experienced in maritime archaeology will be retained by the Wexford County Council for the duration of the relevant works to advise on and resolve archaeological matters.

A heritage architect or engineer experienced in industrial and riverine architectural heritage will be retained by the Wexford County Council for the duration of the relevant works, to advise specifically in relation to works associated with Enniscorthy Bridge and the quays.

Archaeological licences will be required to conduct the on-site archaeological works. Licence applications require the inclusion of detailed method statements, which outline the rationale for the works, the means by which the works will be resolved, and the archaeological strategies proposed to recover, record and curate objects and materials recovered during site works. Licence applications take a minimum of four weeks to process through the Department, and advance planning is required to ensure that the necessary permits are in place before site works commence. One can anticipate that the following licence types will be required: Excavation, to

cover monitoring and investigations works; Detection, to cover the use of metal-detectors; and Dive Survey, to cover the possibility of having to conduct underwater inspections.

Since 2017, excavation licence applications must be accompanied by a letter from the client confirming that the project will provide sufficient funds and other facilities to the applicant to complete the archaeological excavation, post-excavation, and preliminary and final reports (including specialist reports).

In the event of archaeologically significant features or material being uncovered during the construction phase, machine work will cease in the immediate area to allow the archaeologist/s to examine the area.

Once the presence of archaeologically significant material is established, full archaeological recording of such material will be recommended. If it is not possible for the construction works to avoid the material, full excavation will be recommended. The extent and duration of excavation will be a matter for discussion between the client and the licensing authorities.

A core of a suitable archaeological team will be on standby to deal with any such rescue excavation. This would be complimented in the event of a full excavation.

An archaeological dive team will be retained on standby for the duration of any in-water disturbance works on the basis of a twenty-four or forty-eight-hour call-out response schedule, to deal with any archaeologically significant/potential material that is identified in the course of the river bed disturbance activities.

Secure wet storage facilities will be provided on site by the client to facilitate the temporary storage of artefacts that may be recorded during the course of the site work.

- Buoying/fencing of any such areas of discovery will be necessary if discovered and during excavation;
- Construction traffic will be restricted to avoid any identified archaeological site/s and their environs; and
- Spoil will not be dumped on any of the selected sites or their environs.

It is a condition of archaeological licensing that a detailed project report is lodged with the DCHG within 12 months of completion of site works. The report should be to publication standard and should include a full account, suitably illustrated, of all archaeological features, finds and stratigraphy, along with a discussion and specialist reports. Artefacts recovered during the works need to meet the requirements of the National Museum of Ireland.

10.6 Residual Impacts

No significant residual impacts are anticipated provided that the mitigation and monitoring described above is implemented.

11 Air Quality and Climate

11.1 Introduction

This Chapter examines the baseline environment in terms of air quality and climate and assesses the potential impact of the proposed works associated with the Enniscorthy Flood Defence Scheme. This Chapter has been prepared by AWN Consulting Ltd.

This Chapter has been structured as follows;

- **Section 11.2**- Outline the assessment methodology. Air quality is governed by European Union (EU) air quality directives and Irish air quality regulations which set limit values and objectives for a range of pollutants. An assessment was carried out of the likely air quality and climate impacts associated with the proposed scheme in the context of the regulations
- **Section 11.3**- Describes the outputs of the desktop analysis carried out within the study area and describes the value of the existing environment study area in terms of air quality and climate impacts;
- **Section 11.4**- Provides technical information on the principal elements of the proposed scheme and examines the potential impacts on the air quality and climate;
- **Section 11.5**- Describes the proposed mitigation measures and dust monitoring regime to be carried out during the proposed construction phase; and
- **Section 11.6**- Summarises the potential for significant residual effects.

11.2 Assessment Methodology

11.2.1 Ambient Air Quality Standards

In order to reduce the risk to human 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 in Table 11.1.

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, which incorporate European Commission Directive 2008/50/EC which has set limit values for the pollutants SO_2, NO_2, PM_{10}, benzene and CO. Council Directive 2008/50/EC combines the previous Air Quality Framework Directive (96/62/EC) and its subsequent daughter directives (including 1999/30/EC and 2000/69/EC). Provisions were also made for the inclusion of new ambient limit values relating to $PM_{2.5}$.

Table 11.1: Air Quality Standards Regulations 2011 (based on EU Council Directive 2008/50/EC)

Pollutant	Regulation Note 1	Limit Type	Value
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m^3 NO_2
		Annual limit for protection of human health	40 µg/m^3 NO_2

Pollutant	Regulation Note 1	Limit Type	Value
		Critical limit for protection of vegetation	30 µg/m^3 NO + NO_2
Lead	2008/50/EC	Annual limit for protection of human health	0.5 µg/m^3
Sulphur dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	350 µg/m^3
		Daily limit for protection of human health - not to be exceeded more than 3 times/year	125 µg/m^3
		Critical limit for the protection of vegetation	20 µg/m^3
Particulate Matter (as PM10)	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3 PM10
PM2.5	2008/50/EC	Annual limit for protection of human health	25 µg/m^3 PM2.5
Benzene	2008/50/EC	Annual limit for protection of human health	5 µg/m^3
Carbon Monoxide	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	10 mg/m^3 (8.6 ppm)

Source: EU 2008/50/EC – Clean Air for Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC

11.2.2 Dust Deposition Guidelines

The concern from a health perspective is focussed on particles of dust which are less than 10 microns and the EU ambient air quality standards outlined in Table 11.1 have set ambient air quality limit values for PM_{10} and $PM_{2.5}$.

With regard 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.

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, Health & Local Government (DOEHLG, 2004) apply the Bergerhoff limit of 350 mg/(m^2/day) to the site boundary of quarries. This limit value can be implemented with regard to dust impacts from construction of the proposed scheme.

11.2.3 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. To achieve the initial targets Ireland was obliged, by 2010, to meet national emission ceilings of 42 kt for SO_2 (67% below 2001 levels), 65 kt for NO_X (52% reduction), 55 kt for VOCs (37% reduction) and 116 kt for NH_3 (6% reduction). In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the

main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$. In relation to Ireland, 2020 emission targets are 25 kt for SO_2 (65% below 2005 levels), 65 kt for NO_X (49% reduction), 43 kt for VOCs (25% reduction), 108 kt for NH_3 (1% reduction) and 10 kt for $PM_{2.5}$ (18% reduction).

European Commission Directive 2001/81/EC and the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005. The data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for SO_2, VOCs and NH_3 but failed to comply with the ceiling for NO_X. Directive (EU) 2016/2284 "On the Reduction of National Emissions of Certain Atmospheric Pollutants and Amending Directive 2003/35/EC and Repealing Directive 2001/81/EC" was published in December 2016. The Directive will apply the 2010 NECD limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4. In relation to Ireland, 2020-29 emission targets are for SO_2 (65% below 2005 levels), for NO_X (49% reduction), for VOCs (25% reduction), for NH_3 (1% reduction) and for $PM_{2.5}$ (18% reduction). In relation to 2030, Ireland's emission targets are for SO_2 (85% below 2005 levels), for NO_X (69% reduction), for VOCs (32% reduction), for NH_3 (5% reduction) and for $PM_{2.5}$ (41% reduction).

11.2.4 Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change in April 1994 and the Kyoto Protocol in principle in 1997 and formally in May 2002. For the purposes of the European Union burden sharing agreement under Article 4 of the Kyoto Protocol, in June 1998, Ireland agreed to limit the net growth of the six Greenhouse Gases under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012.

The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties to the Convention (COP23) took place in Bonn, Germany from the 6th to the 17th of November 2017 and focussed on advancing the implementation of the Paris Agreement. The Paris Agreement was established at COP21 in Paris in 2015 and is an important milestone in terms of international climate change agreements. The "Paris Agreement", agreed by 200 nations, has a stated 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 greenhouse gas emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress has also been made on elevating adaption onto the same level as action to cut and curb emissions.

The EU, on the 23rd/24th of October 2014, agreed the "2030 Climate and Energy Policy Framework". The European Council endorsed a binding EU target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990. The target will be delivered collectively by the EU in the most cost-effective manner possible, with the reductions in the ETS and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005, respectively. Secondly, it was agreed that all Member States will participate in this effort, balancing considerations of fairness and solidarity. The policy also outlines, under "Renewables and Energy Efficiency", an EU binding target of at least 27% for the share of renewable energy consumed in the EU in 2030.

11.2.5 Assessment Methodology

11.2.5.1 Construction Phase

Air Quality

The document titled *Guidance on the assessment of dust from demolition and construction* issued by the Institute of Air Quality Management in the UK (IAQM, 2014) outlines an assessment methodology for predicting the impact of dust emissions from construction and demolition activities based on the scale & 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 results of this assessment are used to determine the appropriate level of dust mitigation required during the construction phase.

Climate

The impact of the development on climate during the construction phase of the project is determined by a qualitative assessment of the nature and scale of the construction activities associated with the proposed scheme.

11.2.5.2 Operational Phase

Local Air Quality

The air quality assessment has been carried out following procedures described in the publications by the EPA (EPA 2017a, 2015) and using the methodology outlined in the policy and technical guidance notes, LAQM.PG (UK DEFRA 2016a) and LAQM.TG (UK DEFRA 2016b), and other guidance issued by UK Department for Environment, Food and Rural Affairs (UK Highways Agency 2007). The assessment of air quality was carried out using a phased approach as recommended by the UK DEFRA (UK DEFRA 2016b). The phased approach recommends that the complexity of an air quality assessment be consistent with the risk of failing to achieve the air quality standards. In the current assessment, an initial scoping of possible key pollutants was carried out and the likely location of air pollution “hot-spots” identified. An examination of recent EPA and Local Authority data in Ireland (EPA 2017b), has indicated that SO_2 and smoke and CO are unlikely to be exceeded at locations such as the current one and thus these pollutants do not require detailed monitoring or assessment to be carried out. However, the analysis did indicate potential problems in regard to nitrogen dioxide (NO_2) and PM_{10} at busy junctions in urban centres (EPA 2017b). Benzene, although previously reported at quite high levels in urban centres (EPA 2017b), has recently been measured at several city centre locations to be well below the EU limit value (EPA 2017b). Historically, CO levels in urban areas were a cause for concern. However, CO concentrations have decreased significantly over the past number of years and are now measured to be well below the limits even in urban centres (EPA 2017b).

The current assessment thus focused firstly on identifying the existing baseline levels of NO_2, PM_{10}, $PM_{2.5}$, benzene and CO and in the region of the Proposed scheme, both currently (by analysis of suitable EPA monitoring data), and when the Proposed scheme is operational (through modelling). Thereafter, the impact of the Proposed scheme on air quality at the neighbouring sensitive receptors was determined relative to “Do nothing” levels for the opening and design years (2019 and 2034). The assessment methodology involved air dispersion modelling using the UK DMRB Screening Model (UK Highways Agency 2007) (Version 1.03c, July 2007), the NO_x to NO_2 Conversion Spreadsheet (UK DEFRA 2016c), the Highways Agency’s Long-Term Gap Analysis Calculator (UK Highways Agency, 2013) and following guidance issued by Transport Infrastructure Ireland (TII 2011), UK DEFRA (UK DEFRA 2016b),

UK Highways Agency (2007) and the EPA (EPA 2017a, 2015). The inputs to the air dispersion model consist of information on road layouts, receptor locations, annual average daily traffic movements (AADT), annual average traffic speeds and background concentrations. Using this input data, the model predicts ambient ground level concentrations at the worst-case sensitive receptors using generic meteorological data. The DMRB model uses conservative emission factors, the formulae for which are outlined in the DMRB Volume 11 Section 3 Part 1 – HA 207/07 Annexes B3 and B4. These worst-case concentrations are then added to the existing background concentrations to give the worst-case predicted ambient concentrations. The worst-case predicted ambient concentrations are then compared with the relevant ambient air quality standards to assess the compliance of the Proposed scheme with these ambient air quality standards.

Although no relative impact, as a percentage of the limit value, is enshrined in EU or Irish Legislation, the Transport Infrastructure Ireland document titled *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (TII 2011) details a methodology for determining air quality impact significance criteria for road schemes. The degree of impact is determined based on both the absolute and relative impact of the proposed scheme. The TII significance criteria have been adopted for the proposed scheme and are detailed in Table 11.2 to Table 11.4. The significance criteria are based on PM_{10} and NO_2 as these pollutants are most likely to exceed the limit values. However, the criteria have also been applied to the predicted 8-hour CO, annual benzene and annual $PM_{2.5}$ concentrations for the purposes of this assessment

Table 11.2: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Magnitude of Change	Annual Mean NO_2 / PM_{10}	No. days with PM_{10} concentration > 50 µg/m^3	Annual Mean $PM_{2.5}$
Large	Increase / decrease ⩾4 µg/m^3	Increase / decrease >4 days	Increase / decrease ⩾2.5 µg/m^3
Medium	Increase / decrease 2 - <4 µg/m^3	Increase / decrease 3 or 4 days	Increase / decrease 1.25 - <2.5 µg/m^3
Small	Increase / decrease 0.4 - <2 µg/m^3	Increase / decrease 1 or 2 days	Increase / decrease 0.25 - <1.25 µg/m^3
Imperceptible	Increase / decrease <0.4 µg/m^3	Increase / decrease <1 day	Increase / decrease <0.25 µg/m^3

Source: *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* – Transport Infrastructure Ireland (2011)

Table 11.3: Air Quality Impact Significance Criteria For Annual Mean Nitrogen Dioxide and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor

Absolute Concentration in Relation to Objective/Limit Value	Change in Concentration Note 1		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value with Scheme (⩾40 µg/m^3 of NO_2 or PM_{10}) (⩾25 µg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value with Scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with Scheme (30 - <36 µg/m^3 of NO_2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value with Scheme (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value with Scheme (⩾40 µg/m^3 of NO_2 or PM_{10}) (⩾25 µg/m^3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value with Scheme (36 - <40 µg/m^3 of NO_2 or PM_{10}) (22.5 - <25 µg/m^3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value with Scheme (30 - <36 µg/m^3 of NO2 or PM_{10}) (18.75 - <22.5 µg/m^3 of $PM_{2.5}$)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value with Scheme (<30 µg/m^3 of NO2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial

Source: *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* – Transport Infrastructure Ireland (2011)

Table 11.4: Air Quality Impact Significance Criteria for Changes to Number of Days with PM_{10} Concentration Greater than 50 µg/m³ at a Receptor

Absolute Concentration in Relation to Objective/Limit Value	Change in Concentration Note 1		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value with Scheme (⩾35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value with Scheme (32 - <35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with Scheme (26 - <32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value with Scheme (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value with Scheme (⩾35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value with Scheme (32 - <35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value with Scheme (26 - <32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value with Scheme (<26 days)	Negligible	Negligible	Slight Beneficial

Source: *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* – Transport Infrastructure Ireland (2011)

Receptor Locations

Eight locations were modelled close to the existing and proposed roads for which traffic will be impacted by the proposed scheme. The receptors modelled represent the worst-case locations in the vicinity of the proposed scheme and were chosen due to their close proximity to the proposed scheme as well as existing and proposed local roads. Details of the receptor locations are provided in Table 11.5.

Table 11.5: DMRB Screening Air Quality Assessment. Details of Assessment Locations

Receptor	Location	Co-ordinates (Irish Grid) Note 1
ASR01	Island Street (opp. Enniscorthy Bridge)	297381 E 139873 N
ASR02	Shannon Quay	297566 E 139793 N
ASR03	Bridge Point (Abbey Quay)	297466 E 139783 N
ASR04	10 Mill Park Road	297337 E 139536 N
ASR05	National 1798 Centre	297222 E 139280 N
ASR06	Society of Friends Meeting House	297589 E 139734 N
ASR07	Along N30 South of Prop. Bridge	297213 E 139101 N
ASR08	Along N11 South of Prop. Bridge	297660 E 297080 N

Note 1: Co-ordinates are approximate to nearest 5m

Air Quality Impacts on Sensitive Ecosystems

The TII guidance (TII, 2011) states that as the potential impact of a scheme is limited to a local level, detailed consideration need only be given to roads where there is a significant change to traffic flows (>5%) and the designated site lies within 200 m of the road centre line.

The impact of NO_x (i.e. NO and NO_2) emissions resulting from the proposed scheme at the River Slaney Valley SAC/ SPA and pNHA was assessed using the UK DMRB Screening Model (UK Highways Agency 2007), the NO_x to NO_2 Conversion Spreadsheet (UK DEFRA 2016c) and the Highways Agency's Long-Term Gap Analysis Calculator (UK Highways Agency, 2013). A new bridge will form part of the proposed scheme and will cross the River Slaney Valley SAC and pNHA. The existing Seamus Rafter Bridge crossing the SAC and pNHA will be removed as part of the proposed scheme. Predictive modelling using the DMRB spreadsheet was carried out at typical traffic speeds to assess the existing and proposed scenarios for the bridge crossings. Ambient NO_x concentrations predicted for the opening and design years along a transect of up to 200 m within the SAC / pNHA were modelled. The road contribution to dry deposition along the transect was also calculated using the methodology outlined in Appendix 9 of the Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (TII, 2011).

Regional Air Quality & Climate

The impact of the proposed scheme at a national / international level has been determined using the procedures given by Transport Infrastructure Ireland (TII, 2011) and the methodology provided in Annex 2 in the UK DMRB (UK Highways Agency 2007). The assessment focused on determining the resulting change in emissions of CO, particulates (PM_{10}), volatile organic compounds (VOCs), nitrogen oxides (NO_x) and carbon dioxide (CO_2). The Annex provides a method for the prediction of the regional impact of emissions of these pollutants from road schemes. The inputs to the air dispersion model consist of information on road link lengths, AADT movements, percentages of heavy good vehicles (HGV) and traffic speeds.

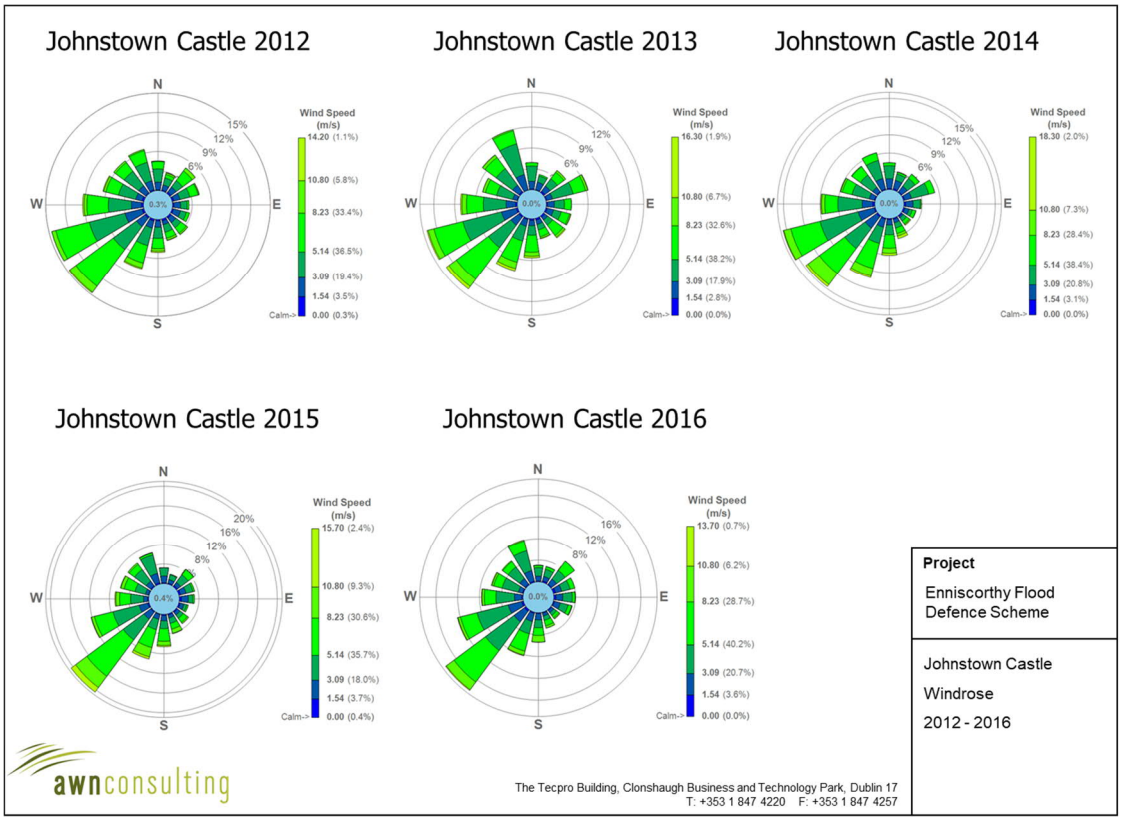
11.3 Receiving Environment

11.3.1 Meteorological Data

A key factor in assessing temporal and spatial variations in air quality is 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 and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles ($PM_{2.5}$ - PM_{10}) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

The nearest representative weather station collating detailed weather records is Johnstown Castle meteorological station, which is located approximately 22 km south of the proposed scheme. Meteorological data over a five-year period (Johnstown Castle, 2012 – 2016) provides an indication of the prevailing wind conditions for the region (see Figure 11.1). Results indicate that the prevailing wind direction is south-westerly in direction.

Figure 11.1: Wind Direction at Johnstown Castle Meteorological Station (2012 – 2016)



11.3.2 Trends in Air Quality

Air quality is variable and subject to both significant spatial and temporal variation. In relation to spatial variations in air quality, concentrations generally fall significantly with distance from major road sources (UK Highways Agency 2007). Thus, residential exposure is determined by the location of sensitive receptors relative to major roads sources in the area. Temporally, air quality can vary significantly by orders of magnitude due to changes in traffic volumes, meteorological conditions and wind direction.

In 2011 the UK DEFRA published research (UK DEFRA, 2011) on the long-term trends in NO_2 and NO_x for roadside monitoring sites in the UK. This study marked a decrease in NO_2 concentrations between 1996 and 2002, after which the concentrations stabilised with little reduction between 2004 and 2010. The result of this is that there now exists a gap between projected NO_2 concentrations which UK DEFRA previously published and monitored concentrations. The impact of this 'gap' is that the DMRB screening model can under-predict NO_2 concentrations for predicted future years. Subsequently, the UK Highways Agency (HA) published an Interim advice note (IAN 170/12) in order to correct the DMRB results for future years. There is a lack of similar modelling in Ireland, however, in order to ensure conservative modelling, IAN 170/12 is also applied to the predictions for future years.

11.3.3 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 "Air Quality Monitoring Annual Report 2016" (EPA 2017b), details the range and scope of monitoring undertaken throughout Ireland.

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 2017b). 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, the region of the proposed scheme is categorised as Zone D (EPA 2017b).

NO_2 monitoring was carried out at two rural Zone D locations in 2016, Emo Court and Kilkitt and in two urban areas, Enniscorthy and Castlebar (EPA 2017b). The NO_2 annual average in 2016 for Enniscorthy was 9.6 µg/m^3 and for the other urban Zone D location of Castlebar was 8.5 µg/m^3. The rural Zone D locations of Emo Court and Kilkitt recorded results of 4.1 µg/m^3 and 3.0 µg/m^3 in 2016, respectively. Hence long-term average concentrations measured at all Zone D locations were significantly lower than the annual average limit value of 40 µg/m^3. The average results over the last three years in Enniscorthy suggests an upper average of no more than 13 µg/m^3 as a background concentration as shown in Table 11.6. Based on the above information a conservative estimate of the background NO_2 concentration in the region of the proposed scheme is 13 µg/m$^{3.}$

Table 11.6: Annual Mean NO_2 Concentrations in Zone D Locations 2012 - 2016 (µg/m^3)

Year	Enniscorthy	Kilkitt	Emo	Castlebar
2012	-	4	-	8
2013	-	4	4	11
2014	13	3	3	8
2015	9	2	3	8
2016	10	3	4	9

Long-term PM_{10} monitoring was carried out at the Zone D locations of Castlebar, Kilkitt, Enniscorthy and Claremorris in 2016 (EPA 2017b). The maximum 24-hour concentration (as a 90.4th%ile) at each of the Zone D locations is shown in Table 11.7. The long-term average of the 90.4th%ile of 24-hour concentrations over the past 3 years in Enniscorthy is 34 µg/m^3. The average annual mean concentrations measured at the Zone D locations over the past 5 years are shown in Table 11.8. The average annual mean results over the last three years at Enniscorthy is 19 µg/m^3 with a maximum annual average of 22 µg/m^3. Based on the above information an estimate of the background annual average PM_{10} concentration in the region of the proposed scheme is 20 µg/m$^{3.}$

Table 11.7: 90th%ile of 24-Hour PM_{10} Concentrations In Zone D Locations 2012 – 2016 (µg/m^3)

Year	Claremorris	Kilkitt	Enniscorthy	Castlebar
2012	18	16	-	20
2013	21	19	-	27
2014	15	15	37	21
2015	17	18	34	23
2016	17	15	32	20

Year	Claremorris	Kilkitt	Enniscorthy	Castlebar
Average	18	17	34	22

Table 11.8: Annual Mean PM_{10} Concentrations in Zone D Locations 2012 - 2016 (µg/m^3)

Year	Claremorris	Kilkitt	Enniscorthy	Castlebar
2012	10	9	-	12
2013	13	11	-	15
2014	10	9	22	12
2015	10	9	18	13
2016	10	8	17	12
Average	11	9	19	13

The results of $PM_{2.5}$ monitoring at the Zone D location of Claremorris from 2012 - 2016 (EPA 2017b) indicated that $PM_{2.5}/PM_{10}$ ratios ranged from 0.5 - 0.61 over that period. Based on this information, a ratio of 0.6 was used to generate a background $PM_{2.5}$ concentration of 12 µg/m^3.

The results of CO monitoring carried out at Enniscorthy (Zone D) over the period 2014 – 2016 showed no exceedances of the 8-hour limit value (EPA 2017b), with annual average levels ranging from 0.4 to 0.6 mg/m^3. Based on this information, a conservative estimate of the background CO concentration for the region of the proposed scheme is 0.6 mg/m^3.

In terms of benzene, there was no monitoring conducted at zone D locations in 2016, however, the average annual mean concentration in the Zone C location Kilkenny Seville Lodge for the period 2012 to 2016 was 0.2 µg/m^3. This is well below the limit value of 5 µg/m^3 (EPA 2017b). Based on this data, a conservative estimate of the background benzene concentration in the vicinity of the proposed scheme is 0.5 µg/m^3.

Background concentrations for 2020 and 2035 were calculated from the 2015 background concentrations using the year on year reduction factors outlined in Appendix 5 of the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* issued by Transport Infrastructure Ireland (2011).

In summary, existing baseline levels of NO_2, PM_{10}, $PM_{2.5}$, CO and benzene based on extensive long-term data from the EPA are expected to be below ambient air quality limit values in the vicinity of the proposed scheme. A summary of the background concentrations is detailed in Table 11.9.

Table 11.9: Summary of Background Concentrations Used in the DMRB Model

Background Values	NO_2	NO_x	PM_{10}	$PM_{2.5}$	CO	Benzene
2016	13	18	20	12	0.6	0.5
2019	11.4	15.8	19.7	11.7	0.6	0.5
2034	10.9	15.0	19.5	11.6	0.6	0.5

11.3.3.1 Do Nothing Scenario

In the do-nothing scenario, there will be no construction phase impacts.

11.4 Assessment of Impacts

11.4.1 Construction Phase

11.4.1.1 Air Quality

It is important to note that the potential impacts associated with the construction phase of the proposed scheme are temporary in nature. Construction dust has the potential to cause local impacts through dust nuisance at nearby sensitive receptors. Construction activities such as demolition, excavation, earth moving and backfilling may generate quantities of dust, particularly in dry and windy weather conditions. While dust from construction activities tends to be deposited within 200m 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. Vehicles transporting material to and from the construction site also have the potential to cause dust generation along the selected haul routes from the construction areas.

The Institute of Air Quality Management in the UK (IAQM) guidelines (IAQM 2014) outline an assessment method for predicting the impact of dust emissions from construction and demolition activities based on the scale & 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 results of this assessment are used to determine the appropriate level of dust mitigation required during the construction phase.

Define the Sensitivity of the Receiving Environment

In terms of receptor sensitivity to dust soiling, there are greater than 100 high sensitivity receptors (residential receptors) located less than 50m from the proposed construction works which is considered a high sensitivity environment for dust soiling according to the IAQM criteria outlined in Table 11.10.

Table 11.10: 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. 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. The current annual mean PM_{10} concentration in the vicinity of the proposed scheme is estimated to be 20 µg/m^3 and there are more than 100 high sensitivity receptors located less than 50m from the proposed construction works. Based on the IAQM criteria outlined in Table 11.11, the worst-case sensitivity of the area to human health is considered to be low.

Table 11.11: Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number of Receptors	Distance from source (m)			
			<20	<50	<100	<200
High	< 24 µg/m3	>100	Medium	**Low**	Low	Low
		10-100	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium	< 24 µg/m3	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Low	< 24 µg/m3	>1	Low	Low	Low	Low

The IAQM guidelines also outline the assessment criteria for determining the sensitivity of the area to ecological impacts from dust. The criteria take into consideration whether the receiving environment is classified as a Special Area of Conservation (SAC), a Special Protected Area (SPA), a Natural Heritage Area (NHA) or a proposed Natural Heritage Area (pNHA) as dictated by the EU Habitats Directive or whether the site is a local nature reserve or home to a sensitive plant or animal species. As the demolition of the Seamus Rafter Bridge and construction of the proposed road bridge will occur directly adjacent to the River Slaney Valley SAC and pNHA, the worst-case sensitivity of the area to ecological impacts is considered to be high.

Define the Potential Dust Emission Magnitude

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. The major dust generating activities are divided into four types within the IAQM guidance to reflect their different potential impacts. These are:

- Demolition;
- Earthworks;
- Construction; and
- Trackout (truck movements).

Demolition

The existing Seamus Rafter Bridge and part of the quay walls on the Promenade side south of the bridge will be demolished as part of the proposed scheme. The dust emission magnitude from demolition works can be classified as small, medium or large based on the definitions from the IAQM guidance. The dust emission magnitude for the proposed demolition activities can be classified as small based on the small volume of structures to be demolished.

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 11.12, this results in an overall medium risk of short-term dust soiling impacts, an overall negligible risk of human health impacts and an overall medium risk of ecological impacts as a result of the proposed demolition activities.

Overall, in order to ensure that no dust nuisance occurs during the demolition activities, a range of dust mitigation measures associated with a medium risk of dust impacts must be implemented. When the dust mitigation measures detailed in the mitigation section of this Chapter are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors.

Table 11.12: Risk of Dust Impacts - 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 Risk**

Earthworks

Earthworks will primarily involve excavating material, haulage, 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. The dust emission magnitude for the proposed earthwork activities can be classified as large as a worst-case. The civil engineering works and in-stream works required for the flood defence scheme will involve the excavation, haulage, filling and stockpiling of significant volumes of material.

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 11.13, this results in an overall high risk of temporary dust soiling impacts, an overall low risk of temporary human health impacts and an overall high risk of ecological impacts as a result of the proposed earthworks activities.

Overall, in order to ensure that no dust nuisance occurs during the earthwork activities, a range of dust mitigation measures associated with a high risk of dust impacts must be implemented. When the dust mitigation measures detailed in the mitigation section of this Chapter are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors.

Table 11.13: 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 Risk

Construction

Dust emission magnitude from construction can be classified as small, medium or large based on the definitions from the IAQM guidance. The dust emission magnitude for the proposed construction activities can be classified as medium.

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 11.14 below, this results in an overall medium risk of temporary dust soiling impacts, an overall low risk of temporary human health impacts and an overall medium risk of ecological impacts as a result of the proposed construction activities.

Overall, in order to ensure that no dust nuisance occurs during the construction activities, a range of dust mitigation measures associated with a medium risk of dust impacts must be implemented. When the dust mitigation measures detailed in the mitigation section of this Chapter are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors.

Table 11.14: Risk of Dust Impacts - Construction

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 Risk

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.

The dust emission magnitude for the proposed trackout can be classified as medium as there may be phases during the construction period where there are between 10 and 50 truck movements per day associated with the works.

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 11.15, this results in an overall medium risk of temporary dust soiling impacts, an overall low risk of temporary human health impacts and an overall medium risk of ecological impacts as a result of the proposed trackout activities.

Overall, in order to ensure that no dust nuisance occurs during the trackout activities, a range of dust mitigation measures associated with a medium risk of dust impacts must be implemented. When the dust mitigation measures detailed in the mitigation section of this Chapter are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors.

Table 11.15: 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 Risk

Summary of Potential Dust Impacts

The risk of dust impacts as a result of the proposed scheme are summarised in Table 11.16 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.

Table 11.16: Summary of Dust Impact Risks used to Define Site-Specific Mitigation

Potential Impact	Dust Emission Magnitude			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium Risk	High Risk	Medium Risk	Medium Risk
Human Health	Negligible Risk	Low Risk	Low Risk	Low Risk
Ecosystems	Medium Risk	High Risk	Medium Risk	Medium Risk

11.4.1.2 Climate & Transboundary Pollution

Construction traffic and machinery would be expected to be the dominant source of greenhouse gas emissions as a result of the construction phase of the development. Construction vehicles and machinery will give rise to CO_2 and NO_2 emissions during construction of the proposed scheme. The entire construction period will be approximately three years in duration with the works undertaken in phases. Based on the phased and temporary nature of impacts, the potential impact on climate and transboundary pollution from the proposed scheme is deemed to be slight, negative and short-term.

11.4.1.3 Human Health

An adverse impact to air quality during the construction phase has the potential to impact human health. The mitigation measures that will be put in place during construction of the proposed scheme will ensure that the impact of the development complies with all ambient air quality legislative limit values which are based on the protection of human health. Therefore, the impact of construction of the proposed scheme is likely to be short-term and not significant with respect to human health.

11.4.1.4 Cumulative Impacts

As the predicted impacts to air quality and climate are deemed short-term and not significant for construction of the proposed scheme assuming dust mitigation measures are implemented, the cumulative impacts from simultaneous construction of the proposed scheme and any external developments within 350m of the site are deemed not significant with mitigation measures in place.

11.4.2 Operational Phase

11.4.2.1 Local Air Quality

NO_2

The results of the assessment of the impact of the proposed scheme for NO_2 in the opening and design years are shown in Table H.1 and Table H.2 in Appendix H. The annual average concentration is within the limit value at all worst-case receptors using both the UK DEFRA method and more conservative IAN guidance. Future trends, with the proposed scheme in place, indicate similarly low levels of NO_2. Levels of NO_2 including background reach 49% of the annual limit value in 2019 and 2034 using the UK DEFRA method and 53% of the annual limit value in 2019 and 2034 following the IAN method. The 1-hour maximum NO_2 limit value (expressed as a 99.8th%ile) is not predicted to be exceeded using either technique.

Relative to baseline levels, some increases and decreases in NO_2 levels at the worst-case receptors are predicted as a result of the proposed scheme. With regard to impacts at individual receptors, one receptor (ASR01) will experience an increase in its annual NO_2 concentration of 6% of the limit value in 2019 and 5% of the limit value in 2034 and two receptors (ASR02 and ASR06) will experience a decrease in their annual NO_2 concentration of 9 - 11% of the limit

value in 2019 and 2034. The five other worst-case receptors modelled will experience increases or decreases in concentration of less than 5% of the annual limit value in 2019 and 2034.

Using the assessment criteria outlined in Section 11.2.5 the impact of the proposed scheme in terms of NO_2 is classified as negligible at seven of the eight receptors assessed and as slight beneficial at one receptor assessed (ASR02).

PM_{10}

The results of the modelled impact of the proposed scheme for PM_{10} in the opening and design years are shown in Table H.3 in Appendix H of this EIAR. Predicted annual average concentrations with the proposed scheme in place are below the ambient standards at all worst-case receptors, reaching 53% of the limit value including background in both 2019 and 2034. In addition, the 24-hour limit value will be exceeded five times in 2019 (35 exceedances are permitted per year).

The impact of the Proposed Scheme can be assessed relative to the “Do Minimum” levels in 2019 and 2034 (as set out in Table H.3 in Appendix H). Relative to baseline levels, some small increases and decreases in PM_{10} levels at the worst-case receptors are predicted as a result of the proposed scheme. With regard to impacts at individual receptors, none of the eight receptors assessed will experience an increase or decrease in concentrations of over 2% of the limit value in 2019 and 2034.

The greatest impact on PM_{10} concentrations in the region of the proposed scheme in either 2019 or 2034 will be an increase of 1% of the annual limit value at ASR01. Furthermore, the greatest improvement in PM_{10} concentrations will be a decrease of 2% of the annual limit value at ASR02.

Therefore, using the assessment criteria outlined in Section 11.2, the impact of the proposed scheme with regard to PM_{10} is negligible at all eight of the receptors assessed.

$PM_{2.5}$

The results of the modelled impact of the proposed scheme for $PM_{2.5}$ in the opening and design years are shown in Table H.4 in Appendix H. Predicted annual average concentrations with the proposed scheme in place are below the ambient standard at all worst-case receptors, reaching 55% of the limit value in 2019 and 2034.

The impact of the proposed scheme can be assessed relative to “Do Minimum” levels in 2019 and 2034 as set out in Table H.4 of Appendix H. Relative to baseline levels, some small increases and decreases in $PM_{2.5}$ levels at the worst-case receptors are predicted as a result of the proposed scheme. With regard to impacts at individual receptors, none of the eight receptors assessed will experience an increase or decrease in concentrations of over 2% of the limit value in 2019 and 2034.

The greatest impact on $PM_{2.5}$ concentrations in the region of the proposed scheme in either 2019 or 2034 will be an increase of 1% of the annual limit value at ASR01. Furthermore, the greatest improvement in $PM_{2.5}$ concentrations will be a decrease of 2% of the annual limit value at ASR02.

Thus, using the assessment criteria outlined in Section 11.2, the impact of the proposed scheme with regard to $PM_{2.5}$ is negligible at all eight receptors assessed.

CO & Benzene

The results of the modelled impact of the proposed scheme for CO and benzene in the opening and design years are shown in Table H.5 and Table H.6 in Appendix H of in this EIAR. Predicted pollutant concentrations with the proposed scheme in place are below the ambient standards at all locations. Levels of both pollutants range from 12 - 34% of the respective limit values in 2019 and 2034.

The impact of the proposed scheme can be assessed relative to “Do Minimum” levels in 2019 and 2034 (see Table H.5 and Table H.6). Relative to baseline levels, some small increases and decreases in pollutant levels at the worst-case receptors are predicted as a result of the proposed scheme. With regard to impacts at individual receptors, none of the eight receptors assessed will experience an increase or decrease in concentrations of greater than 5% of the limit value in either 2019 or 2034.

The greatest impact on CO and benzene concentrations in either 2019 or 2034 will be an increase of 1.3% of their respective limit values at ASR01. Furthermore, the greatest improvement in CO and benzene concentrations will be a decrease of 2.3% of their respective limit values at ASR02.

Thus, using the assessment criteria for NO_2 and PM_{10} outlined in 11.2 and applying these criteria to CO and benzene, the impact of the proposed scheme in terms of CO and benzene is negligible.

11.4.2.2 Air Quality Impacts on Sensitive Ecosystems

The impact of NO_x (i.e. NO and NO_2) emissions resulting from the proposed scheme at the River Slaney Valley SAC and pNHA was assessed. Ambient NO_x concentrations predicted for the opening and design years along a transect of up to 200 m within the River Slaney Valley SAC and pNHA are given in Table H.7 in Appendix H of this EIAR. The road contribution to dry deposition along the transect is also given and was calculated using the methodology of TII 2011.

The predicted annual average NO_x level in the River Slaney Valley SAC and pNHA is below the limit value of 30 µg/m^3 for the “Do Something” scenario in 2019 and 2034 with NO_x concentrations reaching 68% of this limit in 2019 and 67% in 2034 including background levels.

The impact of the proposed scheme can be assessed relative to “Do Minimum” levels in 2019 and 2034 (see Table H.7). The impact of the proposed scheme leads to a decrease in NO_x concentrations of at most 9.6 µg/m^3 within the River Slaney Valley SAC and pNHA. As the proposed scheme will cause a decrease in NO_x concentrations within the SAC / pNHA, and the predicted total concentrations (including background) with the proposed scheme in place are below the limit value for the protection of vegetation of 30 µg/m^3, no further analysis of the sensitivity of the habitat to NO_x is therefore required under TII guidance (TII, 2011).

The road contribution to the NO_2 dry deposition rate along the 200 m transect within the SAC / pNHA is also detailed in Table H.7. The maximum decrease in the NO_2 dry deposition rate is 0.17 Kg(N)/ha/yr in 2019 and 0.14 Kg(N)/ha/yr in 2034. This equates to 3% reduction when expressed as a percentage of the critical load for inland and surface water habitats of 5-10 kg(N)/ha/yr (TII, 2011).

Regional Air Quality & Climate

The regional impact of the proposed scheme on emissions of NO_x and VOCs has been assessed using the procedures of TII (2011) and the UK Highways Agency (2007). The results

(see Table 11.17) indicate that the impact of the proposed scheme is not significant. For the assessment year of 2019, the predicted impact of the proposed scheme is to increase NO_x levels by 0.0036% of the NOx emissions ceiling and increase the VOC levels by 0.0011% of the VOC emissions ceiling to be compiled with in 2020. For the assessment year of 2034, the predicted impact of the proposed scheme is to decrease NO_x levels by 0.00009% of the NO_x emissions ceiling to be complied with after 2030 whilst VOC levels will not increase or decrease as a result of the proposed scheme.

The impact of the proposed scheme on emissions of CO_2 was also assessed against Ireland's 2020 target for the Non-ETS sectors which is to reduce CO_2 levels by 20% of 2005 levels by 2020, this equates to 37.5 Megatonnes of CO_2eq (see Table 11.17). The results show that the impact of the proposed scheme will be to increase CO_2 emissions by 0.0038% of Ireland's reduction target in 2019 and to slightly reduce CO_2 emissions in 2034. Therefore, the impact of the proposed scheme on national greenhouse emissions will not be significant in terms of Ireland's obligations under the EU Commission's Climate and Energy Package.

Table 11.17: Proposed Enniscorthy Flood Defence Scheme. Regional Air Quality and Climate Assessment

Year	Scenario	VOC	NO_X	CO_2
		(kg/annum)	(kg/annum)	(tonnes/annum)
2019	Do Nothing	1340	4641	2445
	Do Something	1831	6952	3901
2034	Do Nothing	1576	5167	2859
	Do Something	1576	5132	2845
Increment in 2019		491.1 kg	2310.9 kg	1455.5 Tonnes
Increment in 2034		-0.1 kg	-34.7 kg	-14.3 Tonnes
Emission Ceiling (kilo Tonnes) 2019 Note 1		44	64	38,600 Note 2
Emission Ceiling (kilo Tonnes) 2034 Note 1		40	39	37,500 Note 2
Impact in 2019 (%)		0.0011 %	0.0036 %	0.0038 %
Impact in 2034 (%)		0 %	-0.00009 %	0 %

Note 1 Targets for VOCs and NO_x under Directive (EU) 2016/2284 "On the Reduction of National Emissions of Certain Atmospheric Pollutants and Amending Directive 2003/35/EC and Repealing Directive 2001/81/EC"
Note 2 CO_2 Targets under the 20-20-20 Climate and Energy Package

The draft "Guidelines on the Information to be Contained in Environmental Impact Assessment Reports" (EPA 2017a) state that impacts relevant to adaptation should be assessed and that projects should be assessed in terms of their vulnerability to climate change in addition to determining the nature and magnitude of greenhouse gas emissions. Climate change has the potential to cause extreme weather events and increased likelihood of flooding. The proposed flood defence scheme is being constructed to help mitigate against an increased risk of flooding as a result of climate change. The proposed measures to be implemented as part of the Enniscorthy Flood Defence Scheme will provide sufficient capacity for adaption to future increased rainfall and potential flooding events as a result of climate change.

11.4.2.3 Human Health

An adverse impact to air quality during the operational phase has the potential to impact human health. Modelling using the DMRB model has shown that there are no significant air quality impacts predicted for the operational phase of the proposed scheme. Therefore, the impact to

air quality and human health from the operational phase of the proposed scheme will be imperceptible.

11.4.2.4 Cumulative Impacts

Traffic data used for the DMRB modelling for 2019 and 2034 for both the Do Minimum and Do Something Scenarios has assumed that the M11 Gorey to Enniscorthy PPP Scheme is in place. Modelling results have shown that the predicted cumulative impacts of both the proposed flood defence scheme and the M11 Gorey to Enniscorthy PPP Scheme will not be significant at the worst-case receptors modelled within Enniscorthy Town.

11.5 Mitigation Measures

11.5.1 Construction Phase

The objective of dust control at the site is to ensure that no significant nuisance occurs at nearby sensitive receptors. The appointed Contractor will prepare a dust control strategy as part of the CEMP. The following outline management plan has been formulated by drawing on best practice guidance from Ireland, the UK and the USA (IAQM (2014), The Scottish Office (1996), USEPA (1997), UK Office of Deputy Prime Minister (2002), BRE (2003)).

11.5.1.1 Site Management

The aim is to ensure good site management by avoiding dust becoming airborne at source. This will be done through good design and effective control strategies.

At the construction planning stage, the siting of activities and storage piles will take note of the location of sensitive receptors and prevailing wind directions in order to minimise the potential for significant dust nuisance (see Figure 11.1 for the wind rose for Johnstown Castle). As the prevailing wind is predominantly south-westerly, locating construction compounds and storage piles downwind of sensitive receptors will minimise the potential for dust nuisance to occur at sensitive receptors.

Good site management will include the ability to respond to adverse weather conditions by either restricting operations on-site or quickly implementing effective control measures before the potential for nuisance occurs. When rainfall is greater than 0.2mm/day, dust generation is generally suppressed (UK Office of Deputy Prime Minister (2002), BRE (2003)). The potential for significant dust generation is also reliant on threshold wind speeds of greater than 10 m/s (19.4 knots) (at 7m above ground) to release loose material from storage piles and other exposed materials (USEPA, 1986). Particular care should be taken during periods of high winds (gales) as these are periods where the potential for significant dust emissions are highest. The prevailing meteorological conditions in the vicinity of the site are favourable in general for the suppression of dust for a significant period of the year. Nevertheless, there will be infrequent periods were care will be needed to ensure that dust nuisance does not occur. The following measures will be taken in order to avoid dust nuisance occurring under unfavourable meteorological conditions:

- The Principal Contractor or equivalent must monitor the Contractors' performance to ensure that the proposed mitigation measures are implemented and that dust impacts and nuisance are minimised;
- During working hours, dust control methods will be monitored as appropriate, depending on the prevailing meteorological conditions;

- The name and contact details of a person to contact regarding air quality and dust issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details;
- It is recommended that community engagement be undertaken before works commence on site explaining the nature and duration of the works to local residents and businesses;
- A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with earth-moving activities, together with details of any remedial actions carried out; and
- It is the responsibility of the Contractor at all times to demonstrate full compliance with the dust control conditions herein;
- At all times, the procedures put in place will be strictly monitored and assessed.

The dust minimisation measures shall be reviewed at regular intervals during the works to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practise and procedures. In the event of dust nuisance occurring outside the site boundary, site activities will be reviewed and satisfactory procedures implemented to rectify the problem.

11.5.1.2 Dust Monitoring

It is recommended that dust deposition monitoring be put in place to ensure dust mitigation measures are adequately controlling emissions. Dust monitoring, if deemed necessary, shall be conducted using the Bergerhoff method in accordance with the requirements of the German Standard VDI 2119. The Bergerhoff Gauge consists of a collecting vessel and a stand with a protecting gauge. The collecting vessel is secured to the stand with the opening of the collecting vessel located approximately 2m above ground level. The TA Luft limit value is 350 mg/(m^2/day) during the monitoring period which is between 28 - 32 days.

11.5.1.3 Summary of Dust Mitigation Measures

The pro-active control of fugitive dust will ensure that the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released, will contribute towards the satisfactory performance of the Contractor. The key features with respect to control of dust will be:

- The specification of a site policy on dust and the identification of the site management responsibilities for dust issues;
- The development of a documented system for managing site practices with regard to dust control;
- The development of a means by which the performance of the dust minimisation plan can be monitored and assessed; and
- The specification of effective measures to deal with any complaints received.

11.5.2 Operational Phase

As no significant impacts to air quality or climate are predicted to occur during the operational phase of the proposed scheme, no site-specific mitigation measures are required.

11.6 Residual Impacts

If all mitigation measures outlined in Section 11.5 are implemented, there will be no residual impacts of significance on air quality or climate from the construction or operation of the proposed scheme.

12 Noise and Vibration

12.1 Introduction

This Chapter considers the baseline noise climate examined in Nov 2016 and examines the likely impact of noise on noise sensitive receptors within the vicinity of the proposed project and works. The baseline noise study completed in November 2016 was carried out over a daytime, evening and night period. This study also examines the potential noise and vibration effects through prediction for both the construction and operation of the proposed scheme. This Chapter has been prepared by noise consultants ICAN Acoustics.

This Chapter has been structured as follows;

- **Section 12.2**- Outline the assessment methodology used.
- **Section 12.3**- Describes the outputs of the desktop and baseline noise field surveys carried out within the study area;
- **Section 12.4**- Provides technical information on the principal elements of the proposed scheme and examines the potential noise and vibration effects through prediction for both the construction and operation of the proposed scheme;
- **Section 12.5**- Describes the proposed mitigation measures and noise and vibration monitoring regime to be carried out during the proposed construction phase; and
- **Section 12.6**- Summarises the potential for significant residual effects.

12.2 Assessment Methodology

The noise and vibration impact assessment has been undertaken having regard to the following standards and best practise guidance documents:

- British Standard 5228 Part 1 and Part 2 Code of Practice for Noise and Vibration Control on Construction and Open Sites (2009+A1:2014) (BS5228:2009+A1:2014);
- Environmental Protection Agency (EPA), Guidance Note for Noise: Licence Applications, Surveys, and Assessments in Relation to Scheduled Activities (NG4), January 2016);
- DMRB The Design Manual for Roads and Bridges, Volume 11 Environmental Assessment, Section 3 environmental assessment techniques; and
- NRA's guidance document Guidelines for the Treatment of Noise and Vibration in National Road Schemes (2004).

12.2.1 Evaluation Criteria

12.2.1.1 Significance of Effects

Impacts will be identified and significance will be attributed taking into account the interaction between magnitude criteria and sensitivity criteria as presented in the significance matrix in Table 12.1. The methodologies and scales used to assess the magnitude of impact and sensitivity for the key impacts expected during construction and operation are set out in Table 12.2 and Table 12.2.

Table 12.1: Impact Evaluation and Determination of Significance

Magnitude of Impact	Sensitivity			
	Negligible	**Low**	**Medium**	**High**
Negligible	Not significant	Not significant	Not significant	Not significant
Low	Not significant	Not significant	Minor	Minor
Medium	Not significant	Minor	Moderate	Moderate
High -Severe	Not significant	Minor	Moderate	Major

12.2.1.2 Sensitivity

The criteria for noise and vibration receptors sensitivity are provided in Table 12.2. The variation in the sensitivity of receptors in terms of environmental impacts is considered by applying different scales to classify magnitude of impacts (e.g. by using different scales for daytime and night-time) rather than by varying the assignment of sensitivity to specific types of receptors.

Table 12.2: Criteria for Determining Receptor Sensitivity

Category	Description/Examples
High	Residential, educational, institutional and healthcare and place of worship
Medium	Public assembly and entertainment
Low	Commercial and light industrial
Negligible	Heavy industrial

12.2.1.3 Magnitude of Impacts

Construction Noise

The construction phase of a development is often the period over which any potential for noise impact is greatest. 'British Standard 5228[53] provides comprehensive guidance on construction noise including details of typical noise levels associated with various items of plant or activities, prediction methods and measures and procedures that have been found to be most effective in reducing impacts. These guidelines are considered as transferable and appropriate for construction projects in Ireland. The Standard also provides advice on good site practice in the control of noise. The Contractor may be required to follow that advice under the terms of a contract.

The impact of noise from construction activities is different from that of permanent noise sources, since the noise experienced will be of relatively short term. There is no statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. In the absence of specific noise limits, appropriate emission criteria relating to permissible construction noise levels for a development of this scale may be found in the British Standard BS 5228. BS5228 does not define strict criteria to determine the significance of noise impacts. However, examples of how limits of acceptability have been applied historically and some examples of assessing significance are provided within the standard. Example Method 3 has minimum criteria that are applicable to construction noise where existing noise levels are low and construction activities continue for more than one month. These are 45, 55 and 65 dB LAeq,1hr for night-time (23:00-07:00), evening and weekends, and daytime (07:00-19:00) including Saturdays (07:00-13:00) respectively.

[53] British Standard 5228[53] Code of Practice for Noise and Vibration Control on Construction and Open Sites (2009+A1:2014)'(BS 5228:2009+A1:2014

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. For the appropriate period (e.g. daytime), the ambient noise level is determined and rounded to the nearest 5dB. It is proposed that the Category C designation is used following on from the findings of the baseline noise study where ambient noise levels are generally high

Figure 12.1: Example Threshold of significant Effect at Dwellings (reproduced from BS5228)

Assessment category and threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A [A)]	Category B [B)]	Category C [C)]
Night-time (23.00–07.00)	45	50	55
Evenings and weekends [D)]	55	60	65
Daytime (07.00–19.00) and Saturdays (07.00–13.00)	65	70	75

NOTE 1 A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level.

NOTE 2 If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity.

NOTE 3 Applied to residential receptors only.

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

D) 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

Source: BS5228:2014

Construction Vibration

Vibration arising from construction activities is generally ground-borne. In the case of typical earthworks projects, it may be generated by operations such as ground compaction, piling, blasting and the movement of vehicles over irregular surfaces. There are two aspects that require consideration;

- Potential vibration effects on people; and
- Potential vibration effects on buildings.

The magnitude of vibration is expressed in terms of peak particle velocity (ppv) in millimetres per second (mm/s).

BS 5228-2: provides guidance on the effect of vibration and the likelihood this would cause compliant and cosmetic damage to buildings BS5228-2 does not indicate whether particular vibrations are significant. The standard states:

"*Vibrations above these levels [0.14mm/s to 0.3mm/s] can disturb, startle, cause annoyance or interfere with work activities. At higher levels they can be described as unpleasant or even painful. In residential accommodation, vibrations can promote anxiety*…"

BS5228-2 provides the following guidance on effects and perceptibility at various vibration levels (expressed as Peak Particle Velocity (PPV)):

- Vibration level of 0.14mm/s-vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction;
- Vibration level of 0.3mm/s-vibration might be just perceptible in residential environments;
- Vibration level of 1.0mm/s-it is likely that vibration of this level in residential environments would cause compliant, but can be tolerated if prior warning and explanation has been given to residents; and
- Vibration level of and over 10mm/s-vibration is likely to be intolerable for any more than a very brief exposure to this level.

BS5228-2 also considers vibration in terms of disturbance and potential cosmetic and structural damage to buildings. Table B.2 in the Standard discusses limits of transient vibration, above which cosmetic damage could occur. It states that transient levels of vibration, expressed as peak particle velocity (PPV) of 15 mm/s at low frequency may cause cosmetic damage in un-reinforced or light framed structures e.g. for residential/light commercial use. However, dynamic loading due to more continuous vibration and a resonant response of the structure can give rise to dynamic magnification especially at lower frequencies. BS5228-2 advises that, in these cases, thresholds are reduced by 50% to test for the onset of damage. Therefore, sustained PPVs of 7.5 mm/s are considered to be an appropriate indicator where risks of damage become significant.

Where vibration is intermittent or occurs as a series of events, the use of Vibration Dose Values (VDVs) is recommended in BS 6472 for the assessment of subjective response to vibration. The VDVs at which it is considered there will be a low probability of adverse comment are drawn from BS 6472 and presented in Table 12.3. it should be noted however that the proposed work will be carried out over daytime hours only when disturbance thresholds (expressed as Vibration Dose Values) are notably higher than night periods.

Table 12.3: VDV thresholds

Place	Daytime 16 Hour VDV ($ms^{-1.75}$)	Night-time 8 Hour VDV ($ms^{-1.75}$)
Critical working Area	0.11	0.09
Residential	0.22 – 0.43	0.13
Office	0.43	0.36[1]
Workshops	0.87	0.73

Source: these VDV thresholds do not apply unless night-time work was a regular activity at these premises

With reference to the BS 5228 – 2, it notes that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. Important buildings which are difficult to repair might require special consideration on a case-by-case basis. A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive

The NRA *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (2004) also includes a discussion of vibration levels in relation to construction activities. While the document relates to national road schemes, the advice on construction vibration is relevant to all construction activities. Table12.4 includes allowable vibration levels during construction activities which would minimise the risk of building damage. The 2014 NRA's Guidelines are broadly in line with British Standards discussed in this Chapter.

Table 12.4: Allowable Vibration During Construction in Order to Minimise the Risk of Building Damage

Less than 10Hz	10 to 50 Hz	50 to 100 Hz (and above)
Less than 10Hz	10 to 50 Hz	50 to 100 Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

Source: NRA

Therefore, the criteria given in Table 12.5 have been derived on the basis of the thresholds described above. The criteria below are given as a reference to inform monitoring during vibration activities. The Contractor will be obliged to adhere to these limits.

Table 12.5: Criteria for determining magnitude of impact-transient vibration due to construction

	Magnitude of Impact			
	Negligible	**Minor**	**Moderate**	**Major**
Vibration peak particle velocity mm/s	Less than 1	1 to 7.5	More than 7.5 and less than 12.5	12.5 and above

BS5228-Part 4:1992 mentions the vibration sensitivity of retaining walls (in the horizontal), particularly if they are in poor condition. It is proposed that the Contractor would risk assess the condition of retaining walls to ensure that the proposed works does not compromise the integrity of them. If sheet piling is taking place adjacent to some of the Slaney's retaining walls these walls will have to be assessed by a structural engineer in advance of those works. Unlike building walls which are inter tied with other walls, retaining walls do not have such supports and may require propping

Operational Noise

The proposed scheme includes for an improvement in traffic management around Enniscorthy Town. Traffic will be re-routed by constructing a new road bridge over the River Slaney on the south side of the town and removing the existing bridge in the town centre. Consequently, levels of noise from through traffic in the town will alter, in some instances potentially increasing noise levels in some locations and decreasing them in others. An appropriate standard for assessing the impact of traffic noise during the operation of the project would be the UK Design Manual for Roads & Bridges (DMRB) Guidance. The DMRB Guidance states that the magnitude of noise impact from a project should be classified into levels of impact in order to assist with the interpretation of the project. The DMRB example of classification of magnitude of impacts from traffic noise is included in Table 12.6 below.

Table 12.6: Classification of Magnitude of Noise Impacts in the Short Term

Noise Change, LA10,18-hr	Magnitude of Impact
0	No change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

Source: Design Manual for Roads and Bridges, Table 3.1

Operational Vibration

There is a very low likelihood of operational vibration impacts from the proposed scheme on account of the nature of the proposed design which will ensure that potential vibration effects are eradicated at the design stage. Therefore, the potential impacts resulting from operational vibration is not considered any further in this assessment.

12.3 Receiving Environment

The proposed scheme is located within Enniscorthy Town. Enniscorthy is a busy market town and the noise climate in the town is predominately dominated by vehicular traffic noise.

12.3.1 Background noise monitoring

This section presents a description of the baseline noise climate affecting the key sensitive receptors. This has been informed by using the results and observations made during a noise measurement survey conducted by ICAN Acoustics in November 2016.

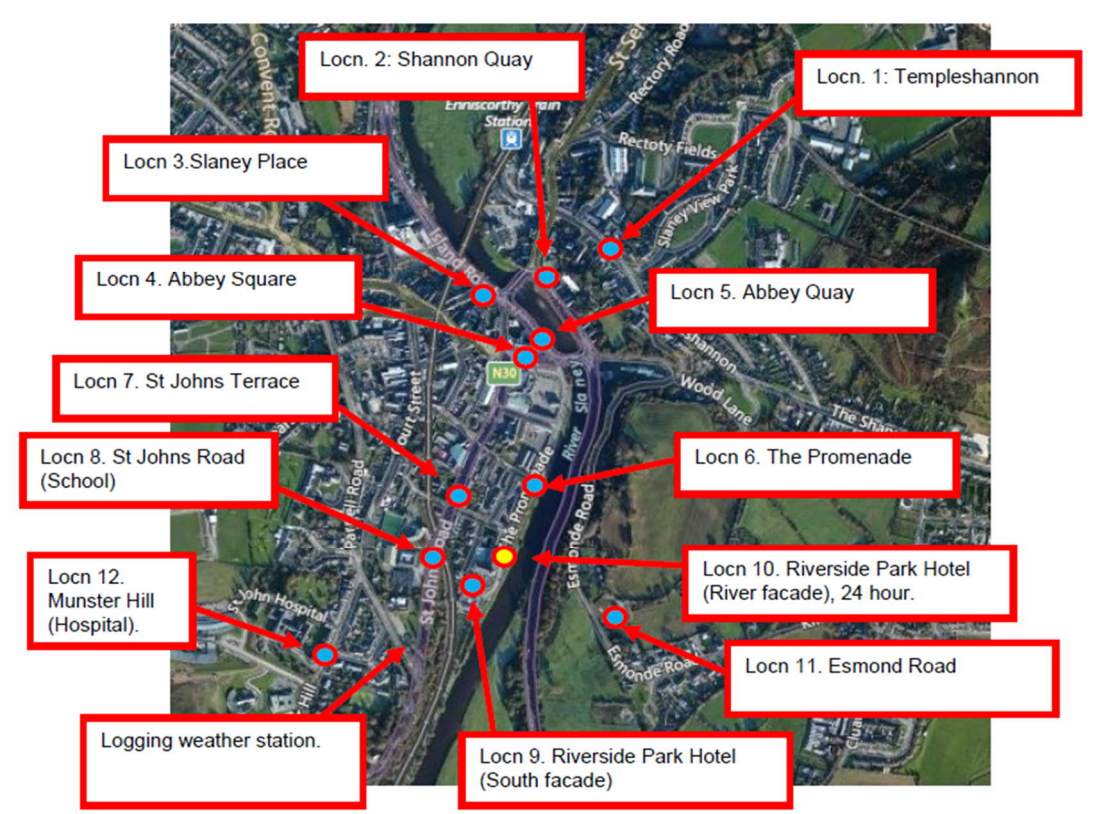
The noise survey comprised a combination of attended short-term measurements and unattended measurements.

- Attended measurements were undertaken at 12 selected locations within the study area; and
- One unattended measurement located adjacent to the Riverside Park Hotel.

The description of the baseline is used within the assessment in considering the context of anticipated noise from the proposed scheme, enabling a comparison of the current situation with the potential scenarios anticipated to affect sensitive receptors during construction and operation.

The noise measurement positions close to the proposed scheme site are indicated in the aerial imagery shown at Figure 12.2, a corresponding position number has been arbitrarily assigned. Aerial photographs of each of the measurement locations are also provided below to help identify the baseline noise survey locations.

Figure 12.2: Locations of Baseline Noise Monitoring



Source: ICAN 2017

12.3.2 Baseline Noise Survey Methodology

The baseline noise measurements were carried out using a digital sound level meter which complies with the requirements of the Class 1 Standard for accuracy. The sensitivity of the measurement system was checked using a sound level calibrator. The detail on the noise equipment used is presented in Table 12.7.

Table 12.7: Detail on Noise Measurement Equipment Used

Make and Model	Serial Number	Date of Calibration
XL2 Audio and Acoustic Analyser	G2P0RAE 01-GO	10 February 2016
XL2 Audio and Acoustic Analyser	A2A-12133-E0	15 September 2016
Field Calibrator B&K 4231	2499109	21 July 2016

Source: ICAN Acoustics,2016

In all cases, the sound level meter was configured to record noise level using the A-weighting frequency function. Furthermore, the sound level meter was configured to measure a range of acoustic parameters averaged over each measurement interval. The main parameters of interest are:

- L_{Aeq} dB - The A-weighted equivalent continuous noise level in decibels;
- L_{A90} dB- The A-weighted noise level exceeded for 90% of the measurement interval;
- L_{A10}dB - The A-weighted noise level exceeded for 10% of the measurement interval; and
- $L_{A(max)F}$ dB- The A-weighted maximum sound pressure level using the fast time weighting.

The baseline noise measurements were undertaken in accordance with the guidance set out in ISO 1996 'Acoustics –Description, measurement and assessment of environmental noise –Part 2: Determination of environmental noise levels'.

The baseline noise monitoring locations used have been set out in Table 12.8 below. These locations were selected having regard to the historical monitoring location selected in the EIS undertaken by Royal Haskoning (2009).

Table 12.8: Baseline Noise monitoring locations

Location	Receiver Location	OSI Grid X-coordinate	OSI Grid Y-coordinate
1	Templeshannon	697525	640020
2	Shannon Quay	697395	639967
3	Slaney Place	697325	639904
4	Abbey Square	697378	639823
5	Abbey Quay	697400	639836
6	The Promenade	697363	639509
7	St John's Terrace	697271	639609
8	St John's Road (Secondary School)	697169	639398
9	Riverside Park Hotel (Southern Locn)	697280	639357
10	Riverside Park Hotel (Eastern Elevation)	697327	639409
11	Esmonde Road	697474	639408
12	Munster Hill Hospital	697000	639245

Source: ICAN Acoustics,2016

12.3.3 Weather Conditions

A weather station was set up during the baseline noise survey. Weather data was captured at 10min intervals during automatic logging periods and manually during attended measurements.

Measurements were made at a height of 1.2 – 1.5m above ground level. The weather conditions were in accordance with the requirements of BS7445: Description and Measurement of Environmental Noise and weather was measured throughout the noise survey.

12.3.4 Baseline Noise Survey Results

The survey results indicate that apart from a few locations, the noise environment along the river is dominated by traffic, mainly passing through but also around the town centre. Summary of the baseline noise measurement results are summarised below.

Table 12.9: Baseline Noise Monitoring Results

Ref	Time	LAeq (15mins) dBA	LAMax dBA(15mins)	LA10 dBA(15mins)	LA90 dBA(15mins)	Comments1
1	17:08	65.2	84.1	69.1	51.8	This location was dominated by traffic noise and is located on a hill, so noise from climbing vehicles is likely to be greater at this location
2	12:40	73.5	89.9	75.5	66.7	This location was dominated by traffic noise, which included cars, motorcycles, vans and

Ref	Time	LAeq (15mins) dBA	LAMax dBA(15mins)	LA10 dBA(15mins)	LA90 dBA(15mins)	Comments1
						HGVs. Another noted source of noise was a loose/worn manhole cover which was audible on occasion. This is a busy heavily trafficked location
3	13:09	72.5	86.2	75.4	65.3	This location was dominated by traffic noise, which included cars, motorcycles, vans and HGVs. Some pedestrians passing by were audible too. This is a busy heavily trafficked location
4	13:28	65.7	87.0	67.5	59.7	This location was dominated by traffic noise, which included cars, motorcycles, vans and HGVs. Other notes sources include noise from an agricultural vehicle and birdsong as well as noise from pedestrians nearby using gates to access a pedestrian walkway entrance to a building nearby
5	13:46	64.8	86.8	67.4dB	58.7	This location was dominated by traffic noise, which included cars, motorcycles, vans and HGVs
7	14:07	62.5	77.8	66.5	51.7	This location was dominated by traffic noise, which included cars, vans and HGV
8	14:31	50.6	65.9	53.3	45.6	This location is somewhat set back from St Johns Road. The primary source of noise was from passing traffic on St Johns Road. Some occasional noise from students of the school passing nearby
9	14:45s	55.2	76.3	57.5	50.6	The noise climate at this location consisted mainly of distant traffic from the N11 circa 110m to the East of the measurement location
10	15:30	61.1	83.2	64.0	54.1	Dominated by traffic noise from the N11 circa 100m to the East of the measurement location. The noise climate also included noise from passing traffic and some road works were taking place to the north of this location (UPC contractors), using a whacking plate intermittently

Ref	Time	LAeq (15mins) dBA	LAMax dBA(15mins)	LA10 dBA(15mins)	LA90 dBA(15mins)	Comments1
11	16:30	64.7	86.8	67.8	49.5	The noise climate included noise from local traffic and distant traffic as well as noise from pedestrians passing by
12	16:04	61.2	73.7	65.3	49.0	The noise climate was dominated by traffic from Munster Hill Road. There was occasion vehicle passes on site, but they were very infrequent
				Day 2		
1	10:23	65.0	87.8	68.1	47.3	This location was dominated by traffic noise and is located on a hill, so noise from climbing vehicles is likely to be greater at this location
2	09:42	77.2	97.5	78.2	70.4	This location was dominated by traffic noise, which included cars, motorcycles, vans and HGVs. Another noted source of noise was a loose/worn manhole cover which was audible on occasion. This is a busy heavily trafficked location. Some distant construction noise was occasionally audible
3	10:00	73.6	89.0	76.4	66.3	This location was dominated by traffic noise, which included cars, motorcycles, vans and HGVs. This is a busy heavily trafficked location
4	08:43	66.4	78.8	68.7	62.8	This location was dominated by traffic noise, which included cars, motorcycles, vans and HGVs.
5	09:09	76.0	95.1	78.0	70.3	This location was dominated by traffic noise, which included cars, motorcycles, vans and HGVs
6	12:50	62.3	83.0	64.9	55.3	The noise climate was dominated by traffic noise from the N11 and local traffic on the road nearby. Other sources included birdsong
7	11:16	72.0	88.6	75.9	58.2	This location was dominated by traffic noise, which included cars, vans and HGVs. Other sounds included birdsong
8	12:04	59.0	80.4	62.1	52.0	This location is somewhat set back from St Johns Road. The primary source

Ref	Time	LAeq (15mins) dBA	LAMax dBA(15mins)	LA10 dBA(15mins)	LA90 dBA(15mins)	Comments1
						of noise was from passing traffic on St Johns Road. Some occasional noise from students of the school passing nearby and the entrance door to the school being used
9	07:56	49.5	60.5	51.1	46.1	The noise climate at this location consisted mainly of distant traffic from the N11 circa 110m to the East of the measurement location. Other sources included birdsong and some local traffic movements at the hotel. A barking dog at a distance was also noted
10	08:20	60.4	70.8	62.4	56.5	Dominated by traffic noise from the N11 circa 100m to the East of the measurement location. Other sources included local traffic passing (guests leaving the hotel
11	10:44	61.9dB	78.8	65.6	50.1	The noise climate included noise from local traffic and distant traffic as well as noise from pedestrians passing by. Some distant construction which sounded very much like a petrol driven consaw.
12	11:38	60.6	72.6	65.0	46.4	The noise climate was dominated by traffic from Munster Hill Road. There was occasion vehicle passes on site, but they were very infrequent. Other sources included noise from a resident bring in a wheelie bin

Source: ICAN Acoustics,2016

Having regard to BS5228 Method 3 assessment shown in Figure 12.1, above the baseline noise study clearly shows that the ambient noise levels are high in many places due to constant traffic noise. Accordingly, the residential dwellings in the vicinity of the proposed scheme are afforded Category C designation as per BS 5228.

12.3.4.1 Do- Nothing Scenario

The volume of through traffic will reduce following the completion of the M11 Enniscorthy to Gorey Scheme, but there will be a significant volume of traffic crossing the River Slaney in Enniscorthy. The noise within the Town will continue to be dominated by road traffic noise. However, in the do-nothing scenario the Town will not be subject to direct construction-led impacts.

12.4 Assessment of Impacts

The construction of the proposed scheme has the potential to generate significant noise from inherently noisy activities such as piling and breaking out of ground, together with the on-site operation of both fixed and mobile construction plant and equipment. Off-site movement of construction related traffic also has the potential for significant noise generation. These potential sources of construction noise are assessed separately below

- Noise and vibration impacts associated with various on-site construction activities;
- Noise impacts arising due to the operation of the proposed scheme; and
- Changes in road traffic noise along the existing road network resulting from traffic generated during the construction phase and operational phase.

The precise type of equipment, quantity and utilisation of the plant and the techniques employed at the proposed scheme site are uncertain at this stage. However, an inventory of plant expected to be required for general works has been derived from the project design team in order to predict noise levels.

12.4.1 Construction Impacts

12.4.1.1 Construction noise

The construction of the bridge is expected to be 18 months in duration and the flood defence elements will be constructed over a three-year period. An overview of the proposed construction programme is set out in Chapter 2.

The sources of noise would include HGV's, earth moving plant, and piling operations. Whilst the distance of works along the river covers circa 3km, the position of work will not be stationery but will gradually move along the river as work progresses. The dry works approach has been designed to facilitate the dredging instream works and minimise potential construction related traffic within the town. Site construction traffic during instream work upstream of Seamus Rafter Bridge will be also limited within dry works areas only. The dry works area will be utilised as a haul route thus reducing the need to route haulage construction vehicles within the existing road network. Downstream of the Seamus Rafter Bridge site construction traffic will access and exist the site via the Bare Meadows onto the N11 national primary road.

A description of the proposed construction approach is set out in Chapter 4 of this EIAR. However, to understand the nature of the works required to facilitate the instream works it is envisaged that an impermeable barrier will be used to divide the main channel and close off the works areas from the main channel river flow. Within each dry works area, the channel will be dredged to the required depth along one side only, thus maintaining half the river width for river flow at all times. It is proposed that piling will first of all be driven into the middle of the river to form a water barrier and river water will be diverted in the western side channel formed by the pile barrier, allowing the eastern side to drain. River bed dredging will then take place on the eastern side of the river and all spoil removed by lorries which will move along the dry bed area, exiting directly at the north island from the river channel and on to the N11 to the south of the town.

Construction noise from general on-site construction activities

Whilst ambient noise levels are elevated at certain noise sensitive locations within the proximity of the River Slaney, predictions show that construction noise is likely to be very significant at particularly noisy activities i.e. piling and excavation. At noise sensitive locations, where ambient noise levels are low, then the noise impact is likely to be greater than the magnitude of

impact of noise at locations where the ambient noise levels are already high. In most cases site hoarding (as a noise barrier) is unlikely to be possible, therefore best practicable means should be adopted which includes keeping residents regularly informed about times when high noise levels can be expected. Additionally, hoarding would not provide any appreciable reduction for, for example, residential units at 3rd and 4th floor levels which are likely to still have line of sight with plant over the hoarding, particularly in relation to plant working at the centre of the river. Indicative predictions have been based on machine noise data contained within BS5228-1:2009 and while time-averaged use for the machines has been considered (based on their expected usage 'on-time' during a typical working day, the predicted levels assume that the plant will be stationary, which will not always be the case.

It is generally accepted that noise from construction activities can be intrusive to persons living and working in the vicinity of the works. However, it is also accepted that such works are essential and that a balance must be struck between the effect of construction noise and the benefit to be achieved by the works. Given the nature of the works, works will be phased, it is recognised that if the works are temporary in nature, persons affected will be prepared to accept a higher level of noise provided that the benefit is accepted, and clear information is given on the methods to control noise and the duration of the event(s). The predicted noise levels associated with the key works activities are set out in the Table 12.10 below.

Table 12.10: Predicted Noise of noise impacts due to construction activities

Site Location	Activity	Location reference	Distance (m) to nearest noise sensitive receptor	Predicted LAeq/day at that location	Baseline level at selected locations LAeq dB,15min	Magnitude of Impact
Flood Defence Wall Construction the Promenade/ Quays/Leisure centre	Multiple source	6	30m	81	62.3	Major
Construction of new road bridge	Site Clearance and excavation	9 (Southern Side of Riverside Park Hotel)	95m~117m	74	55	Major
	Construction of foundations	9 (Southern Side of Riverside Park Hotel)	95m~117m	73.5	55	Major
	construct abutments piers and wing walls	9 (Southern Side of Riverside Park Hotel)	95m~117m	74	55	Major
	Lift beams	9 (Southern Side of Riverside Park Hotel)	95m~117m	71	55	Major
	Construct deck slabs and bridge finishes	9 (Southern Side of	95m~117m	72.3dB	55	Major

Site Location	Activity	Location reference	Distance (m) to nearest noise sensitive receptor	Predicted LAeq/day at that location	Baseline level at selected locations LAeq dB,15min	Magnitude of Impact
		Riverside Park Hotel)				
Removal of Seamus Rafter Bridge	Multiple sources	5 (Abbey Quay)	45m	77.5	65	Major
Construction of Pumping stations	Single Water Pump 75dB(A) at 10m (near Promenade)	6 (Promenade)	25m	70.0	64.5	Major
Construction of Pumping stations	Single Water Pump 75dB(A) at 10m (near Seamus Rafter Bridge)	5 (Abbey Quay)	25m	70.5dB	65	Moderate

Source: ICAN 2017

The baseline survey of existing noise indicates that generally ambient noise levels along the river are relatively high due to the flow of traffic within the town around the existing road network. It has been shown that construction activities will result in a noise level of between 75-80dBA. It is concluded that the magnitude of noise impacts during the daytime construction works will result in significant effects. Work within the river bed will not be stationary and it has been shown that the level of noise from those operations will reduce appreciably as the location of operations moves along the river bed. This is discussed further below.

12.4.1.2 Instream enabling works

It is understood that much of the enabling works will include the installation of an impermeable barrier along the centreline of the River Slaney. The installation of piling will take place progressively at an approximate rate of 60 linear metres per day. The noise level at the noise sensitive receptors will depend on the distance of the receptor from the piling works. Figure 12.3 below sets out the likely magnitude of noise impact of piling activities as it approaches a location from 150m up river, to a point where levels are at a maximum (at circa 40m) from a receiver, to a location 150m down river.

The highest expected noise level at any given noise sensitive receptor along the piling route will be generated when works are in progress immediately adjacent to the noise sensitive receptor in question.

It is expected that closest noise sensitive receptors will be located circa 35m from the centreline of the River Slaney where piling will take place. It is likely that noise levels may exceed the NRAs 70dB(A) construction noise criterion for the short period while works are in progress immediately adjacent to noise sensitive receptors.

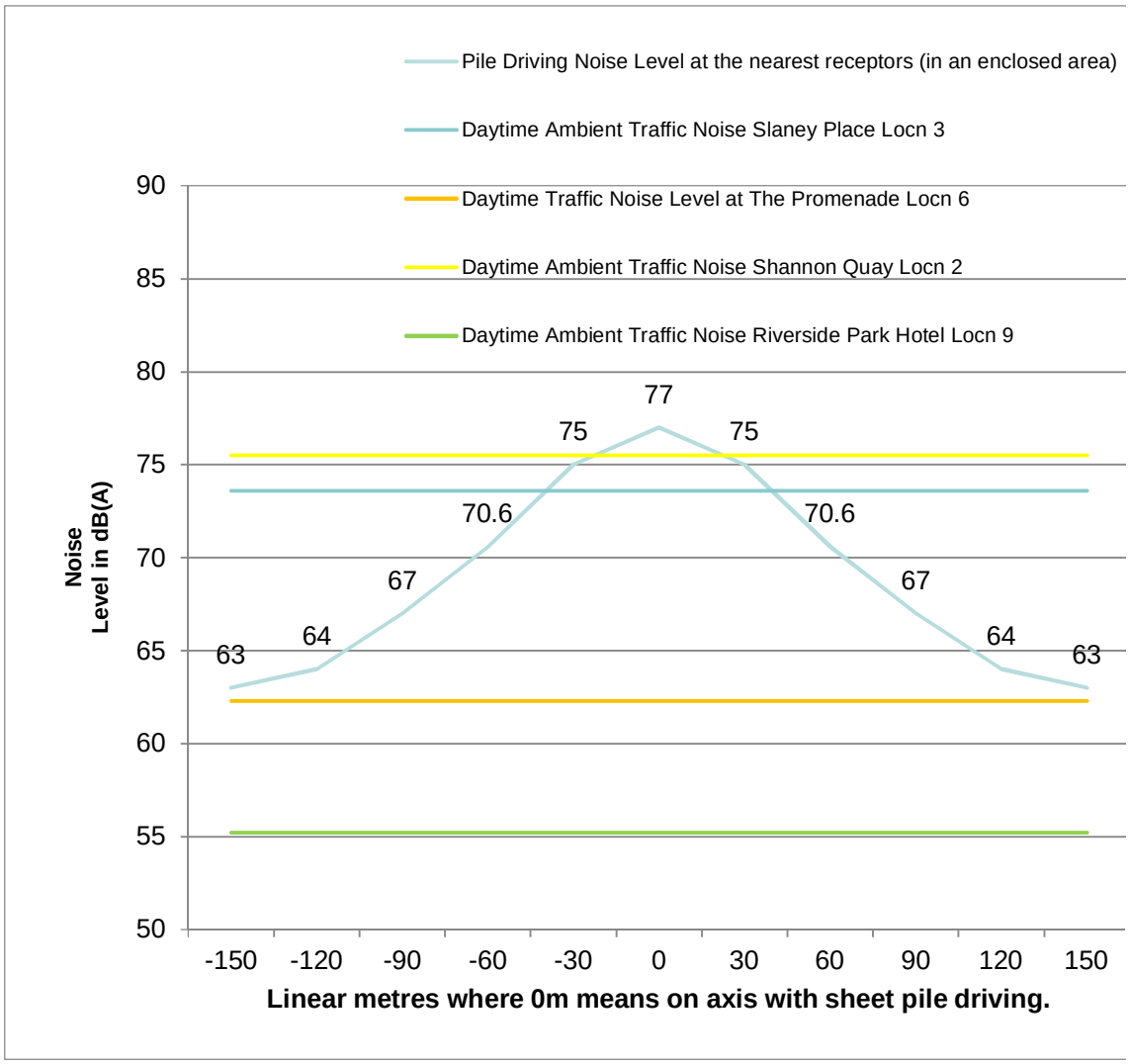
As works progress along the centreline route of the river, the noise level at any given noise sensitive receptor will vary depending on the location of the works along the river. The expected variation in noise level is shown in Figure 12.3. This shows that noise levels from piling will range between 63 ~77dB(A). When piling is taking place directly opposite a noise sensitive receptor, then noise levels would be expected to be 77dB(A). The levels associated with our

predictions assume that the piling activities are the dominant source of noise and that the piling rig will be a vibratory piling rig with a sound pressure level of 88dB(A) at 10m.

However, for vibratory piling, noise levels are likely to reduce to 67dBA when the source has progressed a further 90m downstream of that location. Due to the already elevated ambient noise levels at a number of locations, the magnitude of impact of piling is likely to be significant at location 9 adjacent to the River Park Hotel. The predicted noise levels from piling will be significant at most locations for a full daytime period, but after 1.5 days will have approximately halved in terms of their perceived loudness.

Having regard to Table 12.10, both the level of noise and the duration of maximum exposure, the magnitude of impact at noise sensitive receptors on either side of the river will be moderate- as a result the potential effects are significant.

Figure 12.2: Predicted noise levels at noise receptors at a progression of 60 linear m per day (River Slaney) relative to ambient traffic noise levels



12.4.1.3 Road Bridge Works

It has been noted that the construction of the new road bridge will occur over an estimated 18-month period, but the intensity of works will be at or close to peak intensity for the full duration. The ambient noise levels along the western side of the river along St. Johns Road and the Riverside Park Hotel are relatively low. The effect of noisiest activities during this stage of works is likely to result from piling operations, and excavation for the road bridge. The predicted noise levels at the nearest closest noise sensitive receptor, the Riverside Park Hotel is 70 dB(A) LAeq. The impacts resulting from these temporary works will result in significant effects.

12.4.1.4 On site Construction Traffic Generated

Construction traffic will be required to access the lands adjacent to the N11 to form the cut for the roundabout and the new approach roads. This may require traffic management on the existing N11 during this phase to facilitate construction plant removing and importing material from site. To facilitate the construction of the bridge east abutment it is envisaged that the existing N11 traffic will be diverted onto the new approach roads and roundabout. Material will be removed from site away from Enniscorthy Town along the N11 to the closest appropriately licensed/permitted waste facility. Using the prediction methodology prescribed in BS5228, it has been possible to calculate the likely noise level at the nearest noise sensitive receptors, assuming a worst-case scenario that the closest noise sensitive receptor is minimum 20m from the road and peak 16 vehicle movements hourly, this would result in a predicted daytime noise level of less than 55dB(A). It is noted that the closest quarry to the works is located approximately 2km from the works area and there are no noise sensitive receptors located on the N11 between the site and the quarry.

Instream works will only commence following the completion of the new road bridge. The proposed instream works will occur over an estimated 4-month period in two distinct phases i.e. works upstream of the Seamus Rafter Bridge will occur in the 1st year and works downstream of the bridge will occur in the following year. Dredged material from the instream works upstream of the Seamus Rafter Bridge will be deposited on the permanent depositional area on the North Island via the internal haul route. HVG's hauling dredged material off site will travel along the existing road network i.e. via the N11. Construction traffic will be directed away from the town. HVG's will travel along this route during daytime hours only, it is estimated that peak traffic generated along the haul road will be 16 vehicles per hour. Using the prediction methodology prescribed in BS5228, assuming a worst-case scenario that the closest receptors are approximately 5m from the haulage route this would result in a predicted daytime noise level of 58dB(A). The potential effect on the noise sensitive receptors resulting from the haulage related traffic is not considered to be significant.

Material downstream of Seamus Rafter Bridge will be deposited off site via the Bare Meadows and transported away from Enniscorthy via the N11. It is estimated that at the peak activity approximately 16 vehicle movements per hour will ingress and egress the site via the Bare Meadows onto the N11. Considering that the predicted number of vehicles using this part of the N11 following the opening of the M11 bypass will be more than 500 per hour, the noise impact of an additional vehicle movements on this road will be imperceptible. The movement of material will be directed away from Enniscorthy to the local licenced facility. The impact is assessed as minor at the closest receptors during the daytime the resulting effects are not expected to be significant.

12.4.1.5 Construction vibration

There is potential for vibration impacts during the construction phase on account of the proximity of general construction activities to some of the nearest sensitive receptors and on account of the fact the piling will be required as part of the construction works. It is understood that construction activity for the proposed scheme will generally take place between the hours of 07:00 and 19:00 on Monday to Fridays, and between 08:00 and 13:00 on Saturdays and there will be no activity on Sundays or Bank Holidays.

12.4.2 Operational Impacts

12.4.2.1 Operational noise

No operational impacts associated with the proposed flood defence measures i.e. flood walls and widening/infill works associated with the development are anticipated. However, changes to operational traffic will result in changes to the road traffic noise in the town. These are discussed below.

Change in Noise levels within the town

It is noted in Chapter 2 that the proposed scheme will involve the construction of a new road bridge and relocation of traffic movement in the Town. These will likely result in changes to the traffic within the area and will also potentially impact on the noise sensitive receptors. Details of the proposed operational traffic management is provided in Chapter 13 of this EIAR. The traffic noise levels for the year of opening and design year, have been predicted at each link road within the town. The location of each of the road links and the corresponding traffic flow for each link in the opening and design years are provided in Chapter 13. This assessment is based on the traffic volumes presented in Chapter 13.

Table 12.11: Traffic Noise Changes

Link	Description	Change in dB without scheme Opening year 2019	Change in dB do-Something Opening Year 2019	Change in dB without scheme Design Year 2034	Change in dB Do-Something Design Year 2034
1	N11 Island Road	-0.5	-1.1	0.1	-0.5
4	Abbey Quay	-0.3	-0.8	0.3	-0.2
5	Abbey Square	0.0	-2.1	0.5	-1.6
6	N30 Mill Park Road	-0.2	-0.8	0.3	-0.2
8	N30 St John's Road	-0.2	-0.2	0.4	0.4
9	Proposed Slaney Bridge	N/A	N/A	N/A	N/A
10	N11 Wexford Road – south of the proposed bridge	-0.6	-0.7	0.0	-0.1
11	N11 Wexford Road – north of the proposed bridge	-0.6	-2.9	0.0	-2.4
12	Seamus Rafter Bridge – to be removed as part of proposed scheme	-0.1	N/A	0.4	N/A
14	Spring Valley Road	0.2	4.1	0.8	4.7
15	Shannon Quay	-0.2	-4.3	0.3	-3.9

Link	Description	Change in dB without scheme Opening year 2019	Change in dB do-Something Opening Year 2019	Change in dB without scheme Design Year 2034	Change in dB Do-Something Design Year 2034
16	Enniscorthy (Saint Senan's) Bridge	-0.2	-1.5	0.2	-1.1
17	R744 Templeshannon	0.7	-2.4	1.1	-1.9
18	R744 Saint Senan's Road	0.8	0.8	1.2	1.2

The above table shows that the variation in traffic flows on the town results in only slight changes in the basic noise levels of no greater than 3dB. Changes less than 1dB are likely to be imperceptible. The proposed scheme will have an overall minor positive impact on road traffic noise in the town, which the exception of Spring Valley Road which will result in a minor adverse impact in the design year. It is considered then that there will be no significant effect from noise following the operation of the proposed scheme.

12.5 Mitigation Measures

12.5.1 Construction phase

The Works requirements, which will be contained in the tender documents for the construction of the scheme, shall explicitly state that the Construction Contractor shall comply with the requirements of this EIAR in constructing the scheme. Where the Construction Contractor proposes to deviate, or deviates from, the requirements of this EIAR they shall be responsibility for achieving approval from the appropriate consenting authority.

The Contractor will also prepare a construction noise and vibration management plan as part of the CEMP. In this document the Contractor will be obliged to give due regard to BS 5228:2009+A1:2014 and European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001, which offers detailed guidance on the control of noise and vibration from construction activities. The project will implement best practical means (BPM) as defined in the BS 5228 Standard to all on site activities. Noise and Vibration from construction activities will be limited to the values set out in the tables discussed above and will be adhered to during the construction phase.

The Contractor will be obliged to manage the works to adhere to the limits as set out Section 12.2. The Contractor shall have due regard to the BS2228 Part 4 to ensure the vibration limits are adhered to, particularly in proximity to sensitive receptors and in the vicinity of the works where retaining walls that may not be inter tied with other walls, which may require additional measures. For example, the selecting Continuous Flight Auger (CFA) will be used as they are virtually vibration free and suitable for urban areas. A pre-construction structural survey will be carried out on properties within 200m of the proposed works.

Specific mitigation measures that are relevant for the construction activities include but are not limited to the following:

- Unnecessary revving of engines will be avoided and equipment will be switched off when not in use;
- Internal haul routes will be kept well maintained;
- Use of effective exhaust silence systems or acoustic engine covers as appropriate;

- Plant will always be used in accordance with manufacturers' instructions. Care will be taken to keep site equipment away from noise-sensitive areas. Where possible, loading and unloading will also be carried out away from such areas;
- Regular and effective maintenance by trained personnel will be undertaken to keep plant and equipment working to manufacturers specifications;
- Noise barriers can provide some limited attenuation during particularly noisy activities;
- A complaints register will be kept on site detailing all telephone calls and letters of complaint received in connection with high noise and vibration activities, together with details of any remedial actions carried out;
- Procedures for handling noise and vibration complaints will be set out and the Contractor shall ensure procedures are implemented to rectify the problem. The procedures put in place will be strictly monitored and assessed;
- The name and contact details of a person to contact regarding noise and vibration issues shall be displayed on the site boundary, this notice board should also include head/regional office contact details; and
- Advance notification of at least 24hrs to all sensitive receptors during critical phases of construction. This will ensure that residents are kept informed of ongoing and future operations.

It is also recommended that a comprehensive noise and vibration monitoring protocol will be set out within the Noise and Vibration Construction Management Plan. Construction noise and vibration levels shall be monitored and assessed:

- At continuous basis throughout construction, but not at pre-arranged times and the result will be frequently review (at least weekly) by the EnCoW;
- As and when required, during critical phases of construction, i.e. when possible exceedance of the project noise and vibration criteria is anticipated;
- In response to the receipt of reasonable complaints investigated by the Employer;
- At locations representative of sensitive receptors in the vicinity of the works typically at the agreed locations closest to the works.

Monitoring locations will be identified in agreement with the EnCoW in a detailed Construction Environmental Management Plan (CEMP), prepared by the Contractor.

The CEMP will have cognisance of best practice given in BS 5228:2009: Part 1 and Part 2. In particular, the Plan will indicate how noise and vibration during construction will be monitored, including the method and equipment to be used. A Public and Stakeholder Engagement Communication Plan will be prepared by the Contractor in advance of the works. The Plan recognises the importance of informing members of the public and key stakeholders who will be affected by the noise, of the steps to be taken to minimise noise and devise a means of contacting relevant members of the public.

12.6 Residual Impacts

The application of binding noise limits, hours of operation, along with implementation of appropriate noise and vibration control measures, will ensure that noise and vibration impacts will be reduced as far as is reasonably practicable. The resultant residual noise impact from this source will be of negative, moderate, short term impact.

13 Traffic and Transport

13.1 Introduction

This Chapter examines the potential impacts of the proposed flood defence scheme on the receiving environment with respect to traffic conditions, transport routes, general traffic and transport safety. The proposed scheme includes the removal of the existing Seamus Rafter Bridge, construction of the new road bridge and pedestrian bridge and associated changes to the local traffic arrangements within Enniscorthy Town. The scheme has been designed by developing a traffic management study and traffic modelling for the road network in the vicinity of the scheme. The potential effects of the proposed scheme have been examined through extensive traffic modelling. The details of the traffic management study, traffic modelling and recommendations are set out in the Roughan and O'Donovan, Enniscorthy Flood Defence Scheme, Traffic Modelling Report (2016).

This Chapter has been structured as follows;

- **Section 13.2**- Outline the assessment methodology used.
- **Section 13.3**- Describes the outputs of the desktop and baseline traffic and pedestrian surveys carried out within the study area;
- **Section 13.4**- Examines the traffic analysis carried out and outlines the traffic solutions proposed as part of the proposed scheme;
- **Section 13.5**- Describes the proposed mitigation measures to be carried out during the proposed construction phase; and
- **Section 13.6**- Summarises the potential for significant residual effects.

13.2 Assessment Methodology

This assessment involved desktop research supported by traffic survey analysis, traffic management study and traffic modelling data prepared by Roughan and O'Donovan. The assessment considers the effect on traffic resulting from the Enniscorthy Flood Defence Scheme and the M11 Gorey to Enniscorthy PPP Scheme and makes allowance for traffic growth over a 15-year design period. The traffic modelling software package used in this assessment is S-Paramics Micro Simulation that has been developed in accordance with the Transport Infrastructure Ireland (TII) Project Appraisal Guidelines – Unit 5.2: Construction of Transport Models.

Traffic surveys were carried out on a weekday in March 2016. These surveys included automatic traffic counts (ATC) at 13 locations, origin -destination (O-D) counts using automatic number plate recognition surveys at 13 locations corresponding to ATC locations, manual classified turning counts at 2 locations and queue length surveys at 7 locations. A location plan showing the position of the traffic survey is included in Figure 13.2.

Publications and other data sources that guided the preparation of this Chapter are listed hereunder:

- Wexford County Development Plan 2013-2019;
- Enniscorthy and Environs Development Plan 2008-2014 (as extended);
- Census 2016, Central Statistics Office www.cso.ie ;

- TII publications (formerly NRA) Environmental Assessment and Construction Guidelines, including the Traffic and Transport Assessment Guidelines (2014);
- IEMA Guidelines for the Environmental Assessment of Road traffic;
- Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2002 and Draft Update 2017); and
- Advice Notes on Current Practice (in preparation of Environmental Impact Statements) (EPA, 2003 Draft Update 2015).

13.2.1 Consultation

Written consultation with the TII was carried out as part of the EIA consultation process dated May 2017.

13.3 Receiving Environment

13.3.1 Regional and Local Road Network

Enniscorthy is located along the N11 National Primary Road which is the main road connecting Dublin and Wexford town. The N11 is part of the E01 European network route running in a north south axis on the Irish east coast. E01 route connects Wexford in the Republic of Ireland to Larne in Northern Ireland.

A number of strategic roads intersect the N11 in Enniscorthy, including the N30, the R702 and the R744. In Enniscorthy, the N11 forms a one way gyratory on both sides of the River Slaney on the two road bridges, namely Enniscorthy Bridge and the Seamus Rafter Bridge. The existing road layout and traffic circulation through Enniscorthy Town is shown in Figure 13.2.

Traffic in the town across the river flows via a one-way clockwise circulation with priority given to the circulating traffic, and traffic on the entry arms is required to yield. The existing Enniscorthy Bridge conveys two lanes of traffic in the eastbound direction, while the Seamus Rafter Bridge conveys three lanes of traffic in the westbound direction. The circulation carriageways along both Abbey Quay and Shannon Quay comprise two lanes. All entry arms generally comprise a left-in left-out arrangement. The primary roads leading to this circulation within the town comprise the N11 Dublin to Wexford and the N30 Enniscorthy to New Ross. Other local roads that connect here are Spring Valley, the R744 Templeshannon, The Promenade and Slaney Place.

N11 Island Road is the north arm that connects onto Enniscorthy Bridge. The street carries two-way traffic and has a 7.3m wide carriageway. There are footpaths on both sides of the street.

N11 Wexford Road is the south arm that connects onto Seamus Rafter Bridge / Shannon Quay. The road carries two-way traffic and has a 7.3m wide carriageway. There is a footpath on the west side of the road. Travelling south from the Seamus Rafter Bridge the N11 Wexford Road quickly changes to a rural road and has a 100 kph speed limit commencing approximately 300m to the south of the Bridge.

The N30 via Abbey Square connects with the N11 at Seamus Rafter Bridge and Abbey Quay. There are two lanes of traffic from Seamus Rafter Bridge onto Abbey Square leading to the roundabout at the junction between Abbey Square and (N30) Mill Park Road and two lanes from this roundabout approaching Abbey Quay which give-way to traffic on the Quay. South of the roundabout at Abbey Square the N30 continues south along Mill Park Road and then onto St John's Road. Mill Park Road is a two-way street with a carriageway width of 7.3 - 9m that includes some on-street car parking. Further south, after the railway overbridge along St John's

Road the carriageway reduces to 6.5 – 7m wide. There are footpaths on both side of the street along the full length of the road as far as Parnell Road, where only the footpath on the east side of the road continues south.

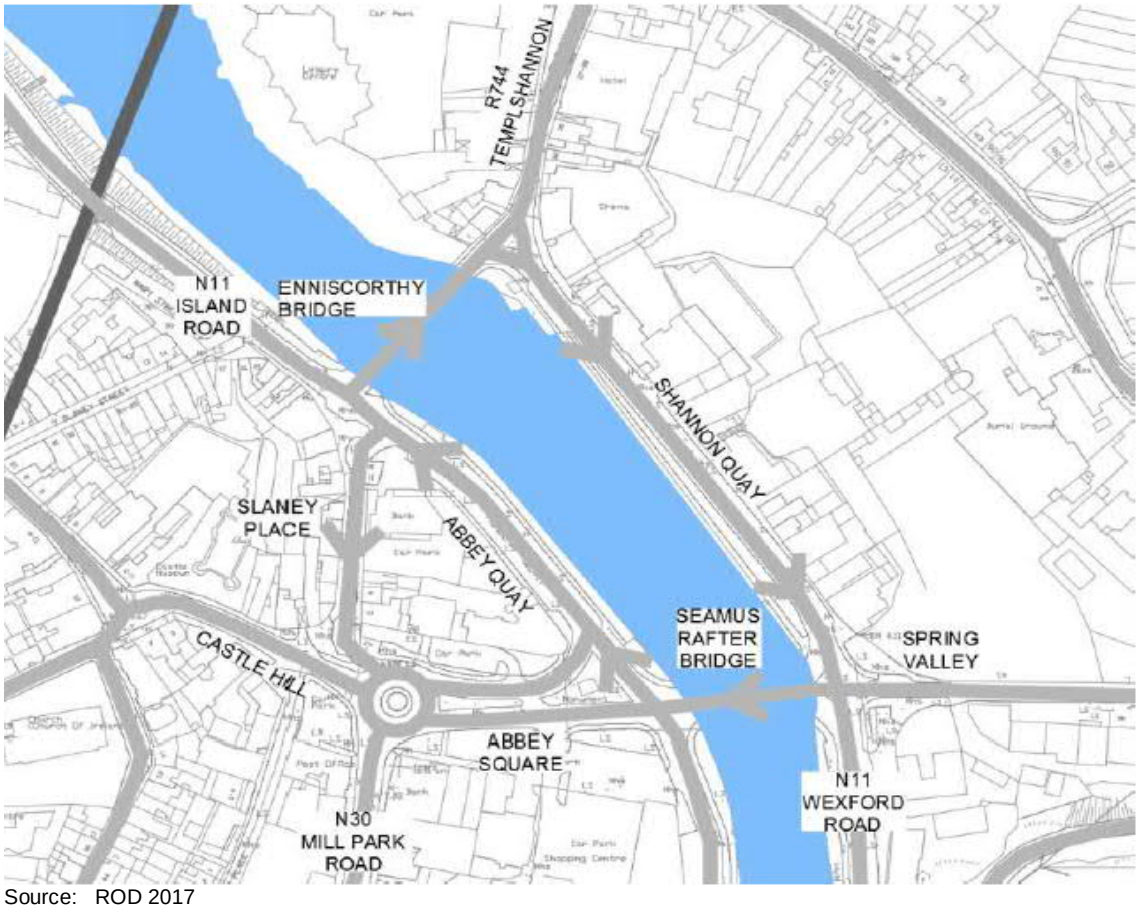
On the east side of the River Slaney, the R744 Templeshannon is a narrow two-way single carriageway road approximately 4.6m wide at certain local pinch points, particularly in the first 120m from the Enniscorthy Bridge. There are footpaths on both sides of the carriageway, but these are very narrow and inadequate. The road extends northwards initially before turning eastwards and continuing to Blackwater. There is a tight bend approximately 200m north of the Enniscorthy Bridge, which is constrained by a cemetery on the east side of the road and residential building to the west. The road is currently too narrow at a number of pinch points locations to allow HGV to pass traffic in the opposite direction freely. HGVs travelling on the R744 Templeshannon are reliant on traffic in the opposite direction giving way and allowing them to pass.

Spring Valley and The Shannon offers an alternative route to the R744 Templeshannon for traffic originating from the east and southeast of the town. Spring Valley comprises a minimum 6m wide two-way single carriageway and with an average gradient of 7% falling towards Shannon Quay.

On the west side of the River Slaney, Slaney Place connects between Abbey Quay and Abbey Square/Castle Hill. It is a one-way street with traffic in the southbound direction where traffic can only access from Abbey Quay.

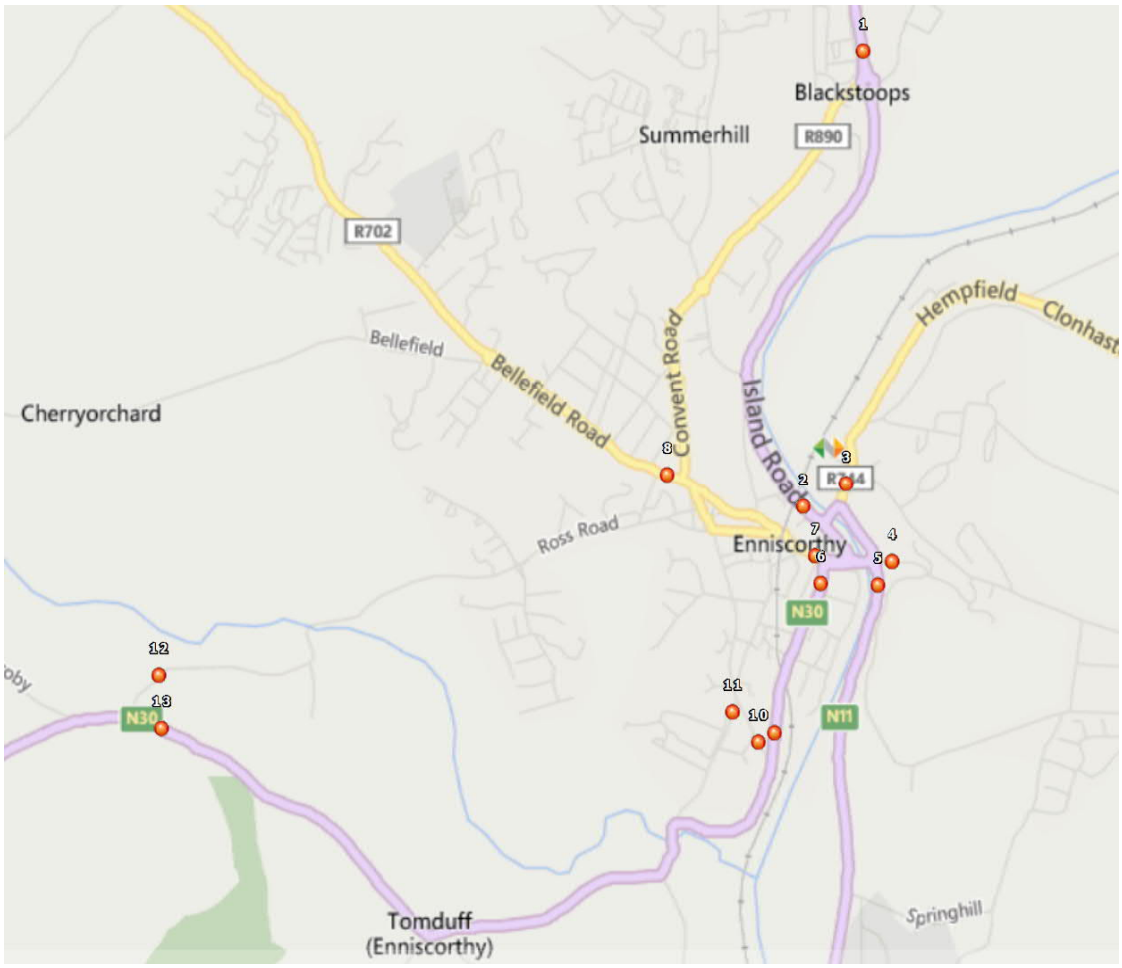
The R890 Parnell Road joins the N30 St John's Road at a priority junction, called Arnold's Cross, immediately to the south of the proposed new road bridge. Parnell Road approaches St. John's Road with a downhill gradient of 5% and connects at a 35-degree skew. There is limited visibility to the right from Parnell Road onto St. John's Road, which can make turning movements out of Parnell Road hazardous.

Figure 13.1: Road Network adjacent to existing Seamus Rafter Bridge in Enniscorthy



Source: ROD 2017

Figure 13.2: Traffic Survey Locations



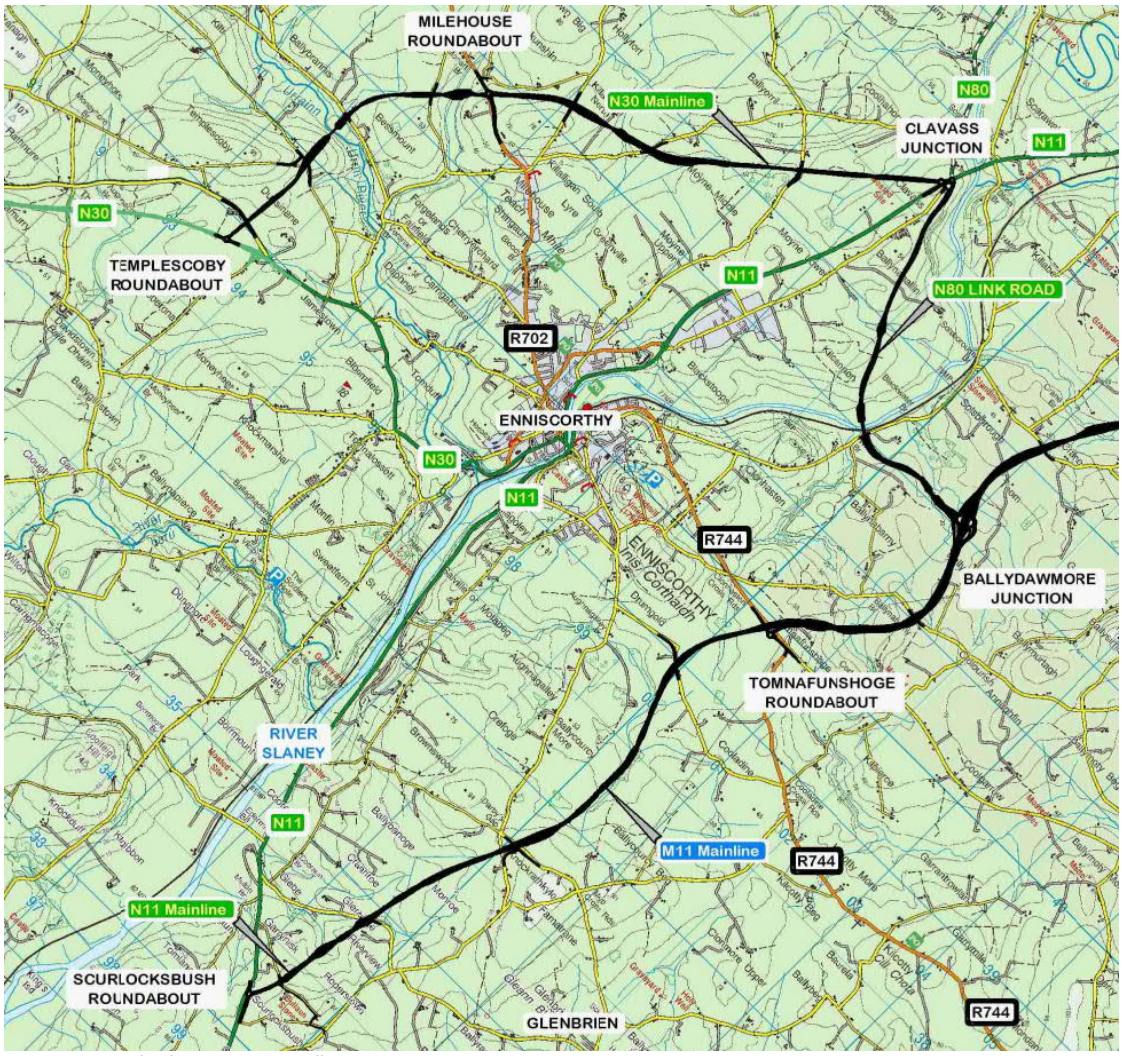
Source: ROD 2017

13.3.1.1 M11 Gorey to Enniscorthy PPP Scheme

The M11 Gorey to Enniscorthy PPP Scheme is currently under construction and includes a new M11 and N30 bypass of Enniscorthy shown in Figure 13.3. The scheme will realign the N11 from south of Gorey at Clogh to north of Oilgate, comprising approximately 26km motorway, which will be located to the east of Enniscorthy. A new 4km dual carriageway will connect from the N11/N80 junction to the M11, and the N30 will bypass Enniscorthy to the west of the Town with a new 8km single carriageway that extends from the existing N11/N80 Junction to the N30 south of Enniscorthy at Templescoby.

Details of the traffic diversions resulting from the M11 Gorey to Enniscorthy PPP Scheme have been obtained from TII and these are incorporated in to the traffic model for the proposed scheme. The M11 Gorey to Enniscorthy PPP Scheme will have a significant positive impact on traffic conditions in Enniscorthy in particular along the N11 and N30 approaches to the Town, however it is also expected to result in an increase in traffic volumes on the R744 at Templeshannon for traffic accessing between Enniscorthy and the proposed M11 Ballydawnmore Junction. The PPP scheme is expected to be complete in mid-2019.

Figure 13.2: M11 Gorey to Enniscorthy PPP Scheme



Source: Wexford County Council 2016

13.3.2 Existing Public Transport

Enniscorthy is located on the main Wexford to Dublin Railway line with five services a day from Dublin. The railway station is located on the east side of the town in Templeshannon. There are a number of public and private bus companies servicing Enniscorthy Town providing vital links with Dublin, Wexford, Waterford and the wider environs. There is a bus stop located on Shannon Quay where the each of regional bus services operate from for both northbound and southbound directions.

13.3.3 Existing Pedestrian Environment

Enniscorthy is bisected by the River Slaney and pedestrian access to either side is via footpaths on the existing bridges. Tracsis carried out a pedestrian survey on both Enniscorthy Bridge and Seamus Rafter Bridge. The surveys were carried out over a 12-hour period from 07.00 to 19.00 on both Thursday, 1 December and Saturday 3 December 2016. The surveys showed between 3134 to 3970 pedestrians crossing the River at the two bridges during the 12-hour period and

the busiest hour had 386 pedestrians crossing Seamus Rafter Bridge (December 1) and 345 pedestrians crossing Enniscorthy Bridge (December 1).

Footpaths are in place throughout the town but need to be improved/upgraded in certain areas. The quality of paving and paths in the town in the vicinity of the River are generally adequate, except for on Enniscorthy Bridge and Templeshannon where the paths substandard in width. Pedestrian crossings within the town are currently substandard in locations, particularly where footpaths and traffic are in close proximity to one another. The problems are further compounded by the unfavourable topography of the town centre. There is only one controlled pedestrian crossing on the Quays, located on Abbey Quay immediately south of Enniscorthy Bridge. There are no other controlled crossings along Abbey Quay, Shannon Quay, Enniscorthy Bridge or Seamus Rafter Bridge, and considering the high volumes of traffic and the multiple traffic lanes it can be difficult for pedestrians to cross from either side of the Slaney River.

13.3.4 Road Safety

A desktop review of the Road Safety Authority (RSA) Collision Records notes that there were no fatal collisions, 3 serious and 21 minor injury collisions recorded within the study area for the period between 2005 and 2014. Of these there was 1 serious collision and 12 minor collisions that involved a pedestrian. The proposed M11 Gorey to Enniscorthy Scheme will remove a significant volume of through traffic and, in particular, heavy goods vehicles, which will help improve road safety and the pedestrian environment through the town.

Existing Parking Facilities

A car park survey was carried out by Nationwide Data Collection (NDC) between 09:00 and 17:00 on Thursday, 17 August 2017 and between 10:00 and 16:00 on Saturday, 17 August 2017. The survey area included 8 off-street car parks and all on-street car parking within a 400m range of the Quays between Enniscorthy Bridge and Seamus Rafter Bridge. The survey involved establishing the number of parking spaces available at each location and undertaking beat counts at hourly intervals.

A summary of the car park survey results is as follows:

- East of the River Slaney 247 spaces available, with approximately 30% available at peak demand.
- West of the River Slaney 741 spaces available, with approximately 33% available at peak demand.

13.4 Traffic Model Analysis

The traffic model considers the effects to road traffic resulting from the Enniscorthy Flood Defence Scheme and the M11 Gorey to Enniscorthy PPP Scheme and makes allowances for traffic growth over a 15-year design period. A Do Minimum Scenario model was constructed using traffic flows determined from the traffic survey data. There are approximately 2,700 vehicles per hour at peak and an Annual Average Daily Traffic Flow (AADT) of 34,000 crossing the River Slaney in Enniscorthy. The Do-Something Scenarios have been modelled with the proposed Enniscorthy Flood Defence Scheme traffic management plan, the traffic estimates from the M11 Gorey to Enniscorthy Scheme and future year traffic forecasts are based on medium traffic growth scenario from TII Project Appraisal Guidelines Unit 5.5 Link-Based Traffic Growth Forecasting for the 2020 opening year, and 15-year Design Year of 2035. The traffic forecasts for each road link in each scenario is summarised in Table 13.1 below. A reference for each link road has arbitrarily assigned.

Table 13.1: Traffic flow and Traffic Forecasts

Link	Description	Opening Year Do Minimum	% HGV	Opening Year Do Something	%HGV	Design Year Do Minimum	%HGV	Design Year Do Something	%HGV
1	N11 Island Road	14,623	9	12,553	8.5	16,561	8	14,296	7
4	Abbey Quay	12,419	7	10,932	9	14,341	6	12,713	8
5	Abbey Square	9,414	10	5,808	8	10,587	5	6,520	6
6	N30 Mill Park Road	8,183	5	7,147	9	9,266	4	8,254	8
8	N30 St John's Road	9,875	4	9,912	4	11,273	4	11,366	4
9	Proposed Slaney Bridge	-	-	12,757	9	-	-	15,116	6.5
10	N11 Wexford Road – south of the proposed bridge	13,605	8	13,281	8	15,593	6	15,403	6
11	N11 Wexford Road – north of the proposed bridge	13,605	8	8,045	3	15,593	6	8,954	3
12	Seamus Rafter Bridge – to be removed as part of proposed scheme	15,271	6	-	-	17,322	6	-	-
14	Spring Valley Road	3,562	4	3,585	4	4,107	4	4,133	3
15	Shannon Quay	13,652	7	5261	5	15,151	5.5	5,831	4.5
16	Enniscorthy (Saint Senan's) Bridge	13,767	7	10227	7	15,224	5.5	11,296	5.5
17	R744 Templeshannon	10,131	5	10,196	4	11,108	3	11,179	3
18	R744 Saint Senan's Road	11,265	4	11,193	4	12,306	3	12,388	3

Source: ROD 2017

13.4.1 Pedestrian and Cycle Survey Analysis

A pedestrian/cyclist survey on both Enniscorthy Bridge and Seamus Rafter Bridge was used to inform the understanding of the movement of pedestrians across the town. The results of the survey indicated that despite the current junction arrangements being not particularly pedestrian friendly there is a strong travel path at this location across the Seamus Rafter Bridge, particularly for children traveling from schools on the east side of the town to the bus stops on The Promenade. The removal of the Seamus Rafter Bridge has the potential to delay or sever pedestrian movement from one side of the town to the other side. Pedestrians would have no other option but to use Enniscorthy Bridge which as the data suggests is already heavily trafficed by pedestrains on narrow foothpaths. This would increase the travel distance for pedestrians by 350m.

13.4.2 Traffic Management Solution

The proposed scheme includes the removal of the Seamus Rafter Bridge and replacing it with a new road bridge 600m downstream that will connect between the N11 Wexford Road and N30 St John's Road. The proposed scheme also includes the construction of a new pedestrian

bridge that will incorporate wheelchair accessible ramps which will improve pedestrian access across the river and along Shannon Quay. The removal of the Seamus Rafter Bridge, an important traffic link in the town centre, will have obvious traffic implications. Therefore, part of the scheme was to undertake a traffic management study and to recommend a preferred traffic management scheme for the town.

As detailed in the scheme design process, The OPW developed an outline design for the preferred scheme in 2009, when Royal Haskoning were appointed to produce an EIS for the proposed scheme, and a traffic management plan was also prepared. Roughan O'Donovan undertook a review of this plan and identified potentially adverse impacts on the traffic flow through and around the town. Further information on the traffic modelling methodology and analysis carried out by Roughan O'Donovan is set out in the Enniscorthy Flood Defence Scheme Bridgeworks & Traffic Management Traffic Modelling Report, 2016.

A range of traffic management options were developed to determine the optimum traffic management layout for the town. A Do-Nothing and twelve Do-Something Options in total were developed by Roughan O'Donovan in consultation with Wexford County Council and key stakeholders. The proposals take account of the M11 Gorey to Enniscorthy PPP Scheme, which will divert a significant volume of through traffic from Enniscorthy Town and result in a redistribution of traffic on the existing road network in the town.

Following detailed consideration and consultations with key stakeholder the proposed traffic management solution for Enniscorthy Town was adopted as illustrated in Figure 13.3.

The proposed scheme involves making Enniscorthy Bridge and Abbey Quay two-way, while retaining one-way on Shannon Quay southbound from Enniscorthy Bridge to Spring Valley. This will enable traffic to cross from east to west across Enniscorthy Bridge and traffic travelling south on the N11 Island Road to continue south along Abbey Quay and on to The Promenade or Abbey Square without diverting to the new bridge located 600m to the south.

The junctions either side of Enniscorthy Bridge will be upgraded to traffic signals to facilitate two-way movements and pedestrian crossing facilities will be incorporated.

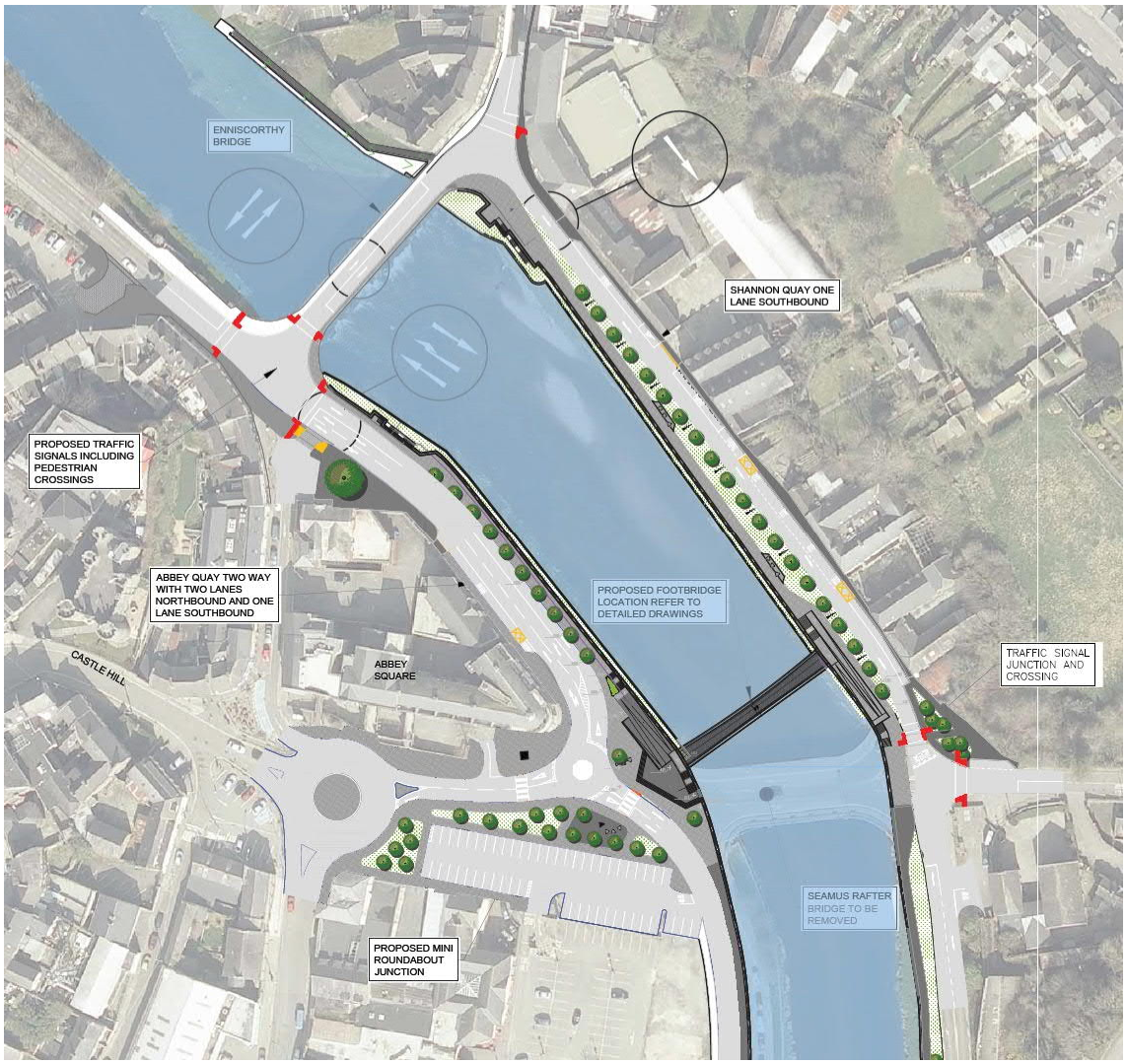
Abbey Quay will be made two-way with two lanes northbound and one lane southbound, and this will involve the removal of some on-street parking.

Shannon Quay will be narrowed with one traffic lane in the southbound direction with the space reallocated to the riverside public realm and footpath. The reduced carriageway width will improve connectivity and safety for pedestrians.

The junction of Abbey Quay, Abbey Square and The Promenade is to be changed to a mini roundabout to accommodate the turning movements and also maximise public realm space adjacent the proposed pedestrian bridge. Pedestrian crossings are proposed on the immediate approaches to the mini roundabout to facilitate improved pedestrian connectivity.

It is proposed to retain two-way traffic on Templeshannon. It is noted that Templeshannon currently suffers from traffic congestion during peak periods. Congestion is likely to continue and get worse over time following the completion of the M11 Gorey to Enniscorthy Scheme and as the town grows. However, the proposed Enniscorthy Flood Defence Scheme will not exacerbate this congestion any further, and potential solutions to this will be considered by Wexford County Council following completion of the various road schemes when traffic redistribution to and through the town have settled.

Figure 13.3: Preferred Traffic Management for Enniscorthy



Source: ROD 2018

The proposed bridge across the River Slaney is located approximately 600m to the south of the existing Seamus Rafter Bridge. This new bridge will accommodate two-way traffic with roundabout junctions either side at the tie-ins with N11 Wexford Road and N30 St John's Road / Mill Park Road. The junction of the new bridge and the N30 will be a compact roundabout with an inscribed circle diameter (ICD) of 30m where traffic speeds reflect the 50kph speed limit. The proposed N11 Wexford Road junction is a normal roundabout with an ICD of 50m, which is proposed to assist the transition from the high speed (currently 100kph speed limit) to the south and the proposed 50kph speed limit to the north leading into Enniscorthy and across the new bridge.

It is proposed as part of the works that the junction visibility from Parnell Road to St John Road will be improved to current design standards.

13.4.3 Do-Nothing Scenario

The impact that would occur as a result of the Do-Nothing scenario is as follows:

- The incidence of flooding in Enniscorthy would have a very significant adverse impact upon traffic progression, not just for local traffic but for traffic movement along the wider regional road network and Dublin to Wexford Railway line and bus services;
- In terms of safety, an increase in flooding could increase the risk of accidents and delay in emergency services access along the existing road network; and
- The volume of through traffic will reduce following the completion of the M11 Enniscorthy to Gorey Scheme, but there will reaming a significant volume of traffic crossing the Slaney River in Enniscorthy. While the road layout at the river crossings in the town is an efficient traffic system it is traffic dominated and it presents an obstacle to pedestrians and cyclists crossing between the east and west sides of the town.

13.5 Assessment of Impacts

The potential impact that the proposed scheme may have on the local traffic and transport environment is assessed under the following headings;

- Construction Transportation Management; and
- Operational Impacts.

IEMA guidelines identity that the following environmental impacts may be considered when assessing the traffic;

- Health and safety;
- Air Pollution, dust and dirt;
- Noise and vibration;
- Pedestrian amenity;
- Severance of communities;
- Heritage and conservation;
- Visual effect; and
- Ecological effects.

Of the above effects, the following have been considered with other Chapters of this EIAR, if the effects are potentially significant:

- Air Pollution and dust and dirt- these are considered in Chapter 11 Air Quality and Climate;
- Noise and Vibration- these are considered in Chapter 12 Noise and Vibration;
- Visual impacts- these are considered in Chapter 9 Archaeology and Architectural and Cultural Heritage;
- Ecological impacts - these are considered in Chapter 6 Biodiversity.

13.5.1 Construction Impacts

At the time of the confirmation of this application, a Contractor had not been appointed. Therefore, a preliminary construction programme that has been produced by Mott MacDonald in December 2017. This was used as a basis to provide an estimate of the construction programme and sequencing of the proposed works. The indicative programme of works is set out in Section 4.5. For this assessment, the construction activities are divided between three primary work streams, these are described hereunder;

- The construction of the new road bridge downstream of the Riverside Hotel will be carried out independently of the flood defence scheme. The removal of the Seamus Rafter Bridge will only commence following the completion of the new road bridge and approach roads;
- River Slaney instream works – comprises dredging (deepening) and/or widening and filling along various sections of the river in and adjacent to Enniscorthy Town and associated measures such as reprofiling of the back channel and flow deflector areas and compound channel; and
- Flood Defence Civil Engineering works- removal and alteration of specific obstructions comprises construction of flood walls, underpinning of Railway bridge and Enniscorthy Bridge, construction of the new pedestrian bridge.

Interventions on the existing infrastructure will be completed in the first stage of works. Flood Defences will also have to been constructed at the Promenade and the Leisure Centre and the construction of the new road bridge before the instream work can take place.

Construction Transportation Management Plan

The construction of the Proposed Scheme will have a temporary impact on traffic volumes in Enniscorthy Town. The traffic impact of the additional vehicles associated with the proposed scheme can be categorised as;

- Additional traffic volumes associated with construction activities, primarily HGV's for the proposed works on the existing works network; and
- Delays to non-project related journeys as a result of slow-moving vehicles;

As noted above the proposed scheme is expected to be carried out over a 3-year period. Further details on the staging of the proposed works are provided in Chapter 2. This assessment focuses on the traffic impacts associated with the busiest phase of each works of the proposed scheme (anticipated to be around the construction works associated with the new road bridge and instream works proposed downstream of Seamus Rafter Bridge including the demolition of the bridge).

Instream Works

For the purpose instream works it is necessary to isolate and de-water the work area to create dry working conditions. This will be formed by the installation of an impermeable barrier down the centre of the River Slaney. Excavated material from the areas upstream of Seamus Rafter bridge to the North Island will be deposited on the North Island. The Contractor will be permitted to haul this material within the dry works area i.e. along the river bed. Site construction traffic during this phase of work will be limited within dry works areas only. Therefore, negligible traffic impacts associated with this phase of works are expected on the local traffic. Whereas, material downstream of the Seamus Rafter Bridge (Area 8, 9 and 10 noted in Appendix A detailed in the CEMP) will be removed by truck to a licence facility via the Bare Meadows and along the N11 Wexford Road. In order to assess the worst-case impact, a total of 100,000m^3 of material will be transported off site over a 4-month period. This would equate to approximately 16 hourly two-way vehicle movements via the N11 Wexford Road. As noted above the phasing of works will ensure that the construction of the new road bridge and its approach roads will be operational before commencing instream works. This new bridge will accommodate two-way traffic with roundabout junctions either side at the N11 Wexford Road and N30 St John's Road / Mill Park Road. The M11 Gorey to Enniscorthy Scheme is also expected to be operational at this stage. Traffic generated during the instream works will access the strategic national road N11 via the new roundabout junctions either side of the new road bridge. Traffic will be directed away from Enniscorthy Town.

Construction of new Road Bridge

Access to the bridge site will be required from both the N30 and the N11 routes either side of the river, with access as follows:

- Access to the West Bank roundabout and abutment will be from the N30 St John's Road;
- Access to the West Bank pier will be from The Promenade;
- Access to the East Bank pier will be from the N11 Wexford Road; and
- Access to the East Bank Cut and Abutment will be from the N11 Wexford Road.

The highest volume of construction HGV traffic will be generated during the main earthworks phase. It is estimated that there will be up to 9,000 truckloads from the East Bank/N11 and 1,500 truckloads from the West Bank/N30 during this phase. This equates to about 130-170 truck movements a day at the N11 and 20-30 movements a day at the N30. This equates to 10% of the existing N11 traffic less than 1% of the existing N30 traffic.

The other construction activities including site clearance, construction of foundations, abutments, walls, bridge beams, deck slabs and roadworks are expected to generate a further 2,000 truckloads, with a peak 15-20 truck movements a day at peak split between the N11 and N30.

Significant craneage will be required from both sides of the river. On the west side it is anticipated that a crane will be required adjacent to the river and possibly adjacent to the N30 at the higher level with elements either brought along the N30 St John's Road for lifting or to a laydown area provided in the location of the existing playground. The area on the east side the existing floodplain will be required as a laydown area for steelwork and for the crane. Temporary supports may be required to provide foundations for crane outriggers, access routes and laydown areas.

The proposed bridge spans over the Dublin-Rosslare Railway Line. Much of the construction activities can be carried out during the day behind temporary trackside safety fences. Works to enable the construction of the main span over the railway will need to be carried out during possessions of the railway, which may be carried out at night or at the weekend as agreed with Iarnród Éireann.

Traffic improvement works in the Town

The proposed works include for the raising and regrading sections of the Riverside Road and along the N11 Wexford Road on the east of the town, modifications to the traffic system from Abbey Square to Abbey Quay, Enniscorthy Bridge and Shannon Quay. This element of works will be in so far as possible undertaken outside of peak traffic periods and will require localised temporary signed diversions and traffic management and will result in temporary major adverse impacts on local traffic.

The last part of the works will be the completion of the proposed traffic management plan including the street works and junctions from Abbey Square to Abbey Quay, Enniscorthy Bridge and along Shannon Quay to Spring Valley and Wexford Road. These works will be phased and carried outside peak traffic periods so as to minimise traffic impacts.

Construction of flood wall

The main construction activities of the flood defence walls will be carried out following the completion of the proposed Road Bridge and the M11 Gorey to Enniscorthy Scheme when national road through traffic has been removed from the town.

The proposed contract works will utilise existing access routes (including farm access tracks within improved grassland areas) where possible. Access to the northern flood plain on the east side of the river will be provided across the Irish Rail access point and equipment will be restricted to using the existing farm tracks and stream crossing currently in the floodplain. Access to the river between the railway bridge and the Enniscorthy Bridge will be provided from Templeshannon, construction equipment can be craned into the river from the bankside at the leisure centre. The walls will be constructed bankside only. In each instance, foundations will be piled landside and access the works areas will be from defined access routes only. Access to the works will be via public roads and the private car park at the Leisure Centre.

Downstream of the Enniscorthy Bridge access will be provided from Shannon Quay. Much of this area is built ground and amenity grassland. Access downstream of the Seamus Rafter Bridge will be from the Promenade and the N11 Wexford Road.

Access to the southern floodplain will be provided from an existing gateway off the Wexford Road and will continue along the existing farm track down to the river.

Site Compound

The location of site compound facilities will be agreed between WCC and the appointed contractor in consultation with the EnCoW. For the purposes of this application, there is one suggested location for the main scheme compound plus one auxiliary site works area directly adjacent to the new Road Bridge on the Bare Meadows. The main compound location is shown below in Figure 4.23 in Chapter 4. Access to the main compound will be limited to the N11 Wexford Road and access to the axillary bridge works compound will be restricted to the existing gate entrance at the Bare Meadows onto the N11 Wexford Road.

13.5.2 Operational Impacts

In general, the historical incidence of flooding in Enniscorthy had a significant adverse impact upon traffic movements not just for local traffic but for traffic movements along the national road networks i.e. along the N30 and N11 and regional rail network. In this regard, the completed defence scheme is expected to have a significant benefit in terms of uninterrupted flow of traffic during a flood event.

Road Safety and Pedestrian Amenity

The removal of the Seamus Rafter Bridge has the potential to delay or sever pedestrian movement from one side of the town to the other side. Pedestrians would have no other option but to use Enniscorthy Bridge which as the data suggests is already heavily trafficked by pedestrains on narrow foothpaths. This would increase the travel distance for pedestrians by 350m.The proposed scheme, with the proposed pedestrian bridge and reduced carriageway widths in particular along Shannon Quay and Abbey Square and the provision of controlled pedestrian crossings, will have a positive impact on pedestrian movement around the town and as such will ensure that the continued and improved access for both cyclist and pedestrians alike. The proposed road bridge to the south of the hotel provides pedestrian and cyclist routes on both sides of the bridge between the N11 Wexford Road and N30 St John’s Road, and with access via a set of staircases between the bridge and The Promenade / riverside walk.

Access for Emergency Services

As well as protecting travel routes during flooding events the proposed scheme improves the flow of traffic through the town and will have a moderate positive impact on access for emergency services, with flexibility of route choice, where traffic can cross in either direction on both the Enniscorthy Bridge and the proposed Road Bridge.

Severance

It is noted that severance is the perceived division that can occur within a community when it becomes separated by a major traffic artery. The proposed scheme will result in a new traffic management system in the town that include the provision of two-way on Enniscorthy Bridge, which will allow for route choice between this and the new road bridge and thereby improving overall accessibility.

Operational Traffic

The proposed Enniscorthy Flood Defence Scheme traffic management works, in conjunction with the M11 Gorey to Enniscorthy Scheme and will have a significant positive impact on traffic conditions along the Quays and the immediate surrounds. The total traffic crossing the River Slaney between the Quays will reduce by nearly 66%, with 50% diverting to the new Road Bridge between the N11 Wexford Road and the N30 St John's Road and the other 16% associated with the removal of national road through traffic.

These traffic diversions allow Enniscorthy Bridge and Abbey Quay to be made two-way, which allows route choice between here and the proposed new Slaney Road Bridge, compared to the existing arrangement where there is only one option for crossing the River in the Town. This improvement in route choice will on average reduce the overall journey times and travel distances compared to the existing situation.

Parking Arrangements

Car parking at Abbey Quay will reduce by 17 spaces, however this will be offset by additional car parking being provided at Abbey Square. Existing car parking arrangements on Shannon Quay will remain largely unchanged except for 4 spaces on the riverside close to Enniscorthy Bridge. Parking on The Promenade is reduced by approximately 50 spaces, however, the parking survey suggests there is ample redundancy in the public car park on Mill Yard Lane to cater for this reconfiguration.

13.6 Mitigation Measures

Prior to the commencement of the proposed works, the appointed contractor will prepare a CEMP and associated Construction Traffic Management Plan (CTMP). The purpose of the CTMP is to set out management and mitigation measures to prevent or minimise the transport impacts during the proposed construction phase.

The CTMP will include details of the following;

- Identify to all staff and contractors the appropriate and safe routes to and from the proposed Project;
- Confirmation that routing of HGV construction traffic during the haulage of dredging material is not permitted via Enniscorthy during instream works upstream of Seamus Rafter Bridge, where all HGV traffic will be routed within the dry works areas only,

- Timing of HGV construction movements to take place outside of peak flow hours, where practicable, to minimise disruption to general traffic flows on the road network, including details of delivery windows confirming when traffic is predicted to arrive on-site
- Measures to ensure access to private properties are maintained throughout the duration of works;
- Measures to ensure pedestrian amenity access to the river is maintained where possible; and
- Appropriate warning signs to be erected to warn all road users of the presence of HGV's and general construction related traffic and operations.

Through the CTMP, regular engagement with the resident engineer and EnCoW shall be undertaken so that they can engage with the local residents and businesses on when each phase of works will commence, including;

- The schedule of works;
- Disseminate details of signage;
- The direction from where HGV loads will be travelling from;
- A dedicated telephone number which the residents and business owners can contact to report any issues;
- Provide details of the dates of the community liaison group meetings; and
- Obtain local resident's feedback on other issues that need to be addressed including details of any forthcoming public events etc. that need to be considered.

The CTMP shall provide for regular inspections to be carried out to ensure that agreed mitigation measures, as outlined above, are being undertaken.

The appointed contractor responsible for the works will be required to undertake a pre-condition survey of the existing road from the N11 and local roads within the town to the site with the scope and method of assessment to be agreed with WCC Transportation Department. Following completion of the works, a further survey will be undertaken to determine any deterioration and the requirement for any remedial works, for agreement with the WCC Transportation Department.

The following text describes the control measures that will be put in place for the construction compound;

- The construction compound will not be located within 20m of the River Slaney. The compound will not be located in sensitive ecological habitat;
- The main construction compound must be located on dry land and set back from waterbodies, and outside of any floodplain;
- The impermeable area within the compound will be minimised to limit surface runoff;
- The EnCoW and the Contractor will ensure that appropriate set back distances are maintained from sensitive ecological and cultural heritage sites and watercourses. At a minimum, any watercourse or drainage ditch that occur in the area of land that will be used for site compound/storage facilities will be fenced off at a minimum distance of 5m. In addition, measures will be implemented to ensure that silt laden or contaminated surface water runoff from the compound does not discharge directly to the watercourse;
- Storage of fuels, other hydrocarbons and other chemicals within the construction compounds will be stored in bund areas. Bund specification will conform to the current best practice for oil storage such as 'Best Practice Guide BPGCS005 Oil Storage Guidelines,' Enterprise Ireland; and

- All surface water runoff will be intercepted and directed to treatment systems for the removal of pollutants prior to discharge.

All compounds will have security to deter vandalism, theft and unauthorised access.

13.7 Residual Impacts

No significant residual impacts are anticipated provided that the mitigation described above is implemented.

14 Material Assets and Land

14.1 Introduction

Material assets are resources that have an intrinsic value to an area. These resources can have defined economic values through to a value based on its importance as part of the overall cultural heritage of an area. Material assets include not only resources of man-made origin but also include natural resources. As part of the EIA process for the proposed scheme the following material assets warranted detailed impact investigation and have been considered in separate Chapters.

- Biodiversity and Ecosystem Services- discussed in Chapter 6;
- Hydrology -discussed in Chapter 7;
- Soils and Geology -discussed in Chapter 8;
- Archaeology, Architecture and Cultural Heritage – discussed in Chapter 10;
- Air Quality and Climate-discussed in Chapter 11; and
- Traffic and Transportation – discussed in Chapter 13.

This Chapter has been prepared with respect to material assets and land with a specific focus on built services, infrastructure and management of waste.

The Chapter has been structured as follows:

- **Section 14.2**- Outline the assessment methodology used.
- **Section 14.3**- Describes the outputs of the desktop baseline environment in the study area;
- **Section 14.4**- Examines the proposed construction and operational impacts resulting from the implementation of the scheme;
- **Section 14.5**- Describes the proposed mitigation measures to be carried out during the proposed construction phase; and
- **Section 14.6**- Summarises the potential for significant residual effects

14.2 Assessment Methodology

This Chapter will focus on the following resources;

- Built Services Infrastructure;
- Land; and
- Waste Management.

This Chapter has been prepared with regard to the specific criteria set out within the EPA Guidance documents noted in Chapter 3.

Information pertinent to waste management within Enniscorthy Town was also reviewed, including:

- Waste Management Act (1996) (as amended);
- Best Practice Guidelines for the Preparation of Waste Management Plans for Construction and Demolition Projects (DoEHLG, 2006);
- Southern Region Waste Management Plan 2015-2021;
- Wexford County Development Plan 2013-2019; and

- Enniscorthy Town and Environs Development Plan 2008-214, as extended

The characteristics of an impact relates to the quality, significance and duration of the impact. The definition of these impact characteristics is set out Chapter 2 of this EIAR.

14.2.1 Consultation

Consultations were held with the known utility providers that would be impacted by the proposed scheme, namely, Irish Water, ESB, Eircom.

14.3 Receiving Environment

Built Services and Infrastructure

Fundamental public infrastructure is present along the route of the flood defence walls. This infrastructure provides basic services for economic activity and day-to-day living for the population of Enniscorthy Town. The proposed scheme will have potential impact on the following material assets:

- Electricity Network;
- Potable Water Network;
- Surface Water collection network;
- Foul Sewers;
- Sewage Pumping stations;
- Combined Sewer Outfalls;
- Telecommunications Network;
- Bridges; and
- Rail and Road Network

Three bridges cross the River Slaney within Enniscorthy Town, namely, Railway Bridge upstream, Enniscorthy Bridge (designated as Protected Structure) and the Seamus Rafter Bridge.

Land

People whose land it is proposed to interfere with as part of the proposed scheme will be notified in accordance with the Arterial Drainage Act 1945, as amended 1995. They will be invited to view the proposed scheme and make their observations on it during the Public Exhibition. The Minister will consider their observations before confirming the scheme. When the scheme is completed the landowners will be entitled to apply for compensation from the OPW for the interference to their land.

14.3.1 Do Nothing Scenario

If the proposed scheme were not to proceed, the existing river channel would remain as it is, maintaining the present-day condition including the continued use of the Seamus Rafter Bridge. This would mean that the material assets of the town would continue to be at risk from frequent floods and the associated outages and disruption that comes with them.

14.4 Assessment of Impacts

Having regard to the EPA Guidelines and Advice Notes the primary considerations under the heading Material Assets for this type of project (Type12A) are discussed below;

- Diversions and interceptions of Infrastructure;

The potential impacts resulting from the alterations to riverbank access routes are discussed separately in Chapter 5 -Population and Human Health and Chapter 9 – Landscape and Visual.

14.4.1 Construction Phase

Water Services

The potable water network currently includes one pipe crossing across the Enniscorthy Bridge. This will remain unaffected by the proposed scheme. Two asbestos water main pipes run under the river, located approximately 30m downstream of the Seamus Rafter Bridge. These water mains are located within the riverbed below dredge level. There are no plans to divert the water mains, detailed design is not finalised however any disturbance to Irish Water assets from dredging works will be discussed and mitigated before construction.

It will be necessary to divert a water main at the Promenade to facilitate river widening. This pipe will be diverted so that it lies on the dry side of the flood defences. When this diversion is taking place, there is potential for temporary loss of supply for local residents and businesses; this risk is not significant, effects are brief and indirect. The effects of the potable water works are positive, allowing for the upgrade of potentially ageing infrastructure.

Wastewater carriage assets

Two gravity foul sewer diversions will be undertaken prior to the construction of the flood wall. The first of these is adjacent to the leisure centre where the pipe will be diverted away from the river bank and through the car park. The second diversion will be undertaken along the Promenade. There will be no impact to the wastewater network during the enabling works as construction well planned methods and techniques allow for uninterrupted network flow, through the transfer of wastewater flows from the existing foul sewer to the new foul sewer.

Surface Water Network

Where river widening is taking place or flood walls are being constructed as part of the scheme, existing surface water outfalls will have to be relocated in the widened river bank or the flood wall. The scheme includes the construction of 14 No. surface water pumping stations. These will pump storm water from behind the wall into the River during flood conditions. The proposed scheme will result in permanent positive impact on the stormwater network in Enniscorthy.

Electricity and Telecommunications

The Proposed Scheme will impact upon telecommunication services at both Seamus Rafter Bridge and at the proposed location of the new bridge where it meets both the N11 and the N30. During consultation with Eir and BT it was found that they both have communication services located within the structure of Seamus Rafter Bridge. During consultation with Eir, it was found that there are telecommunication services located in both the N11 and the N30 which will require diversions to facilitate construction of the junctions at either end of the proposed road bridge. Both telecommunications companies will redirect their services to the new pedestrian bridge, Eir will also divert services through the deck of the new road bridge. Additional spare ducts will be provided in both bridges to accommodate future services.

The impact on electricity supply is centred on the development of the proposed road bridge. Diversion of overhead ESB power lines will be conducted along the new roundabout, north of the junction of the N30 and Parnell Road. The road works will also require the diversion of public street lighting, additional installation of street lighting and ESB chambers for lighting. When the diversion is implemented, the severity of the impact is reduced to slight as the services will have been satisfactorily diverted or amended and will therefore continue to operate in their current form as required.

Disturbance to Bridges

Underpinning works will be undertaken as part of the river bed re-grading work. The methodology and materials to be used in these works will be agreed with Iarnród Éireann and Wexford County Council in advance of the works. This is to ensure that no stability or structural disturbance occurs. Structural surveys of both bridges are ongoing and will inform the approach of the proposed works. In the event that temporary closure is required, measures should be identified and agreed which minimise disruption. Provided sufficient consultation, liaison and agreement are confirmed with the parties mentioned above, temporary adverse impacts are expected in relation to bridges and their structures.

Waste Management

Waste management has been intrinsic within the design of the flood defence scheme with waste generated being re-used on-site, wherever possible. The dredged material has been recognised as a resource for habitat development of the North Island. Waste on-site will be managed in accordance with the Waste Management Hierarchy and in accordance with all relevant Irish and EU waste management legislation. As demonstrated, waste will be re-used on-site where possible; opportunities for recycling will be employed for any waste that cannot be used. Waste will only be sent for disposal if no other economically or technically feasible alternative is found.

As noted in Chapter 8 of this EIAR, the Contractor will appoint a Waste Manager for the project who will be responsible for the preparation and monitoring of the CWMP. Details on the management of waste are discussed in Chapter 8. All wastes will be handled in a responsible manner with due regard to relevant legislation, codes and best practices.

The river widening and re-grading of the river will result in the lowering the riverbed. Dredged material where appropriate, will be deposited onsite to facilitate the construction of a permanent depositional zone and infilling along the North Island and river infilling upstream of the Railway Bridge as described in Chapter 4. Material dredged from the river bed downstream of the Seamus Rafter Bridge will be exported by a permitted waste contractor and brought to a licenced facility for disposal.

Demolition of the Seamus Rafter Bridge will be subject to a detailed structural demolition plan. The volumes of demolition waste generated will be provided within this demolition plan, which will be undertaken during downstream section of the instream works and following the completion of construction of the proposed road bridge.

14.4.2 Operational Phase

The proposed scheme will provide flood protection for flood events up to a 1 in 100-Year event. It will directly benefit specific services within the study area, including, proposed pumping stations, electrical and telecommunication node boxes, bridges and therefore road networks. The flood defence scheme will represent a major positive impact, and as such will have a significant positive effect.

Following the completion of works, no further impacts are anticipated on the existing utilities services in the town.

14.5 Mitigation Measures

All possible precautions will be taken to avoid unplanned disruptions to any services during the proposed works. This will include thorough investigations to identify and reconfirm the location of all utility infrastructure within the works areas, and the implementation of robust procedures when undertaking works in the around known infrastructure services.

Service disruptions impacting the surrounding residential, social and commercial properties shall be kept to a minimum, only occurring where unavoidable. Prior notification of disruptions shall be given to all impacted properties. This shall include information on when disruptions are scheduled to occur and the duration of the disruption. Consultation with relevant neighbouring parties shall be undertaken prior to any proposed disruptions.

As noted in the previous Chapters of this EIAR, a CEMP will be prepared by the nominated contractor in consultation with WCC and their EnCoW. A CEMP has been prepared by Mott MacDonald in advance of seeking confirmation for the scheme. A copy of the CEMP is provided in Appendix A. The nominated contractor will have regard to this in the preparation of the detailed contractor CEMP.

It is the responsibility of WCC to ensure that the requirements of this CEMP and any associated Method Statements are implemented in full.

As noted in Chapter 8, a CWMP will be prepared and maintained by the main contractor and agreed in advance by the EnCoW. The CWMP will addresses the following aspects of the project;

- Analysis of the waste arisings/material surpluses;
- Specific waste management objectives for the project;
- Methods proposed for the prevention, reuse and recycling of waste;
- Proof of disposal to a licensed waste site;
- Material handling procedures; and
- Proposals for education of workforce and planned dissemination programme.

If any potential contaminated material is encountered during the works, it will be segregated from all other material, tested to confirm the classification of the material for disposal purposes (in accordance with Waste Acceptance Criteria and will be collected and disposed of by a permitted waste contractor to a suitably licenced waste facility.

The construction materials required for the civil engineering works such as crushed rock, concrete, and asphalt will be sourced locally where practicable.

14.6 Residual Impacts

The above mitigation measures will reduce the environmental impact of the Proposed Scheme, but certain impacts cannot be avoided in the short term such as the relocation of utilities. Residents and local businesses will suffer short-term inconvenience of water main, foul water and ESB stoppage for several hours during relocation. All residents and local businesses involved will receive prior notice of these stoppages. There will be no additional impact once services are resumed. No significant residual impacts are anticipated provided that the mitigation described above is implemented.

15 Interactions between the Foregoing

This Environmental Impact Assessment Report contains a description of likely significant impacts on defined environmental aspects (air, soil, water etc.) due to the construction and operation of the proposed scheme. Some impacts will affect more than one environmental theme because interactions are recognised to occur.

Impact interactions and inter-relationships have been considered throughout the EIA process and are described in each of the individual impact Chapters. The purpose of this Chapter is therefore to provide a brief summary of the main interactions that were considered as part of the assessment.

The matrix which is presented as a table below has been developed to identify interactions impact between environmental topics. The nature of the environment is such that interactions between all environmental topics are potentially possible and/or may occur to a certain extent for most projects. The purpose of the matrix is therefore to highlight key interactions that are recognised to be specific to this project and warranting special consideration. In the matrix, a white square indicates no interaction, while the aqua blue square indicates that a key interaction exists. The key environmental interactions that have been identified are discussed further in the following sections.

Table 15.1: Interactions Matrix

Technical Chapter	Population and Human Health	Biodiversity	Hydrology and Geomorphology	Soils and geology	Landscape and Visual	Archaeological, Architectural and Cultural Heritage	Air Quality and Climate	Noise and Vibration	Traffic and Transport	Material Assets and Land
Population and Human Health										
Biodiversity										
Hydrology and Geomorphology										
Soils and Geology										
Landscape and Visual										
Archaeological, Architectural and Cultural Heritage										
Air quality and Climate										
Noise and Vibration										
Traffic and Transportation										
Material Assets										

15.1 Populations and Human Health Interactions

15.1.1 Population and Human Health and Hydrology and Geomorphology

Major flood events affect a large number of the population and causes displacement of residents and short-term severance of communities. If the proposed scheme were not to proceed, the existing river channel would remain as it is maintaining the present-day condition is to accept flood damages in the town. If the flood defence scheme is not implemented in Enniscorthy, the possibility of future flood events, similar to those that occurred in 2015, will continue to persist and possibly increase with climate change predications. The proposed scheme has been designed to provide flood protection within the town for a 1 in 100- year flood event. The flood walls are designed so that they are adaptable to the impacts of climate change. The Pedestrian and Road Bridges are both designed so that their soffits are above the flood level likely in the design event following climate change.

Pollution that can be transported by surface water may come into contact with human beings. This poses a serious threat to human health. When surface water drainage in the town becomes flooded, polluting material enters residential and commercial properties thereby impacting the health of the occupants by increasing the risk of disease to them. The management of storm water behind the defence line is a key component of the scheme. In the event of a flood event, where existing storm water outfalls are below the river level the storm water outfall will be restricted and the network will back up which will result in flooding within the town. The scheme includes for the provision of 14No. pumping stations which will prevent this from occurring.

15.1.2 Population and Human Health and Landscape and Visual and Archaeology, Architectural and Cultural Heritage

For many of the proposed elements of the development mitigation measures are either not required or they are ‘embedded’ in the overall design of the scheme already assessed in the predicted impacts section. Such ‘embedded’ mitigation is evident in the high level of architectural consideration given to the design of both the proposed new road and pedestrian bridges as well as the use of ‘local’ stone for flood walls so that they blend with the existing and age-old river walls and bridge.

It should be noted that a previous iteration of the scheme (2009) met with many objections, which principally related to the reduced visual and physical connectivity to the river due to the high stone walls proposed and the consequent adverse effects on aesthetics and recreational use. The scheme has since been revised to address these issues with one of the main aspects of mitigation being the use of extensive sections of glazing within the flood walls to reduce the enclosure of the river by these walls and, in turn, maintain the visual connectivity between the river and the quays. Public display event was subsequently held in 2018 to update the public and stakeholders on the scheme. In response to the feedback provided at that public display, the design of the scheme was further refined. The road level along the Promenade was raised to reduce the height of the wall relative to the footpath level. The scheme also includes the use of additional number of glass panels in this area. The loss of car parking spaces was also refined. Physical connectivity with the river corridor, although reduced from the current scenario is maintained insofar as possible with periodic access stairs and ramps. Along the Abbey Quay and The Promenade sections of the road are raised, which has the effect of reducing the perceived height of the adjacent flood wall. Construction of the proposed scheme is likely to cause significant, yet short-term, effects on the town and its surrounding environs.

15.1.3 Population and Human Health and Air Quality and Climate and Noise and Vibration

During the construction phase the primary air quality issue is typically associated with dust generation. Construction dust has the potential to cause local impacts through dust nuisance at nearby sensitive receptors. The potential impacts associated with the construction phase of the proposed scheme are temporary in nature.

Prior to the commencement of the proposed works, the appointed contractor will prepare a construction Environmental Management Plan (CEMP). This will include a workable and transparent dust control strategy as part of the CEMP. The dust control strategy will be formulated by drawing on best practice guidance from Ireland, the UK and the USA. The aim is to ensure good site management by avoiding dust becoming airborne at source. Specific measures are outlined in Section 11.5 of the report. The pro-active control of fugitive dust will ensure that the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released, will contribute towards the satisfactory completion of the works.

The construction of the works will inevitably result in the emission of high noise levels at certain periods. All practicable steps will be taken to minimise noise and vibration. The Contractor on site will have responsibility to ensure that the noise and vibration levels set out in Best Practice Guidance do not significantly impact on sensitive receptors. It is also recommended that a comprehensive noise and vibration monitoring protocol will be set out within the Noise and Vibration Construction Management Plan. Construction noise and vibration levels shall be monitored and assessed.

15.1.4 Population and Human Health and Traffic and Transport and noise and vibration

There is the potential for temporary disruption to economic activity and wellbeing of residents within the town due to the proposed construction activities. This would predominantly be because of traffic and access issues which could have the potential to reduce footfall into local businesses. Noise and dust from the works will add to this temporary impact on local businesses and sensitive receptors. Prior to the commencement of the proposed works, the appointed contractor will prepare a construction Traffic Management Plan (CTMP). The purpose of the CTMP is to set out management and mitigation measures to prevent or minimise the transport impacts during the proposed construction phase. A comprehensive noise and vibration monitoring protocol will be set out within the CEMP. This will ensure impacts on the receiving environment are acceptable.

15.1.5 Population and Human Health and Material Assets, Land and Traffic and Transport

Waste management has been intrinsic within the design of the flood defence scheme with waste generated being re-used on-site, wherever possible. The dredged material has been recognised as a resource for habitat development of the North Island. Waste on-site will be managed in accordance with the Waste Management Hierarchy and in accordance with all relevant Irish and EU waste management legislation.

The mitigation measures will reduce the environmental impact of the proposed scheme, but certain impacts cannot be avoided in the short term such as the relocation of utilities. Residents will suffer the short-term inconvenience of water main, foul and ESB stoppage for several hours during relocation. There will be no additional impact once services are resumed. Prior to the commencement of the proposed works, the appointed contractor will prepare a construction

Traffic Management Plan (CTMP). The purpose of the CTMP is to set out management and mitigation measures to prevent or minimise the transport impacts during the proposed construction phase.

15.2 Biodiversity Interactions

15.2.1 Biodiversity and Hydrology and Geomorphology

The River Slaney is designated a Natura 2000 site, in the absence of mitigation to the proposed works would have a significant adverse effect on the biodiversity. A partial area of the channel will be isolated and kept dry with the use of an impermeable barrier. Temporary changes to the hydrological regime in the channel have the potential to result in habitat degradation directly impacting Qualifying Interests (QI) habitats and potentially indirectly impacting QI and Special Conservation Interests (SCI) species that utilise these habitats. The potential effects on the QI and SCI are discussed in detail in the project Natura Impact Statement. The NIS acknowledged that there is the potential in the absence of mitigation for the proposed development to have significant indirect or indirect impacts on European sites, with the implementation of the detailed mitigation measures identified in this NIS, the integrity of those European sites will not be adversely affected.

15.2.2 Biodiversity and Noise and Vibration

The potential for interactions arises with terrestrial and aquatic and avian ecology. For example, during construction the proposed scheme has the potential to generate significant noise from inherently noisy activities such as piling and excavation. Disturbance arising from the proposed works on the southern floodplain has the potential to displace waterbirds from the area, including the regularly occurring waterbird species listed as qualifying SCI populations of Wexford Harbour and Slobs SPA. Embedded mitigation such as the phasing of the works over a 3-year period and the restriction on programme of the works and use of technologies such as low vibration sheet piling which will reduce the impact that noise and vibration has on sensitive receptors.

15.3 Soils and Geology Interactions

15.3.1 Soils and Geology and Traffic and Transportation

The potential for interactions arises with traffic generated during the construction phase. Significant volumes of excavated material will be generated. Instream excavated material upstream of the Seamus Rafter Bridge will be deposited in the permanent depositional zone on the North island. Material downstream of the bridge will be exported. Prior to the commencement of the proposed works, the appointed contractor will prepare a construction Traffic Management Plan (CTMP). The purpose of the CTMP is to set out management and mitigation measures to prevent or minimise the transport impacts during the proposed construction phase.

15.4 Air Quality and Climate Interactions

15.4.1 Air Quality and Climate and Traffic and Transportation

An adverse impact on air quality due to construction traffic associated with the works during the construction phase has the potential to impact human health. As part of the CEMP which will be implemented, a dust control strategy will be formulated. It is recommended that dust deposition monitoring be put in place to ensure dust mitigation measures are adequately controlling

emissions. Specific measures are outlined in Section 11.5 of the report. The CEMP will be reviewed regularly and revised as necessary to ensure that the measures implemented are effective. Prior to the commencement of the proposed works, the appointed contractor will prepare a construction Traffic Management Plan (CTMP). The proposed works have been designed to limit the potential adverse impacts resulting from construction traffic on the town. Excavated material from the areas upstream of Seamus Rafter bridge to the North Island will be deposited on the North Island. The Contractor will be permitted to haul this material within the dry works area i.e. along the river bed. Site construction traffic during this phase of work will be limited within dry works areas only. Where possible, construction traffic will be directed away from Enniscorthy Town via the National Road Network.

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Appendices

A. Scheme Supporting Information

B. Scheme Alternatives Assessment Royal Haskinong (2009) and ROD Bridge Review Report

C. Biodiversity

D. Hydrology and Geomorphology

E. Ground Investigations Interpretive Report

F. Landscape and Visual Photomontages

G. Archaeology and Architectural Heritage

H. Air Quality and Climate

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